

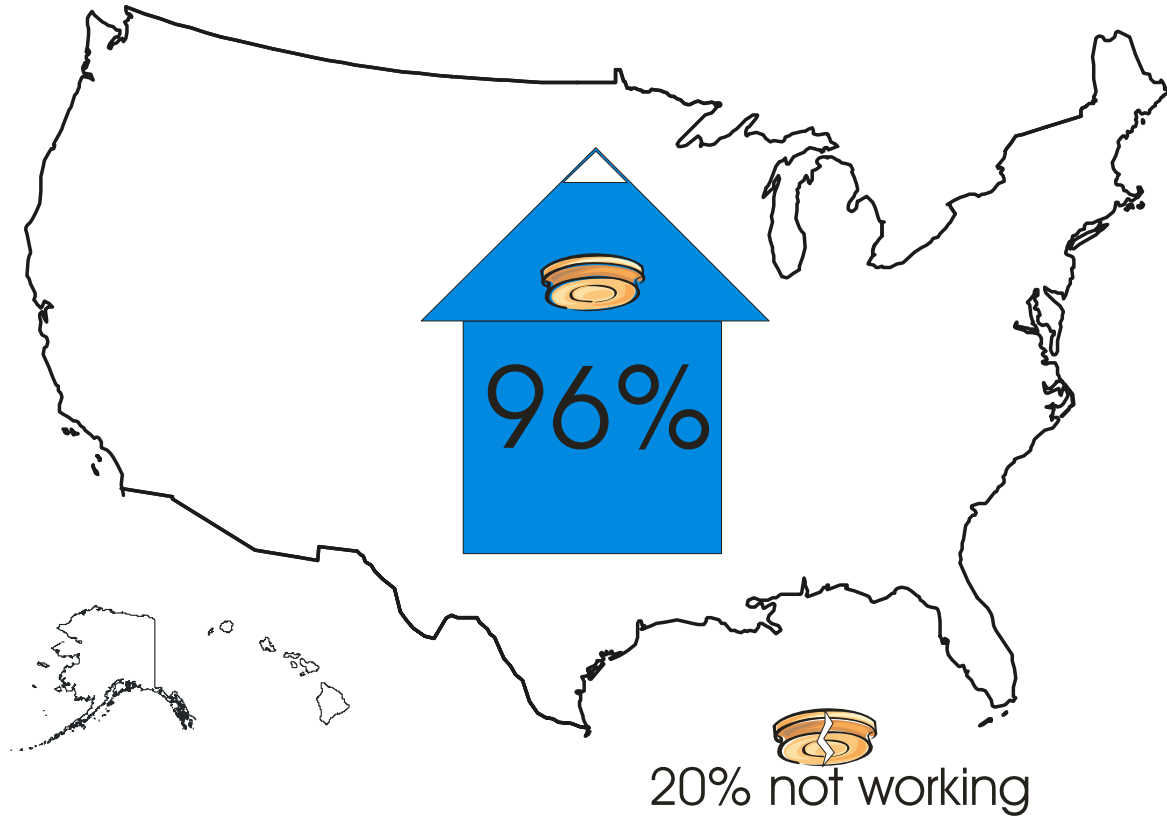


# Improving Residential Smoke Alarms

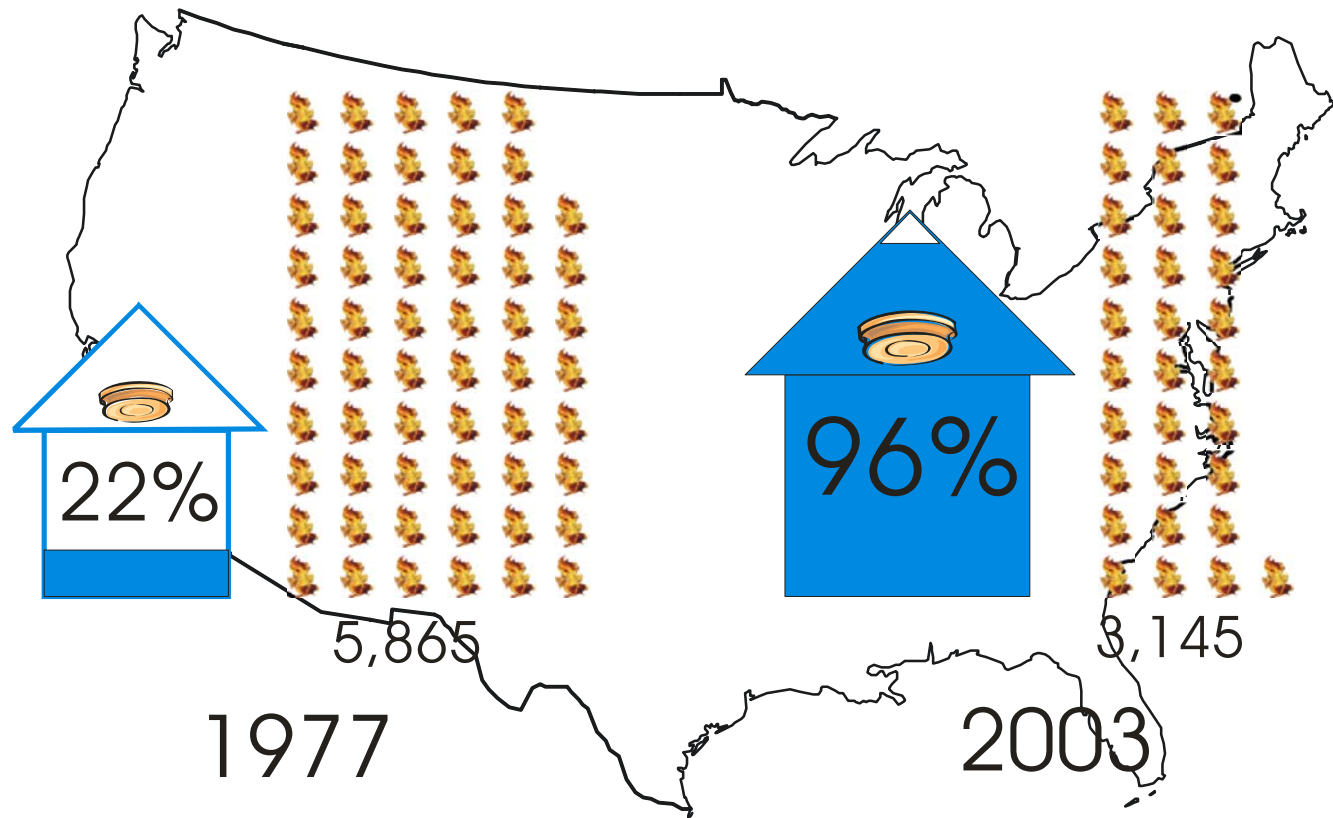
## Detection and Notification

\*These comments are those of the CPSC staff, have not been reviewed or approved by, and may not necessarily reflect the views of, the Commission.

# Number of Smoke Alarms in Homes



# Decline in Fire Deaths

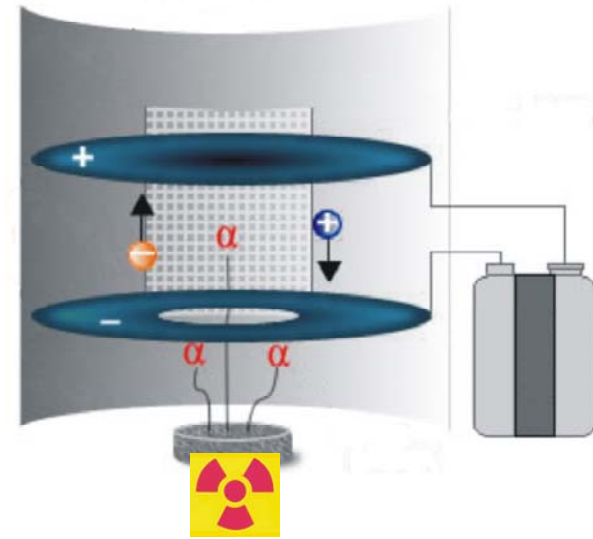


\*source - NFPA

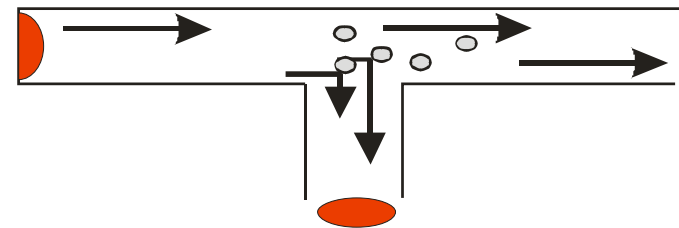
# Sensors in Smoke Alarms

Three main types

- Ionization
  - Flaming fires
- Photoelectric
  - Smoldering fires

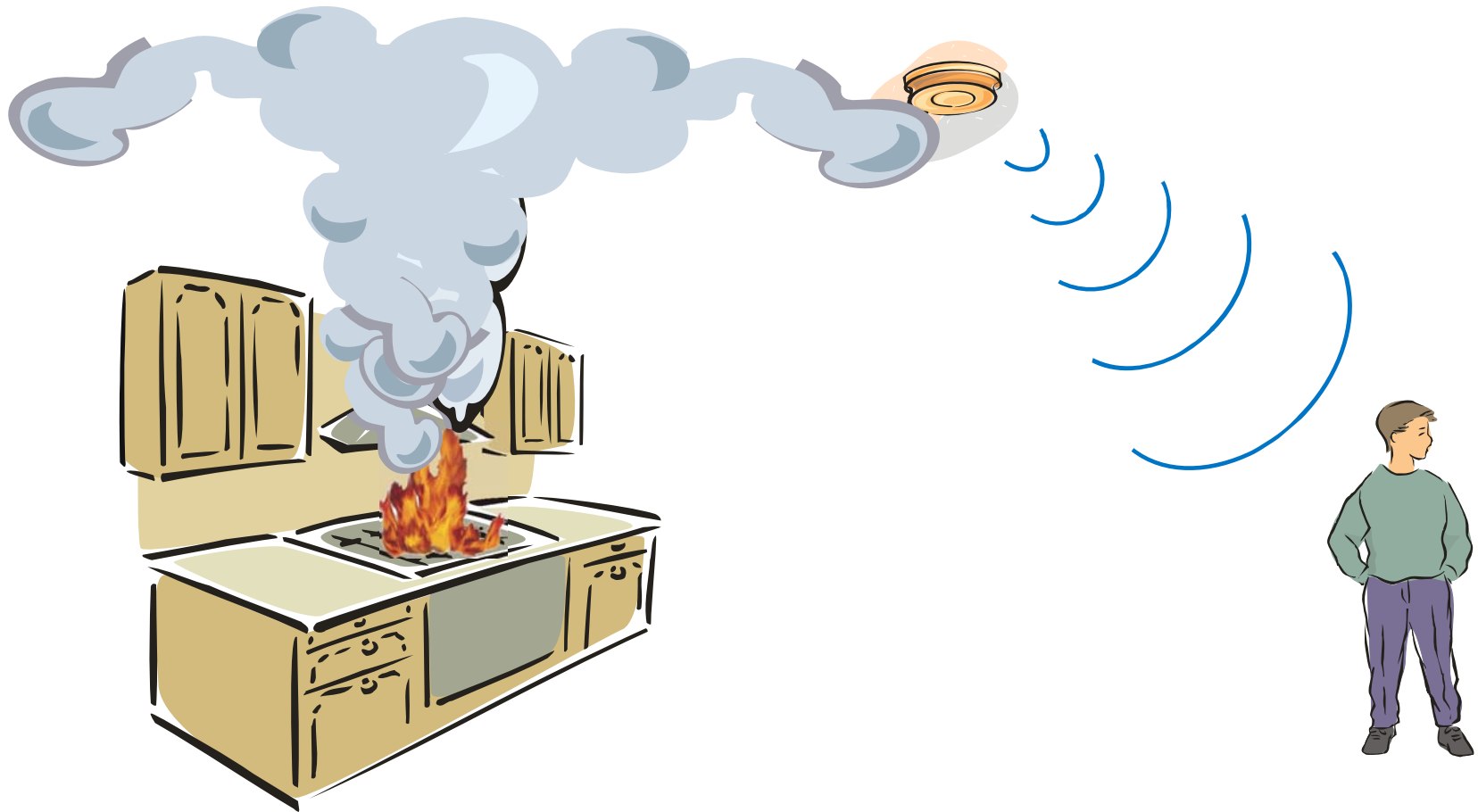


Ionization sensor



Photoelectric sensor

# Smoke to Smoke Alarm Notification to Occupants



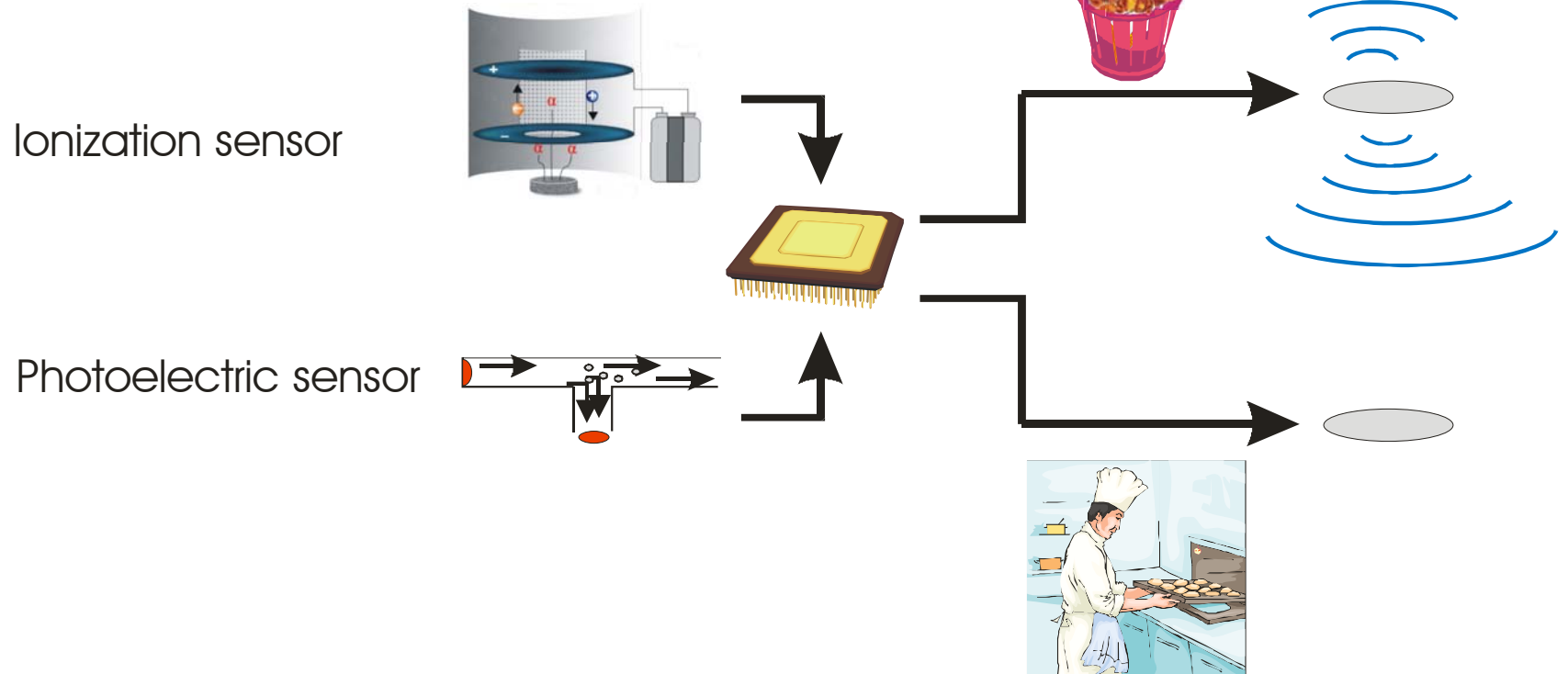


# Improving Detection

- Improve sensor detection
  - Particle discrimination
  - Low concentration
- Improve sensor location
  - Increase number of sensors per area
  - Locate sensors near heat producing equipment.

# Improving Sensor Detection

- Combination Sensors
  - Improve detection
  - Reduce nuisance alarms



# Improving Sensor Location

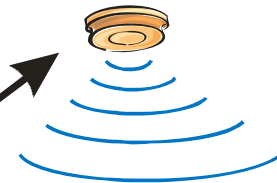
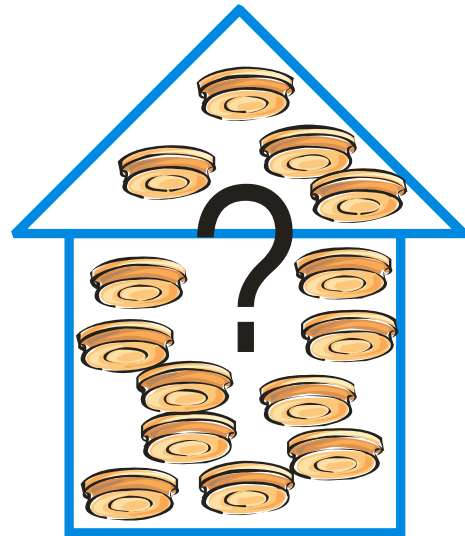
- More smoke alarms per area?
  - Interconnect smoke alarms



- Improve audibility

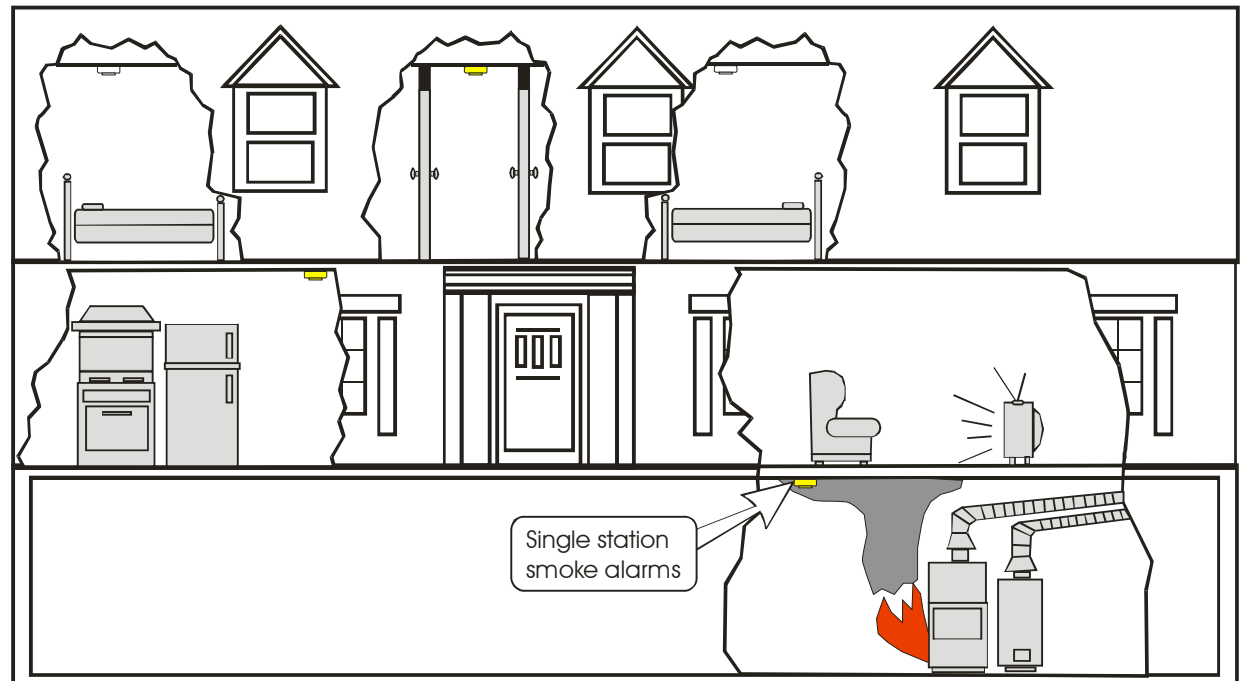


- Smart Sensors in appliances



# Older Homes use Single Station Smoke Alarms

- Prior to 1989, existing homes typically installed single-station, battery-only-powered smoke alarms.
- After 1989, new homes to have interconnected (hard wired) smoke alarms



# Smoke Alarm Audibility – Sound Loss

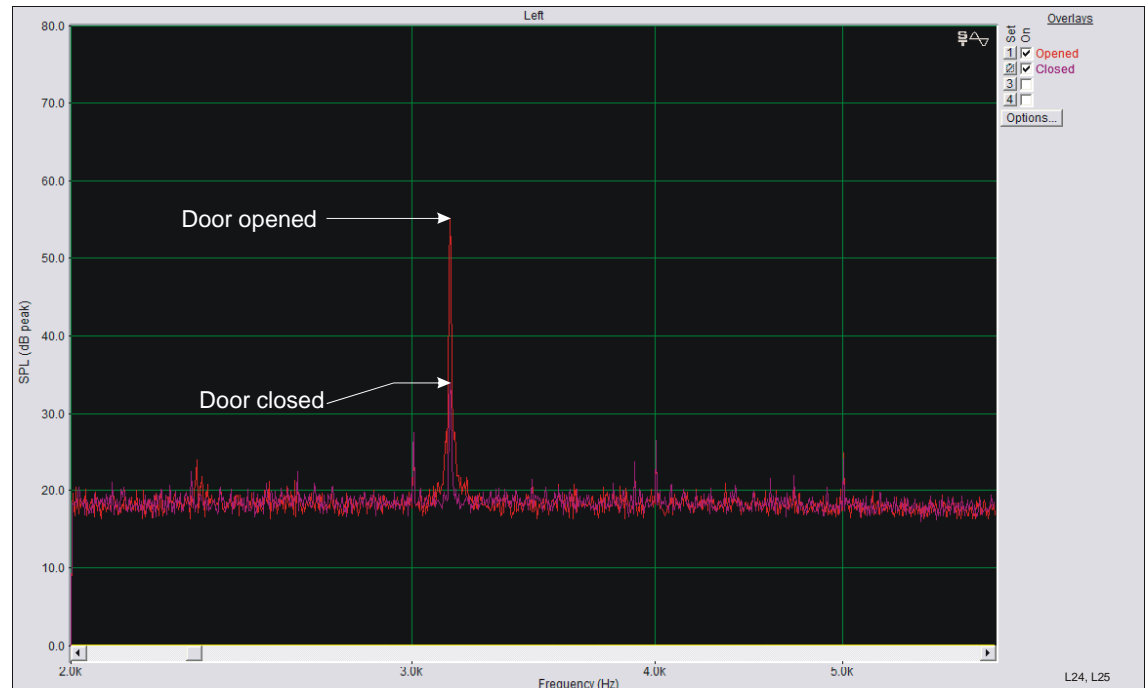
- *The Audibility of Smoke Alarms in Residential Homes*, September 2005
- The CPSC staff conducted sound loss measurements in three different test homes using single station smoke alarms.
  - The homes were built between 1960 and 1989.
  - The sizes of the homes ranged from approximately 1,000 square feet to 3,300 square feet.



# Smoke Alarm Audibility – Sound Loss

- Single station smoke alarm installed in a small, single-level home may be sufficient to alert occupants, even if the bedroom doors are closed.
- In a two-level home, sound levels may not be sufficient to alert occupants in all areas of the home, causing a delay for some individuals to respond immediately. Sound levels as low as 50 dBA.

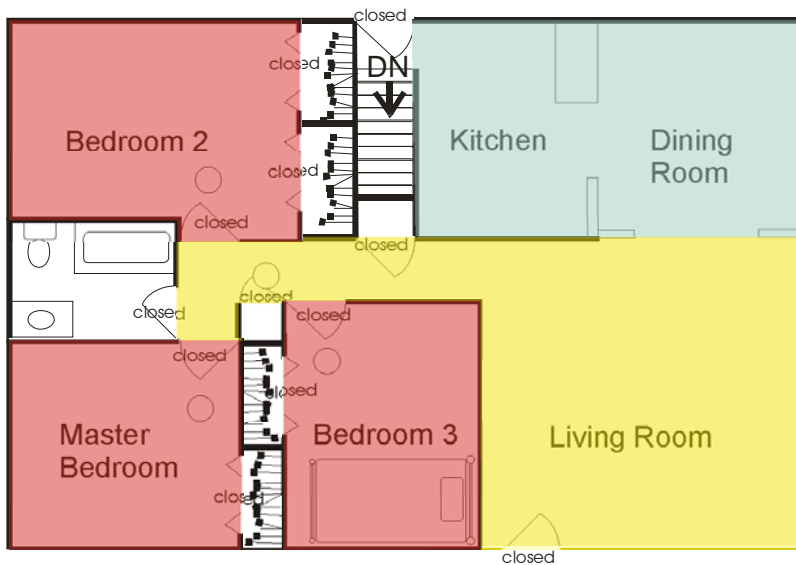
- May not be sufficient to alert occupants in all areas of a three-level home. Sound levels as low as 30 dBA.



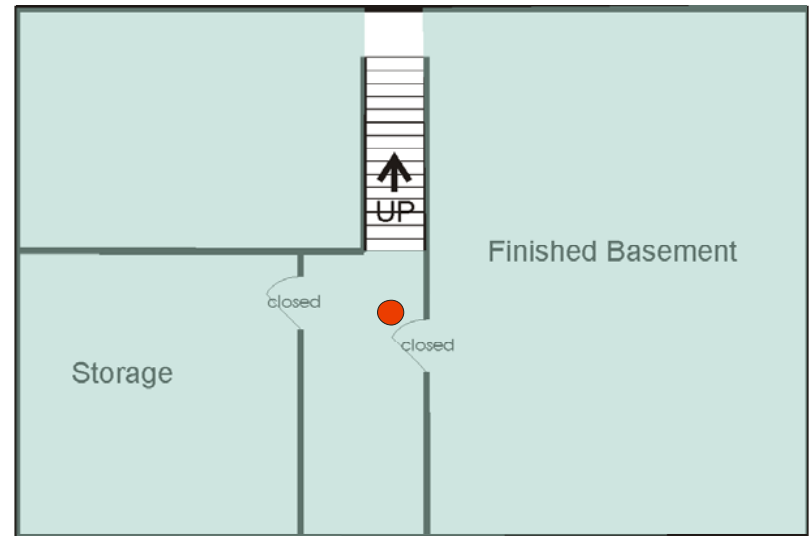
# Smoke Alarm Audibility – Sound Loss

- The complexity of the path that the sound must travel determines the amount of attenuation (reduction) in the alarm signal.
- Closing a door attenuates a smoke alarm signal 10 to 20 dBA.
- Each (home) level that sound travels attenuates a smoke alarm signal about 20 dBA.

# Smoke Alarm Audibility – Sound Loss



First Floor



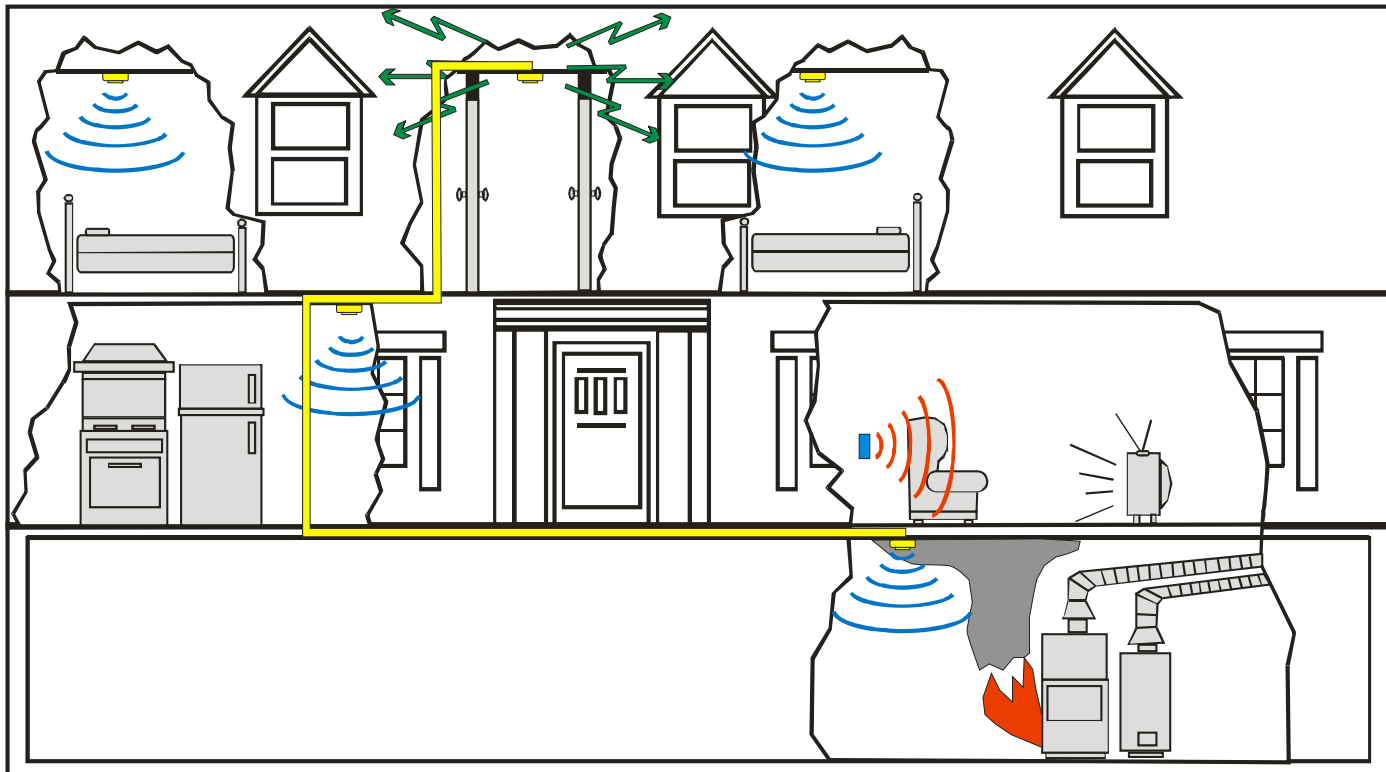
Basement

- Active Smoke Alarm
- Non-active Smoke Alarm

- Above 70 dBA
- Between 60 - 70 dBA
- Below 60 dBA

# Smoke Alarm Audibility – Interconnected

- Interconnected smoke alarms can improve audibility effectiveness
- Hardwired and wireless smoke alarms





# Smoke Alarm Audibility – Children and Older Adults

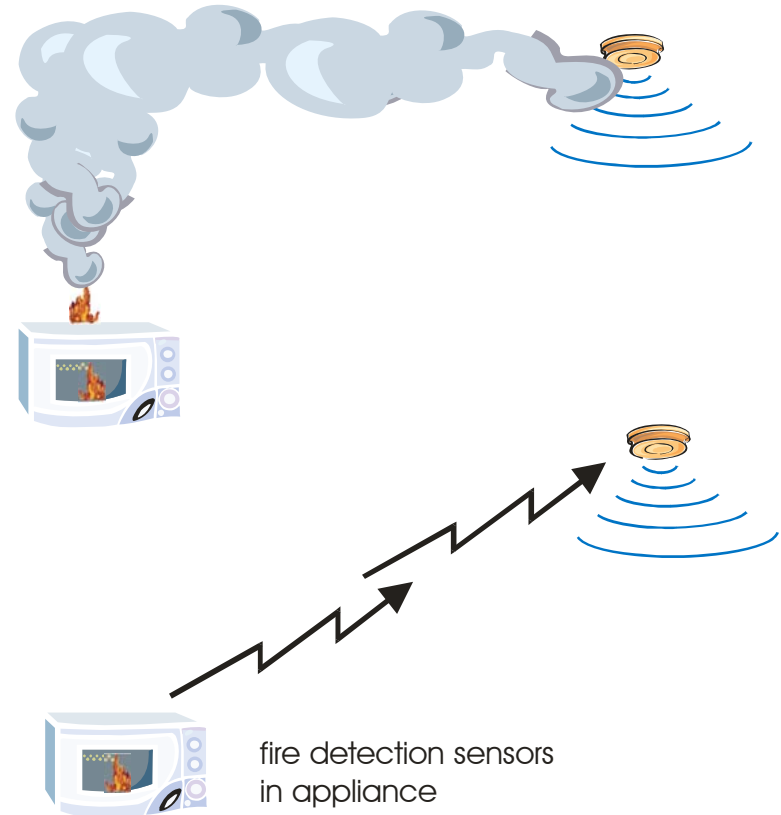
- Children under the age of 16 have longer periods of deep sleep compared to adults.
- Current smoke alarms do not reliably wake children under the age of 16.
- Current smoke alarms are effective in waking most adults not under the influence of drugs, alcohol, and sleep deprivation.
- Current smoke alarms may not reliably notify or alert seniors who are hearing impaired or have high frequency hearing loss.

# Improving Smoke Alarm Sound Characteristics

- Lower frequency may be better at awaking the general population.
  - Smoke alarm frequency typically between 3 KHz to 4KHz.
  - Frequencies between 500 Hz to 1 KHz may be better.
- Familiar recorded voice may improve awaking children.

# Smart Sensors in Appliances

- Bring the sensor to the fire.
  - Faster detection
  - Flame and temperature sensors
  - Notify multiple smoke alarms



# Improving Detection and Notification through wireless technology

