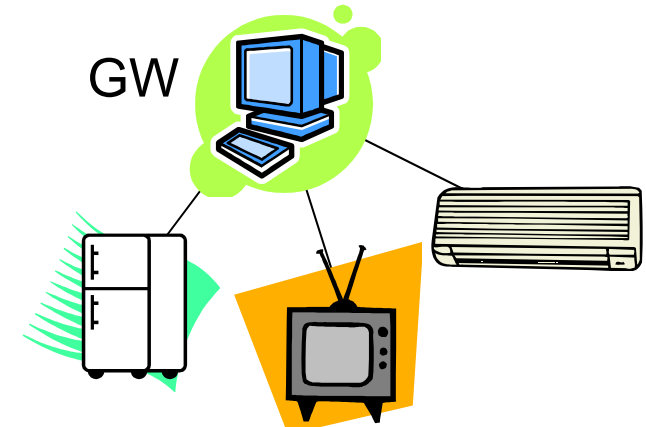
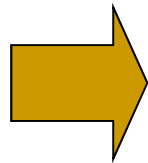


# Background



- **Wireless Home Networks**
  - Zigbee
  - Original network protocol based on IEEE 802.15.4
- **Ambient Networks**
  - Providing service according to location and/or situation of users



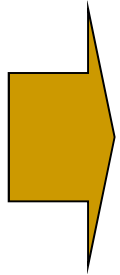
Location estimation method is necessary

- **Location estimation method**
  - Using Received Signal Strength Indication (RSSI)
  - Search area: 1 (large) room (ex: at a show)
  - Many nodes is necessary

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# Objective

- Typical Japanese apartment house
  - Several rooms
  - Several home appliances (nodes) in a room



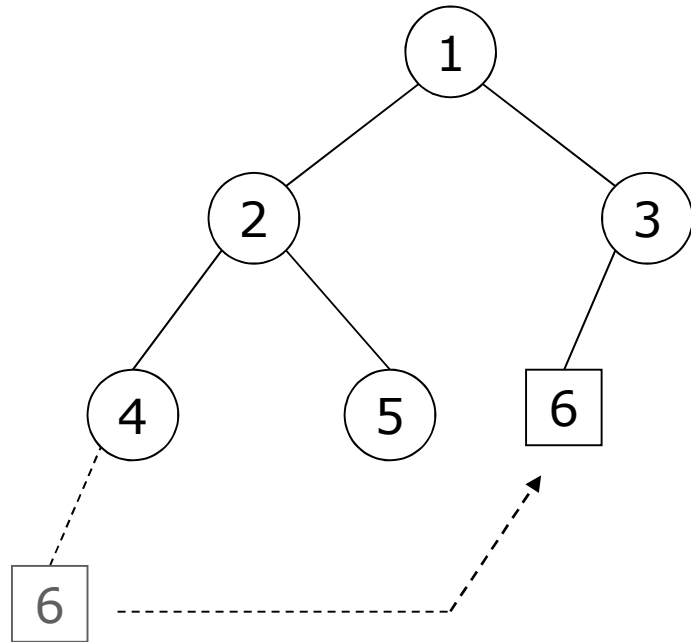
Applying the existing method to home networks is unefficient

**Location estimation method for wireless home network**

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# Wireless Home Network Protocol

The gateway (GW)



## Feature of home networks

### ○ Stationary nodes:

- air conditioners, televisions, etc.
- powered by mains power
- **known** location

### □ Mobile nodes:

- remote-controlling devices, healthcare devices, etc.
- powered by batteries
- **unknown** location

- Tree topology is employed.
- The root of the tree is the gateway (GW).
- Communication occurs only between GW and nodes.

# Location Estimation using RSSI and Maximum Likelihood Estimation Method

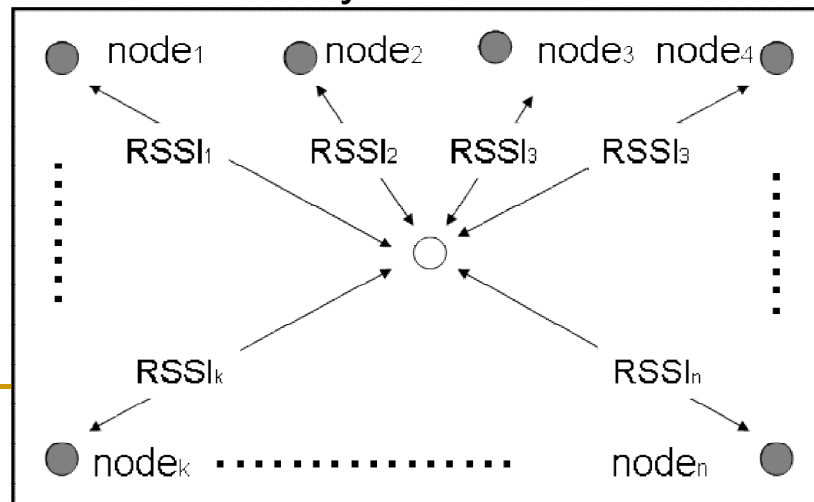
1. Obtain RSSI between mobile node and each stationary node. ( $RSSI_1 \sim RSSI_n$ ) ( $n$ : # of stationary nodes)
2. The location  $\theta$  which maximizes following equation is estimated location

$$p(RSSI|\theta) = p(RSSI_1|r_1) p(RSSI_2|r_2) \cdots p(RSSI_n|r_n)$$

$r_n$ : distance between stationary node<sub>n</sub> and mobile node [m]

$RSSI_n$ : measured RSSI between mobile node and stationary node<sub>n</sub>[dB]

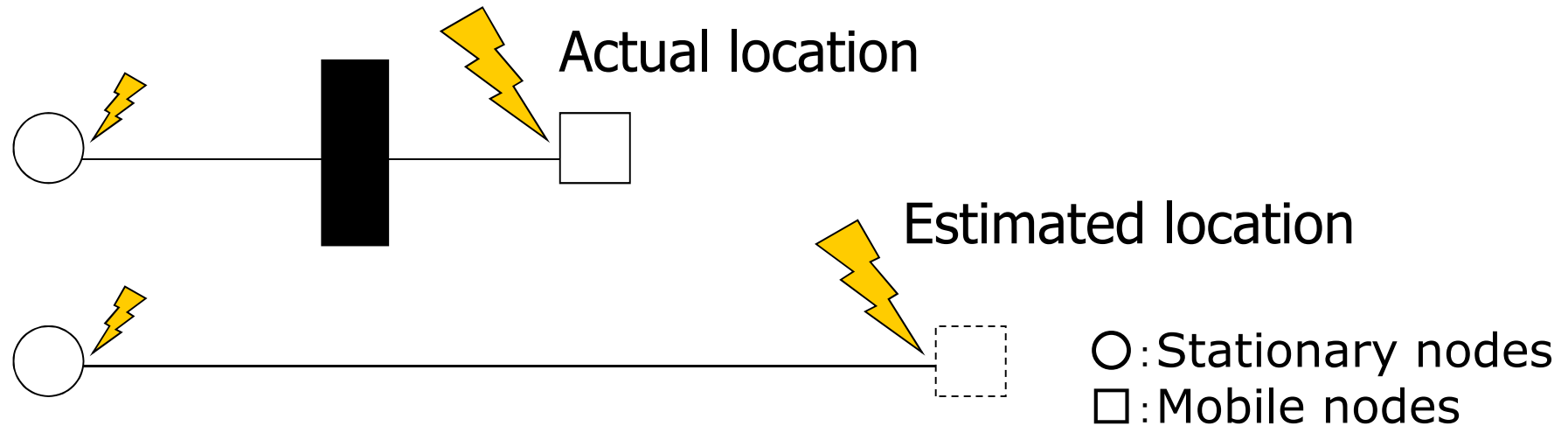
$p(RSSI|r)$ : probability density function (PDF) of RSSI given distance,  $r$ , obtained by RSSI measurement experimentation



○ Mobile node  
● Stationary node

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# Transmission Attenuation



The existing method increases the distance between estimated location and actual location



The new location estimation is proposed in order to remove the influence of transmission attenuation

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# Location Estimation Considering Transmission Attenuation

Obstruction: **Wall**

- All rooms are divided into rectangle area ( $k$ : # of area).
- The exiting location estimation process is executed at each area, and the estimated location ( $E_k$ ) and the likelihood ( $L_k$ ) are obtained.
  - The PDF $_n$  ( $n$ : # of walls) are used according to the number of walls between mobile and stationary nodes.
- The  $E_i$  with  $\max(L_1:L_k)$  is the estimated location to be obtained.

