# Slides for Chapter 19:
# Mobile and Ubiquitous Computing

Figure 19.1
A room responding to a user wearing an active badge
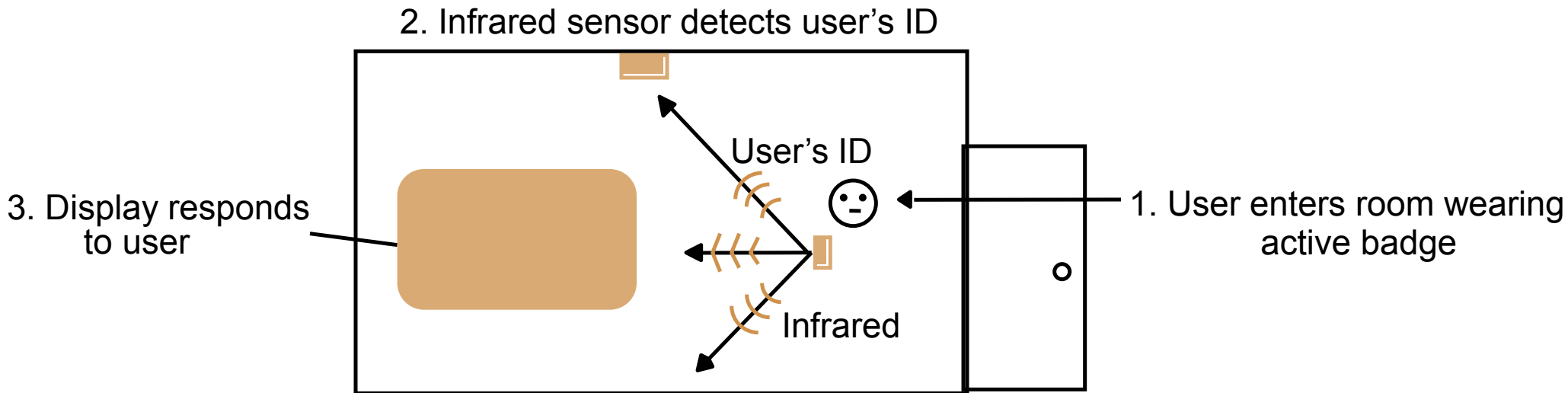
2. Infrared sensor detects user's ID

User's ID

3. Display responds
to user

1. User enters room wearing
active badge

Infrared

# 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* <br><br> Data-driven: *P2P file-sharing applications* <br><br> 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
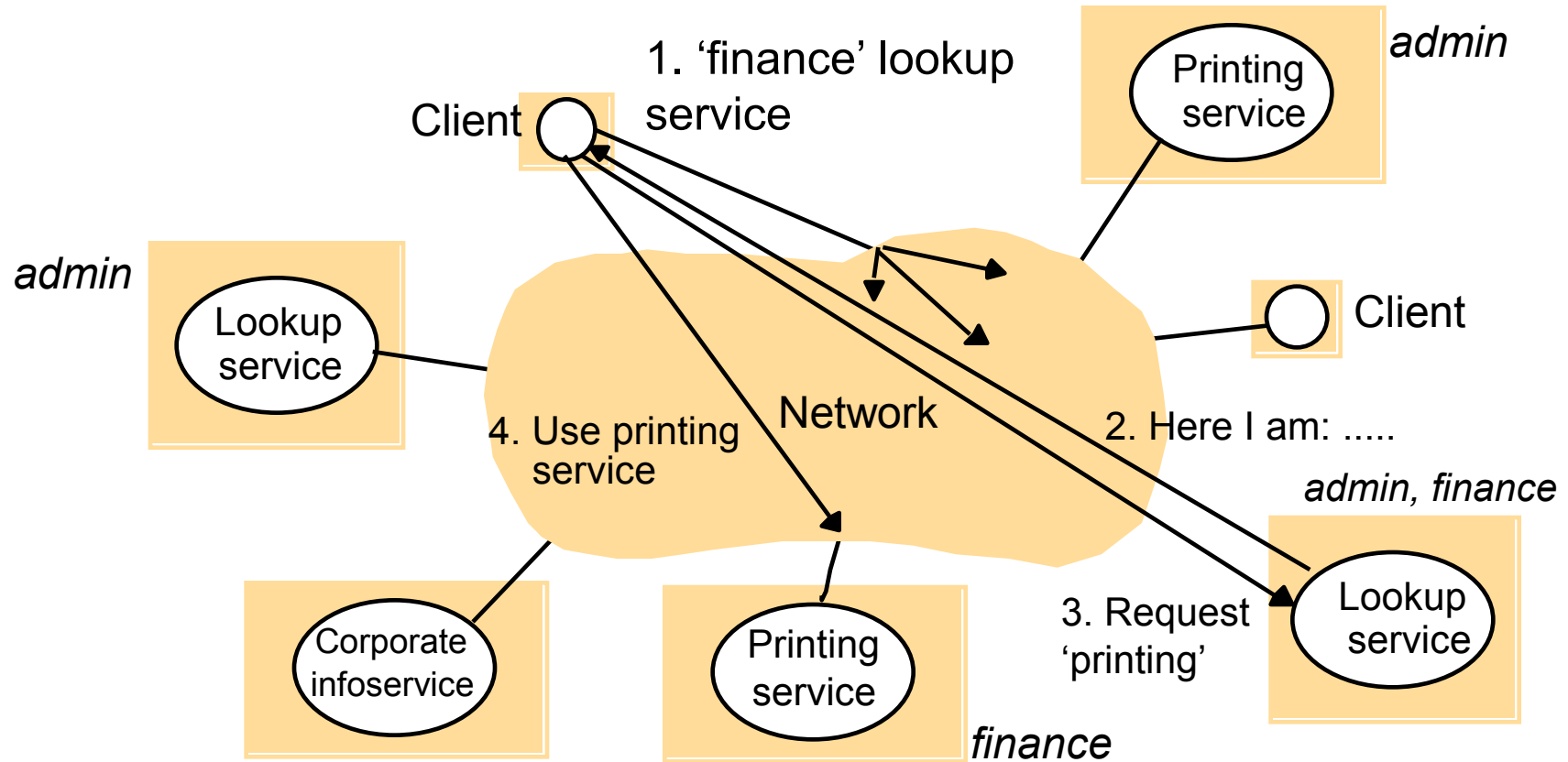
# Figure 19.5
## The *IdentityPresence* widget class of the Context Toolkit

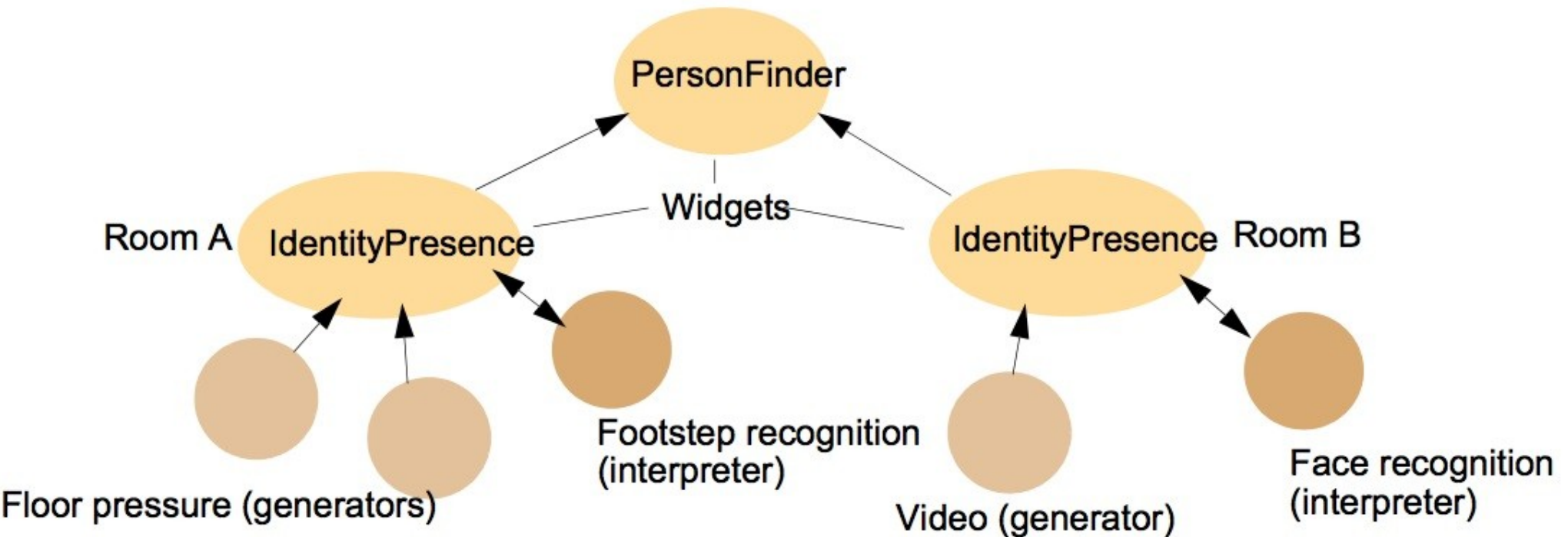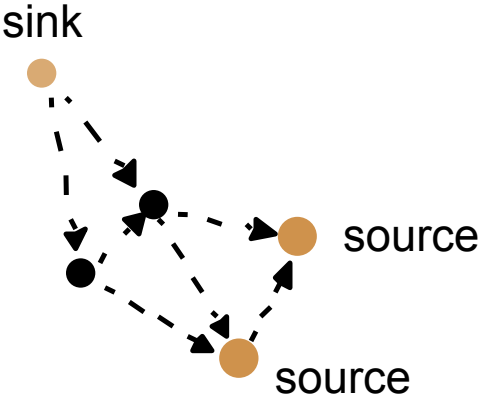| Attributes (accessible by polling) | Explanation |
|---|---|
| *Location* | Location the widget is monitoring |
| *Identity* | ID of the last user sensed |
| *Timestamp* | Time of the last arrival |
| Callbacks | |
| *PersonArrives(location, identity, timestamp)* | Triggered when a user arrives |
| *PersonLeaves(location, identity, timestamp)* | Triggered when a user leaves |

# Figure 19.7
## Directed diffusion



A. Interest propagation
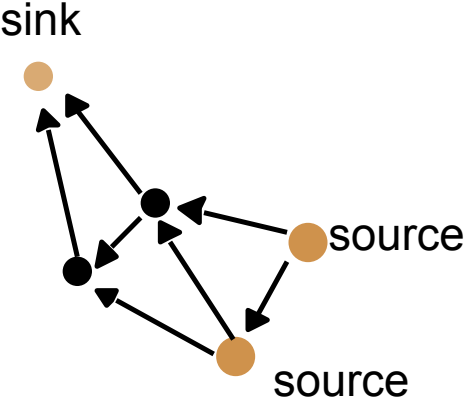
B. Gradients set up
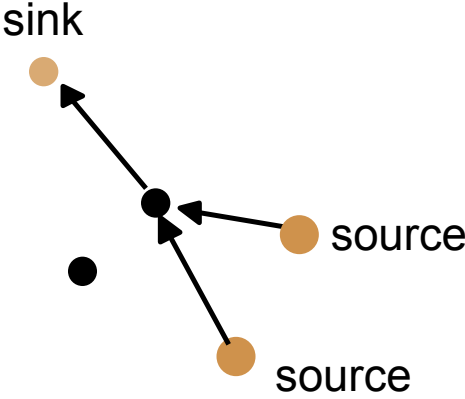
C. Data delivery

# Figure 19.8 Some location-sensing technologies

| Type | 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



1. Base station sends timing signal to ultrasound receivers and radio signal to bat simultaneously

3. Ultrasound receivers report times of flight of ultrasound pulse

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

4. Base station computes distances to ultrasound receivers from times of flight, and thus position of bat
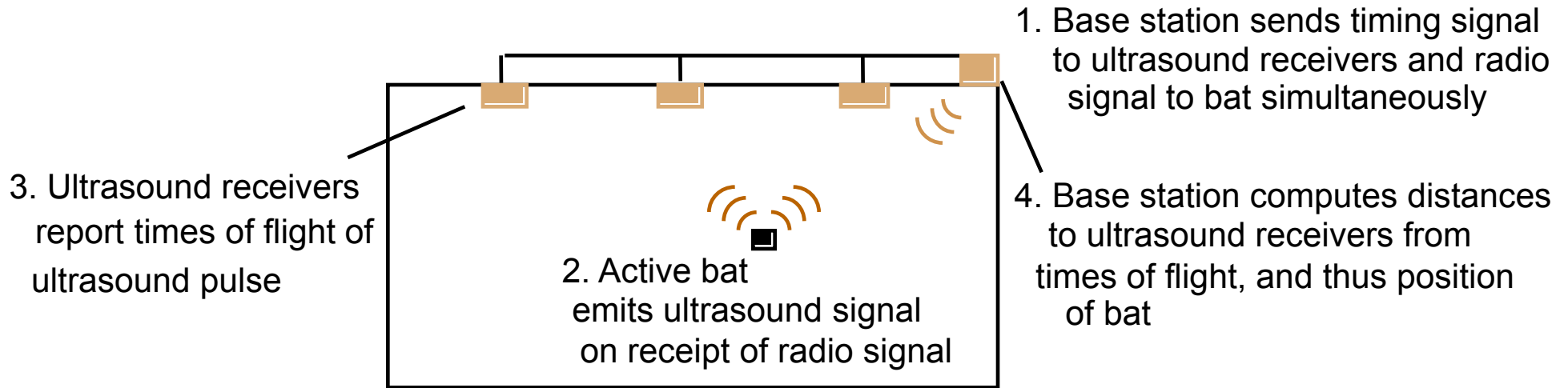
# Figure 19.10
## Secure device association using physical contact



1. Fresh secret key K exchanged by physical contact   2. Devices communicate using secure channel constructed over  W using  K
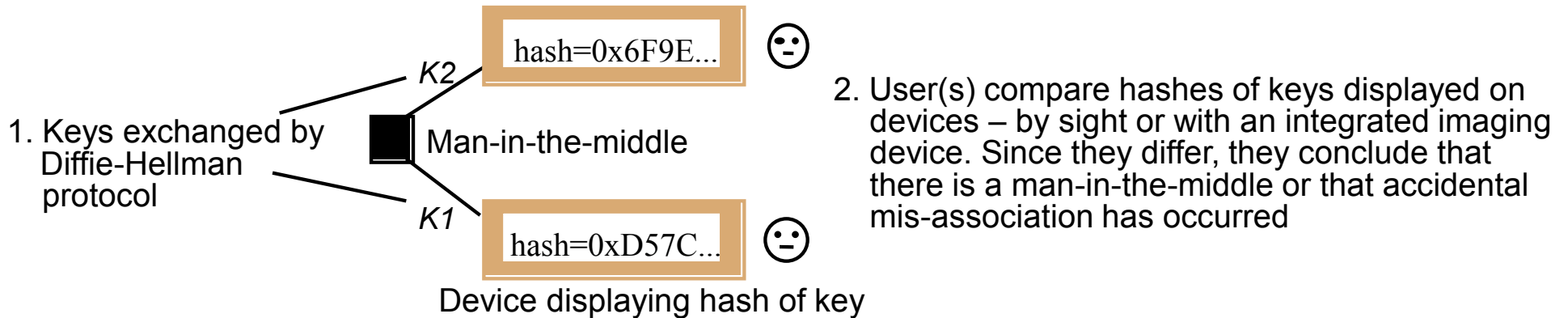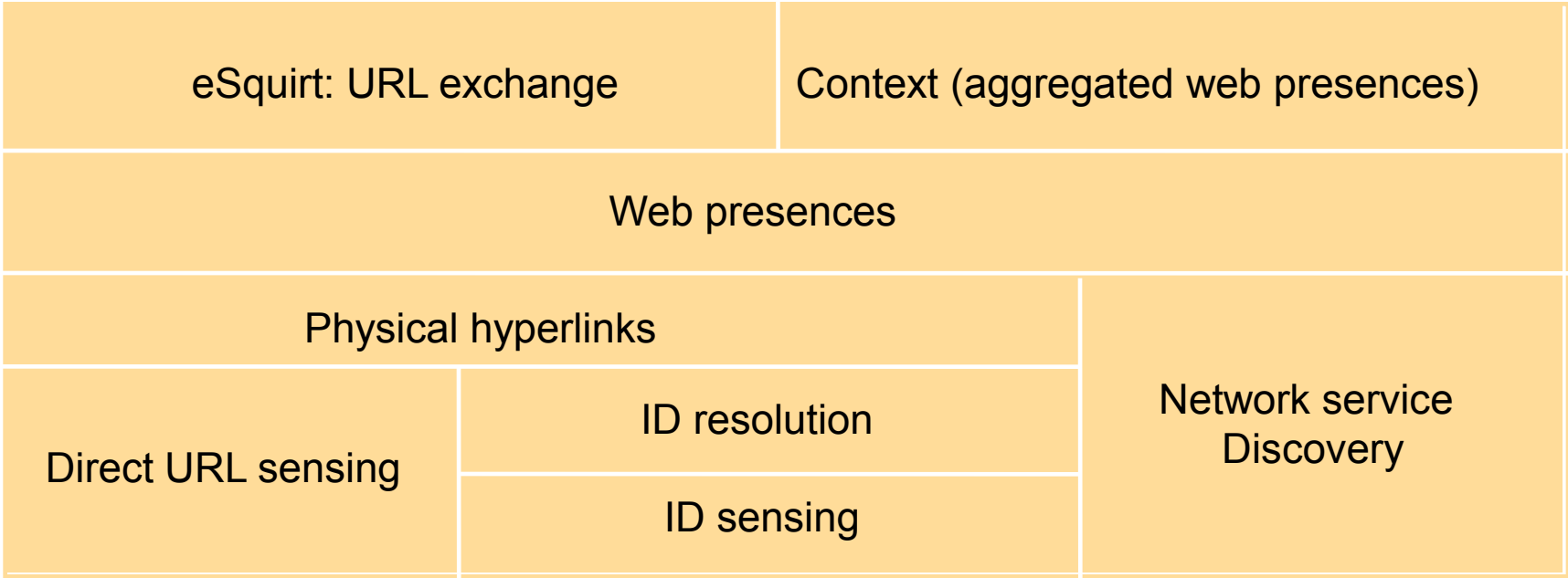
Figure 19.11
Detecting a man-in-the-middle

hash=0x6F9E...

hash=0xD57C...

K2

K1

1. Keys exchanged by Diffie-Hellman protocol

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 exchange | Context (aggregated web presences) |
|---|---|

| Web presences |
|---|

| Physical hyperlinks | | Network service Discovery |
|---|---|---|
| Direct URL sensing | ID resolution | |
| | ID sensing | |

Figure 19.13
Capturing and printing the web presence of a painting
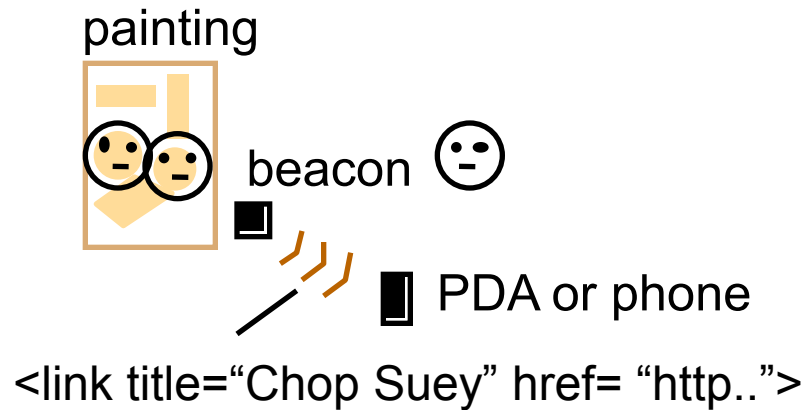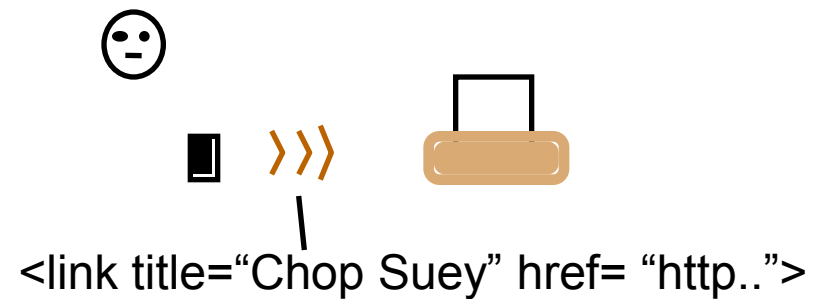
painting

beacon

PDA or phone

<link title="Chop Suey" href= "http..">

a. User captures URL of painting's web presence

<link title="Chop Suey" href= "http..">

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