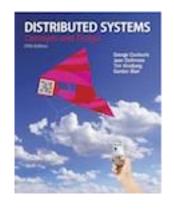
Slides for Chapter 19: Mobile and Ubiquitous Computing



From Coulouris, Dollimore, Kindberg and Blair Distributed Systems: Concepts and Design

Edition 5, © Addison-Wesley 2012

Figure 19.1 A room responding to a user wearing an active badge

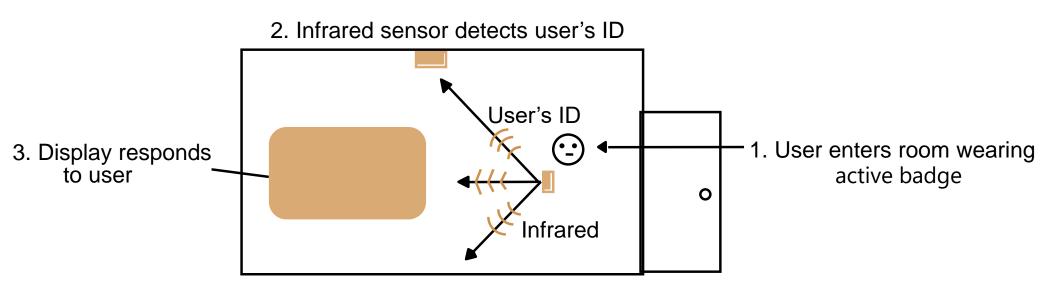


Figure 19.2 Examples of pre-configured versus spontaneous association

Pre-configured

Spontaneous

Service-driven:

email client and server

Human-driven:

web browser and web servers

Data-driven:

P2P file-sharing applications

Physically-driven:

mobile and ubiquitous systems

Figure 19.3 The interface to a discovery service

| Methods for service de/registration | Explanation |
|---|--|
| lease := register(address, attributes) | Register the service at the given address with the given attributes; a lease is returned |
| refresh(lease) | Refresh the lease returned at registration |
| deregister(lease) | Remove the service record registered under the given lease |
| Method invoked to look up a service | |
| serviceSet := query(attributeSpecification) | Return a set of registered services whose attributes match the given specification |

Figure 19.4 Service discovery in Jini

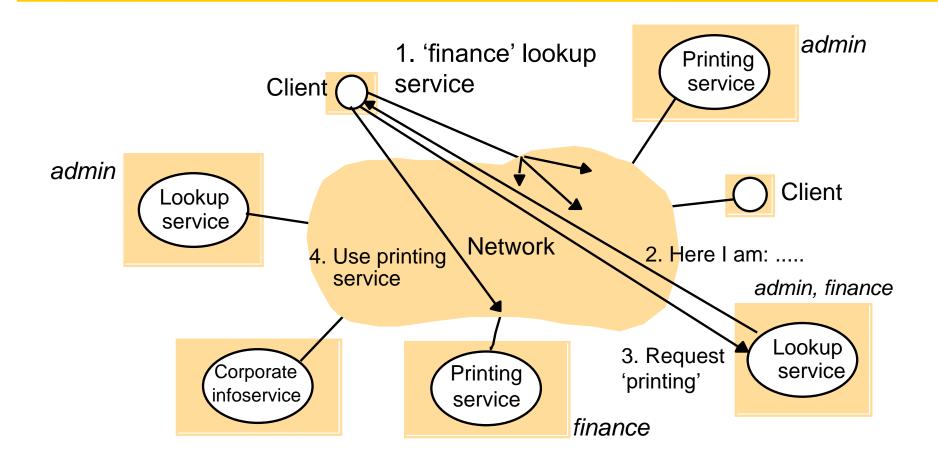


Figure 19.5 The *IdentityPresence* widget class of the Context Toolkit

| Attributes (accessible by polling) | Explanation |
|------------------------------------|-----------------------------------|
| Location | Location the widget is monitoring |
| Identity | ID of the last user sensed |
| Timestamp | Time of the last arrival |
| Callbacks | |

PersonArrives(location, identity, timestamp) Triggered when a user arrives

PersonLeaves(location, identity, timestamp) Triggered when a user leaves

Figure 19.6 A *PersonFinder* widget constructed using IdentityPresence widgets

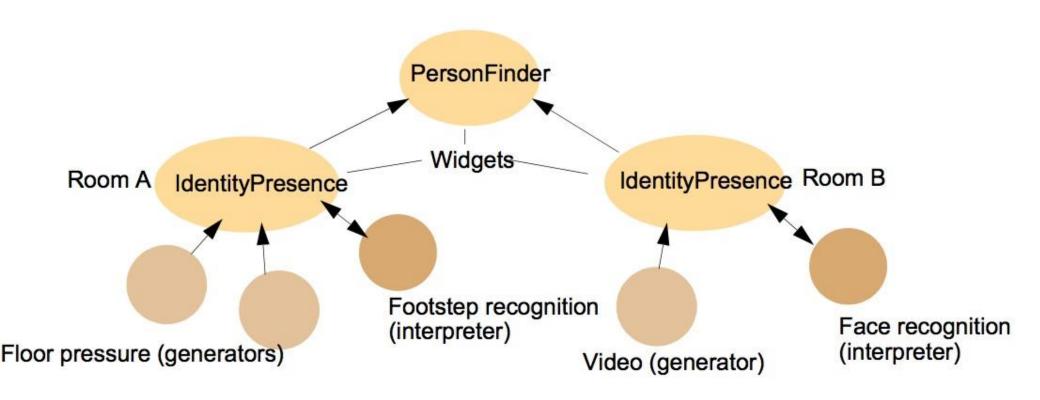
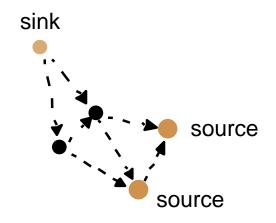
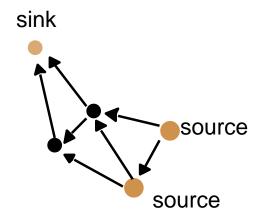


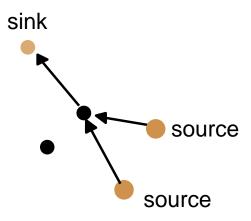
Figure 19.7 Directed diffusion



A. Interest propagation



B. Gradients set up



C. Data delivery

Figure 19.8 Some location-sensing technologies

| Туре | Mechanism | Limitations | Accuracy | Type of location data | Privacy |
|------------------------------|--|--------------------------------------|-----------|---|--------------------------|
| GPS | Multilateration from satellite radio sources | Outdoors only (satellite visibility) | 1–10m | Absolute geographic coordinates (latitude, longitude, altitude) | Yes |
| Radio beaconing | Broadcasts from wireless base stations (GSM, 802.11, Bluetooth) | Areas with wireless coverage | 10m–1km | Proximity to known entity (usually semantic) | Yes |
| Active Bat | Multilateration from radio and ultrasound | Ceiling mounted sensors | 10cm | Relative (room) coordinates. | Bat identity disclosed |
| Ultra Wide Band | Multilateration from reception of radio pulses | Receiver installations | 15cm | Relative (room) coordinates | Tag identity disclosed |
| Active badge | Infrared sensing | Sunlight or fluorescent light | Room size | Proximity to known entity (usually semantic) | Badge identity disclosed |
| Automatic identification tag | RFID, Near Field Communication, visual tag (e.g. barcode) | Reader installations | 1cm-10m | Proximity to known entity (usually semantic) | Tag identity disclosed |
| Easy Living | Vision, triangulation | Camera installations | Variable | Relative (room) coordinates | No |

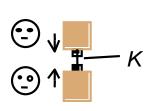
Figure 19.9 Locating an active bat within a room

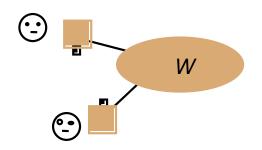
3. Ultrasound receivers report times of flight of ultrasound pulse

2. Active bat emits ultrasound signal on receipt of radio signal

- Base station sends timing signal to ultrasound receivers and radio signal to bat simultaneously
- Base station computes distances to ultrasound receivers from times of flight, and thus position of bat

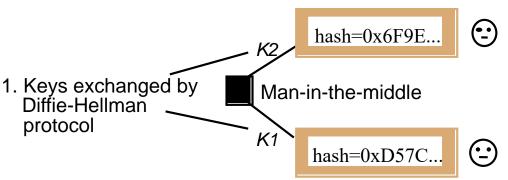
Figure 19.10 Secure device association using physical contact





- Fresh secret key K exchanged by physical contact
 Devices communicate using secure channel constructed over W using K

Figure 19.11 Detecting a man-in-the-middle



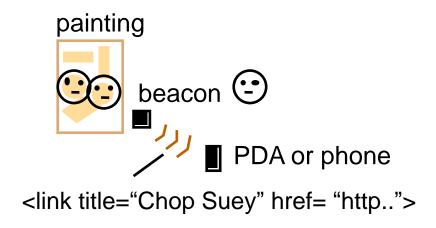
2. User(s) compare hashes of keys displayed on devices – by sight or with an integrated imaging device. Since they differ, they conclude that there is a man-in-the-middle or that accidental mis-association has occurred

Device displaying hash of key

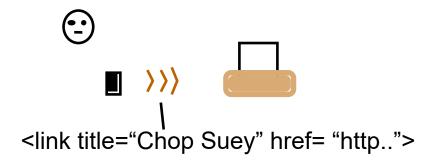
Figure 19.12 Cooltown layers

| eSquirt: URL e | xchange | Context (aggregated web presences) | | |
|----------------------|---------------|------------------------------------|---------------------------|--|
| Web presences | | | | |
| Physical hyperlinks | | | | |
| Direct URL sensing | ID resolution | | Network service Discovery | |
| Direct Orth Scrising | ID sen | sing | | |

Figure 19.13 Capturing and printing the web presence of a painting



a. User captures URL of painting's web presence



b. User sends URL to printer using eSquirt, to print painting's web presence