

# Challenges in Access Right Assignment for Secure Home Networks

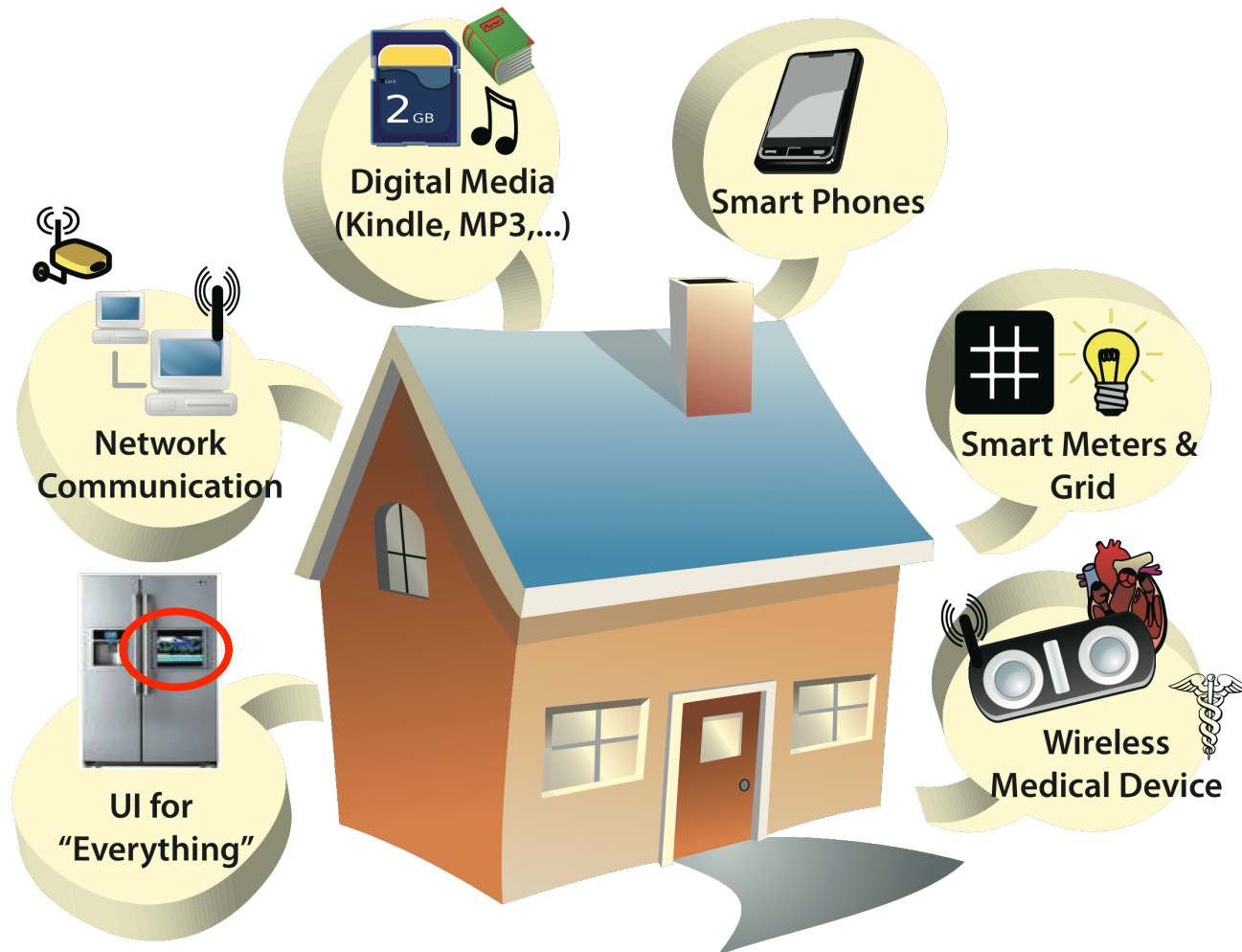
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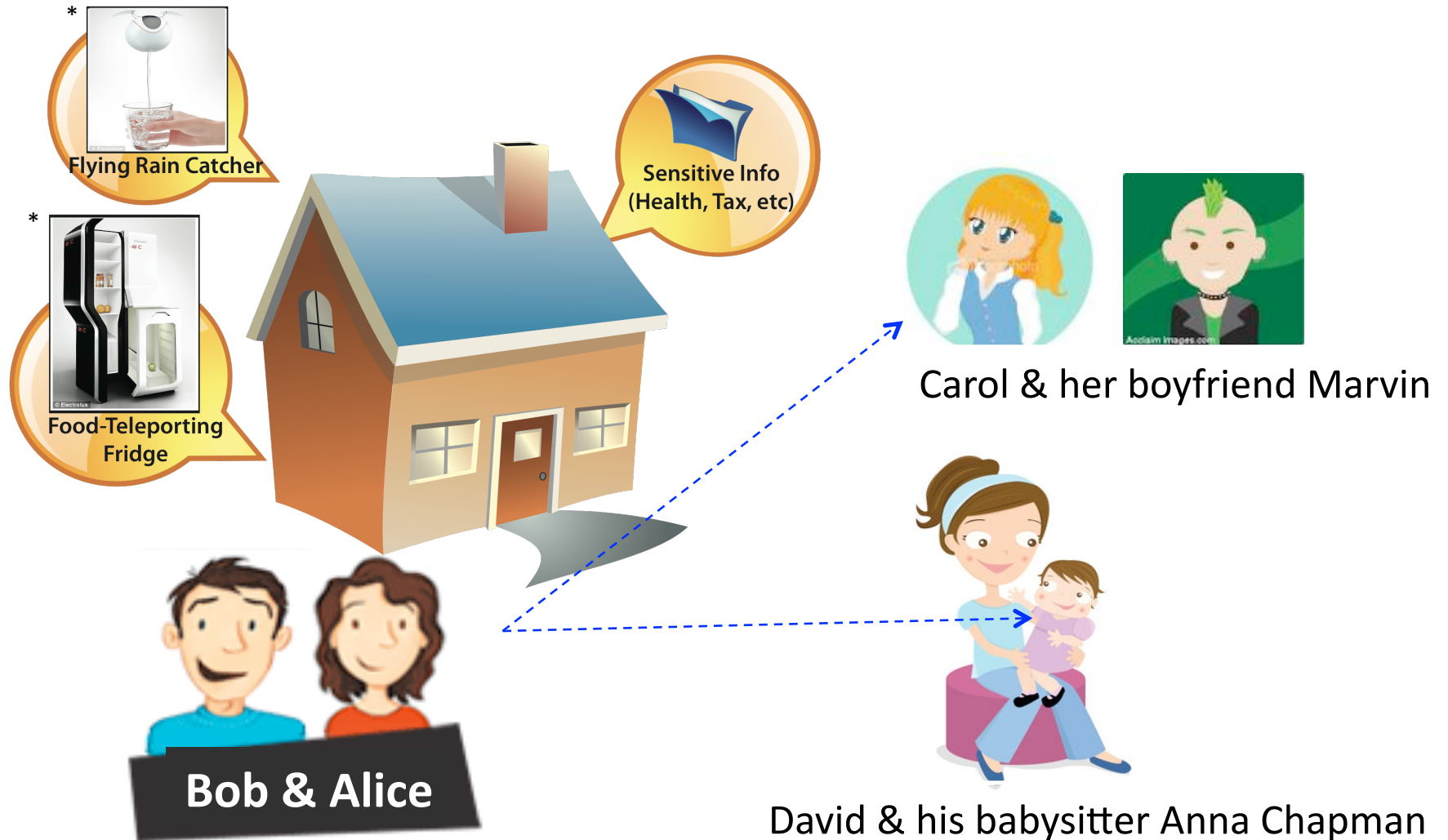
HotSec'10 (5<sup>th</sup> Usenix Workshop on Hot Topics in Security)



# Future Smart Home Vision



# Year 2020



\* <http://www.electroluxdesignlab.com/>

# Security Issues

## ■ Security concern

- Individual & family privacy
- Potential physical harm



## ■ Question

- *How to control access in home environment?*
  - Diversity of visitors
  - Complexity & diversity of devices and resources
  - Low sophistication of administrators
  - Social context

**Potential Home Network**

# Outline

- **Problem Definition**
- **Unique Combination of Challenges**
- **Preliminary Policy Assignment**
- **Related Work**
- **Conclusions**

# Problem Definition

- **Access control mechanisms from a *user's perspective***
  - Assist *non-expert* home owners for access assignment to visitors
  - Protect resources against unauthorized use
- **Adversary Model**
  - Visitor with unintended (over-permissive) access privileges



Curious Anna

# Unique Combination of Challenges

## 1. Complexity of home environments

- Number & diversity of devices
  - Appliances, media storage, network-related, safety devices
- Types of resources each device supports
- Data stored on each device

## 2. No dedicated expert administrator

- Complex configuration & maintenance procedure

## 3. Diversity of **visiting parties**

- From family members, relatives, friends & neighbors to service workers, first responders, elderly care providers...
- Each party requires different access

# Unique Combination of Challenges

## 4. Devices: mixed ownership

- No single owner for all devices (e.g., personal laptops)
- Shared devices with multiple owners (e.g., TV)



Bob & Alice

## 5. Multiple uncoordinated administrators

- Need  $> 1$  *trusted* administrator

## 6. Diverse administrator's preferences

- Security & privacy vs. convenience



Carol

## 7. Social context: distrust revelation problem

- Invisible trustworthiness becomes visible



Anna



# Preliminary Policy Assignment

## ■ Small user study

- Interview on 20 people (8 males & 12 females)
- Age range of 20 to 60

## ■ Interview instructions

- List 8 people
  - Contact on semi-regular basis
  - May be potential future home visitors
- Imagine future electronics & appliances in *their* future home
- Ask access policy assignments for each device for each person

# Observations from Interview

## ■ Validation of some challenges

- Non-expert administrators
- Complexity of home environments
- Diversity of visiting parties
- Concerned about distrust revelation

## ■ 3 types of policies

- Sufficient to capture desired policies

## ■ Fixed groups of access-control policies to visitors

- Duration of relationship
- Level of trust

# 3 Types of Access Policies

## ■ Presence ( $P_U/P_{OU}$ )

- User must be *inside* home to gain access
  - User presence ( $P_U$ )
  - Owner & user presence ( $P_{OU}$ )

## ■ Logging ( $P_L$ )

- Devices maintain detailed audit logs

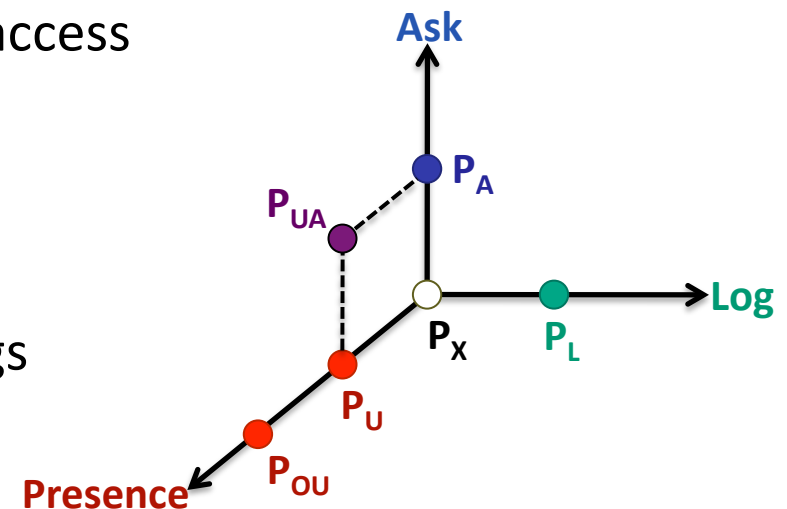
## ■ Ask for permission ( $P_A$ )

- Lazy evaluation approach
- Owner is contacted when visitors attempt to use

## ■ Always deny ( $P_X$ )

## ■ Hybrid policies

- Combination of any dimensions (e.g.,  $P_{UA}$ )



# 4 Groups of Access Rights

## ■ Full control

- Complete control & full access to all devices
- Owners, close relatives, household members



## ■ Restricted control

- Full access control except: entertainment & security systems
- Teenagers in family



## ■ Partial control

- Full access control on sharable devices (e.g., home telephone)
- Trusted friends

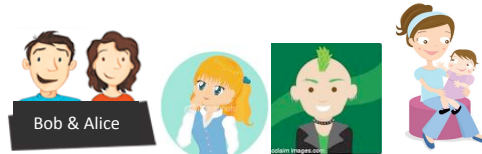


## ■ Minimal control

- Most restrictive
- Casual visitors



# Suggested Basic Policy Assignment



Device/Resource Group	Full Control	Restricted Control	Partial Control	Minimal Control
Personal laptop computer	P <sub>U</sub>	P <sub>U</sub>	P <sub>A</sub>	P <sub>A</sub>
Personal file (tax/diary)				P <sub>X</sub>
Internet			P <sub>U</sub>	P <sub>A</sub>
Home storage (photos, music)			P <sub>OU</sub>	
Personal file storage (USB)		P <sub>A</sub>	P <sub>A</sub>	
Surveillance camera		P <sub>L</sub>	P <sub>X</sub>	
Home telephone (call log)			P <sub>A</sub>	
TV/DVR/game		P <sub>L</sub>	P <sub>U</sub>	P <sub>OU</sub>
Digital photo frame		P <sub>U</sub>		P <sub>A</sub>
Smart fridge (camera inside)			P <sub>L</sub>	P <sub>X</sub>
Door lock			P <sub>L</sub>	P <sub>A</sub>
Window lock				P <sub>A</sub>
Home security controller		P <sub>OU</sub>	P <sub>X</sub>	P <sub>X</sub>

Policy	Meaning
P <sub>U</sub>	User present
P <sub>OU</sub>	User & owner present
P <sub>L</sub>	Logging
P <sub>A</sub>	Ask for permission
P <sub>X</sub>	Always deny

# Related Work

## ■ Home environment

- Carl Ellison: home network security
- Johnson & Stajano: permission to guests
- Argyroudis & O'mahony: foundation architecture for security relationships
- Kostianinen et al.: access control for family members
- Marin et al.: access control middleware for family members
- Brush & Inkpen: results from empirical study of 15 families
- Egelman et al.: user account model for shared home computers
- Seingneur et al.: adjust trust based on reputation
- Mazurek et al.: access control for home data sharing
- ...

# Conclusions

## ■ Access policy to home resources to visitors

- Difficult to address *all* challenges
- Danger: inappropriate access permission
  - Liberal assignment: visitor accesses sensitive personal data
  - Restrictive assignment: visitor cannot use light switch

## ■ Preliminary approach to address some challenges

- 3 policy types
- 4 groups of access rights

## ■ Future work

- Full evaluation with larger set of participants
- Address remaining challenges (e.g., multiple administrators)

**Thank you!**

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# Discussion Questions

## ■ Issue with logging

- How to prioritize entries with illegitimate accesses while preventing entries with legitimate accesses?

## ■ Mental models

- Compelling mental models for consumers?
- Would 3 classes & 4 groups be natural way of thinking?