

# Sociable Objects

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Class 9

# Final Project Progress Reports

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- System diagram
- Protocol overview and details

# XBee Series 1 vs. Series 2

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- 802.15.4 (SERIES 1)

- 802.15.4 only
- ADC & Digital I/O
- point-to-point networking
- unicast or broadcast
- low power with good range
- mature

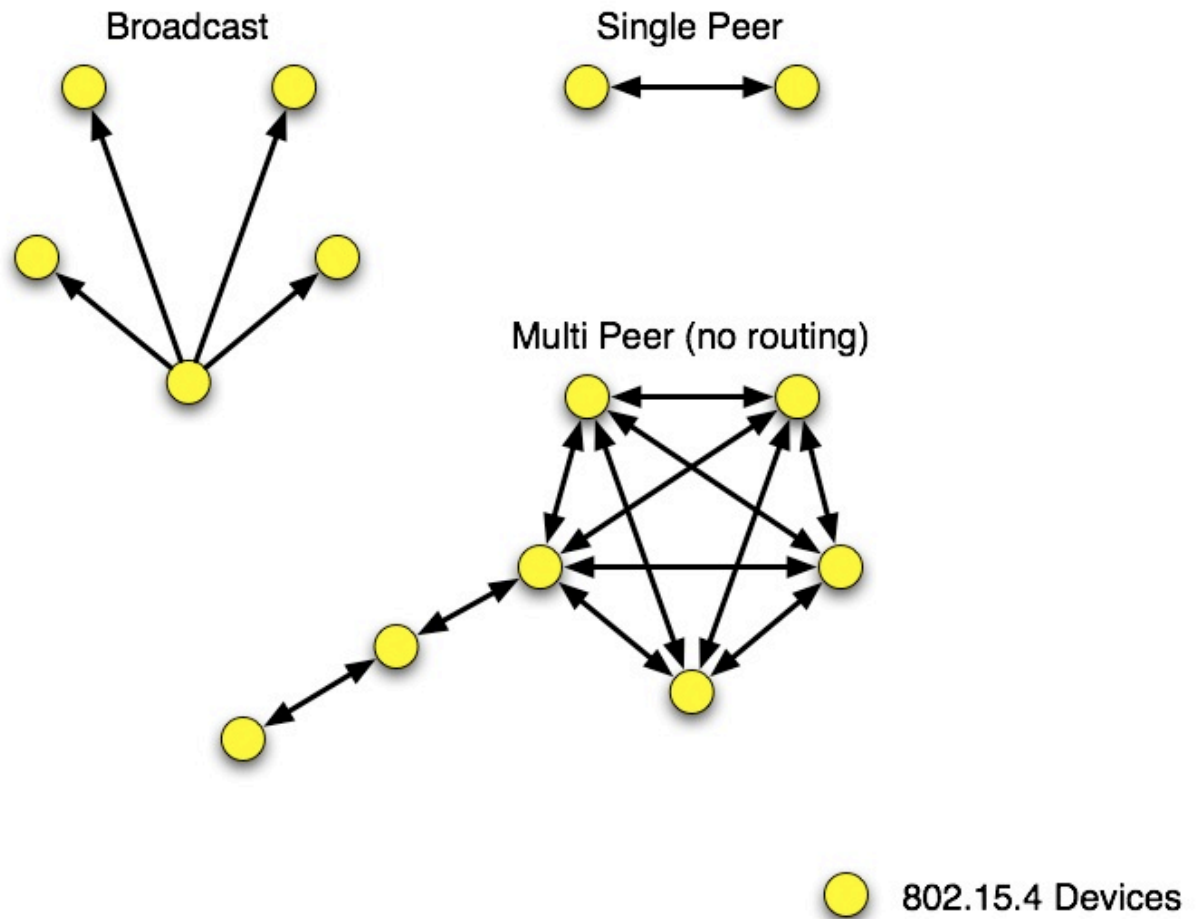
- ZNet 2.5 (SERIES 2)

- ZigBee only
- I/O now available
- Full ZigBee mesh networking
- unicast, broadcast or multicast
- slightly better range & power
- newer & less well-known

# 802.15.4 Topologies

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- single peer
- multi-peer
- broadcast



# ZigBee Basics

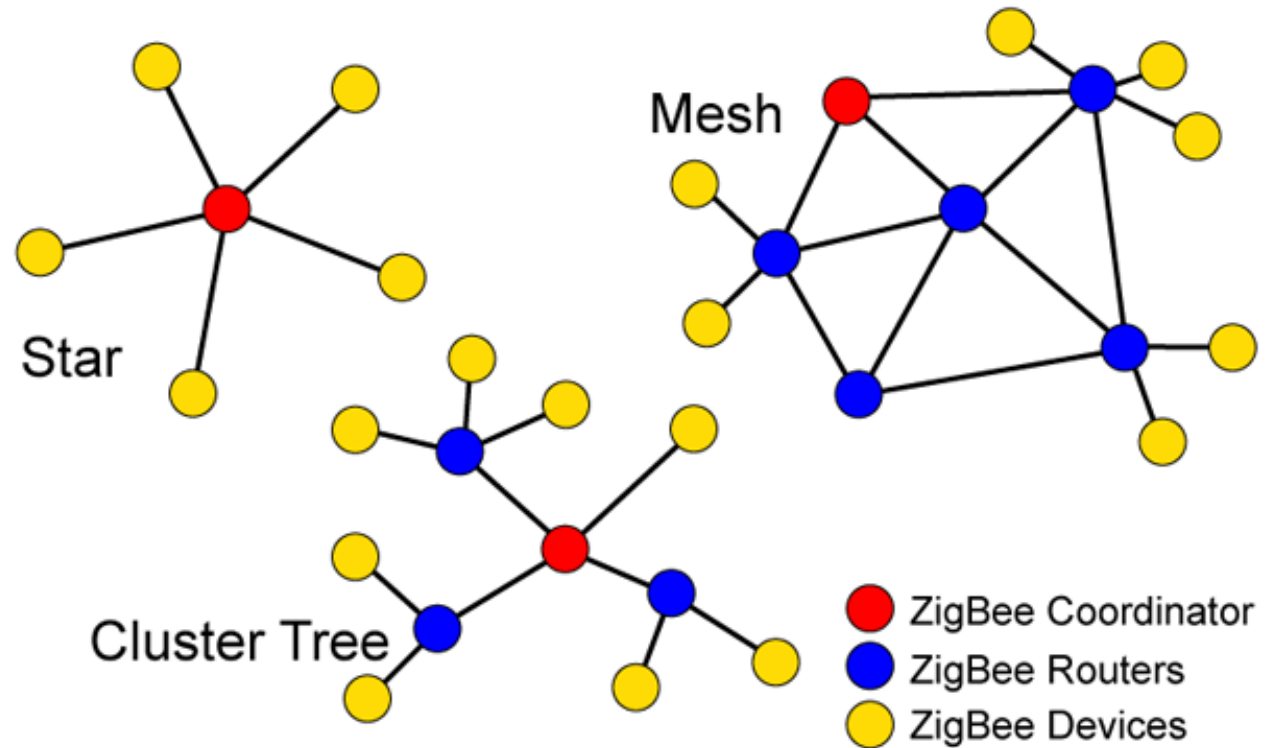
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- Coordinator
  - Routers
  - End devices
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- A ZigBee network is minimally: 1 coordinator and 1 router (or end device)

# ZigBee Topologies

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- peer
- star
- mesh
- routing



# ZigBee Coordinator

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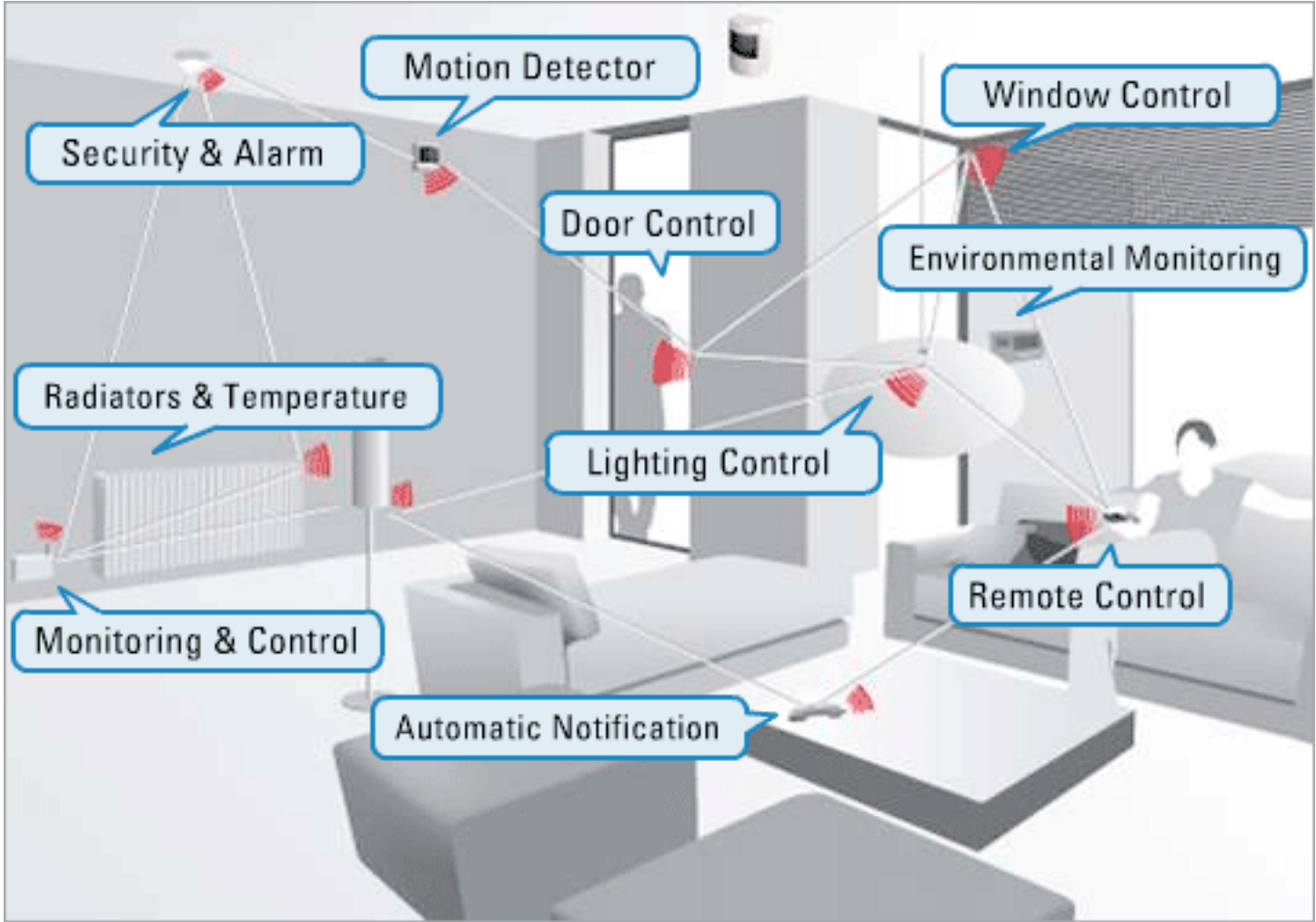
- Every ZigBee network must have a coordinator
- There can only be one coordinator
- Coordinator selects channel and PAN ID
- End devices and routers can then join the PAN
- Typically mains-powered
- Coordinator's 16-bit address is always 0

# ZigBee Router

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- Non-coordinator routers are optional to ZigBee networks
- Typically mains-powered
- Many can be on each PAN
- Issues a beacon request on startup to locate channel and PAN
- Routers can communicate with any device on the network
- Stores packets for sleeping end devices
- 16-bit address assigned by coordinator

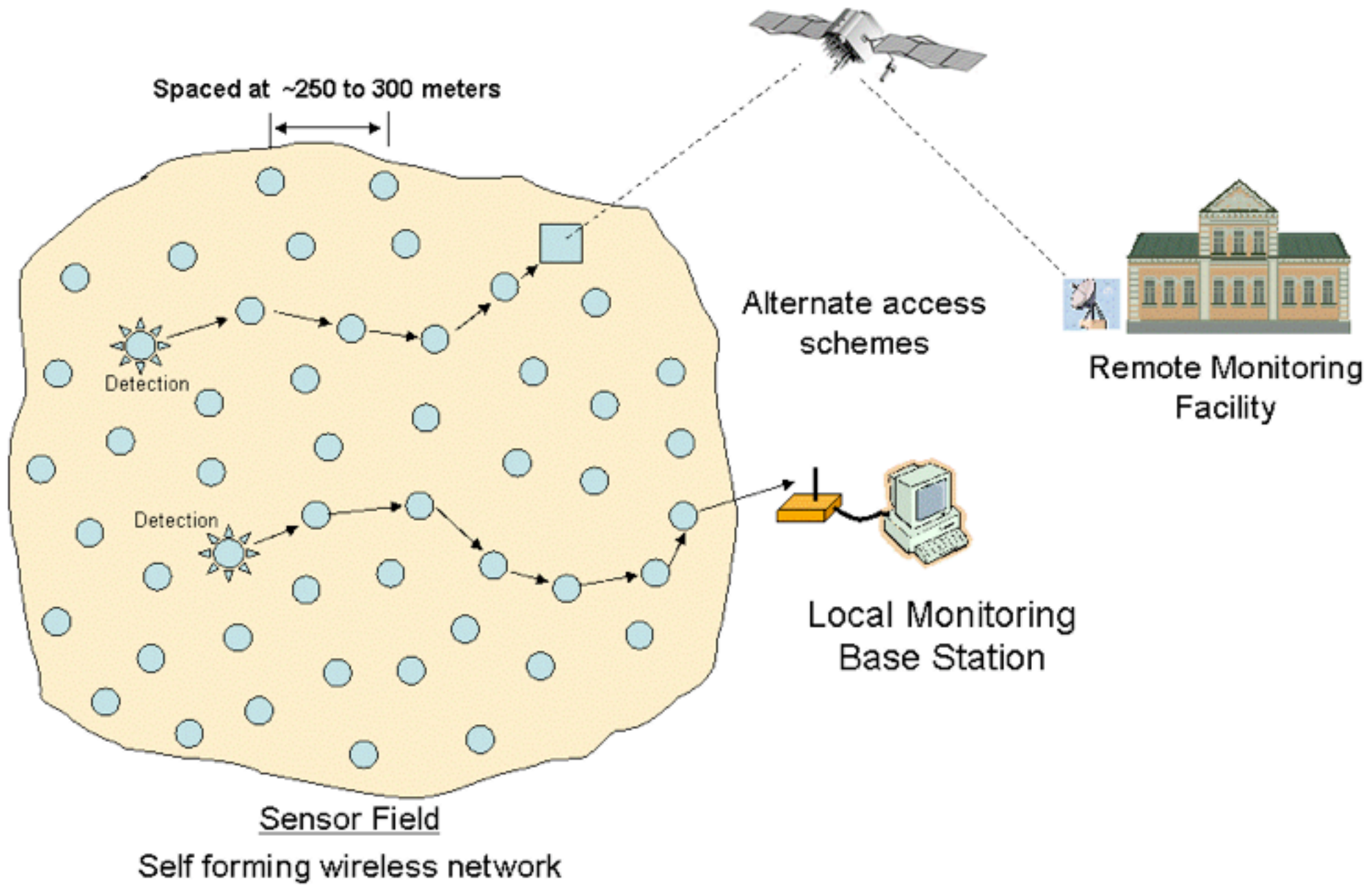


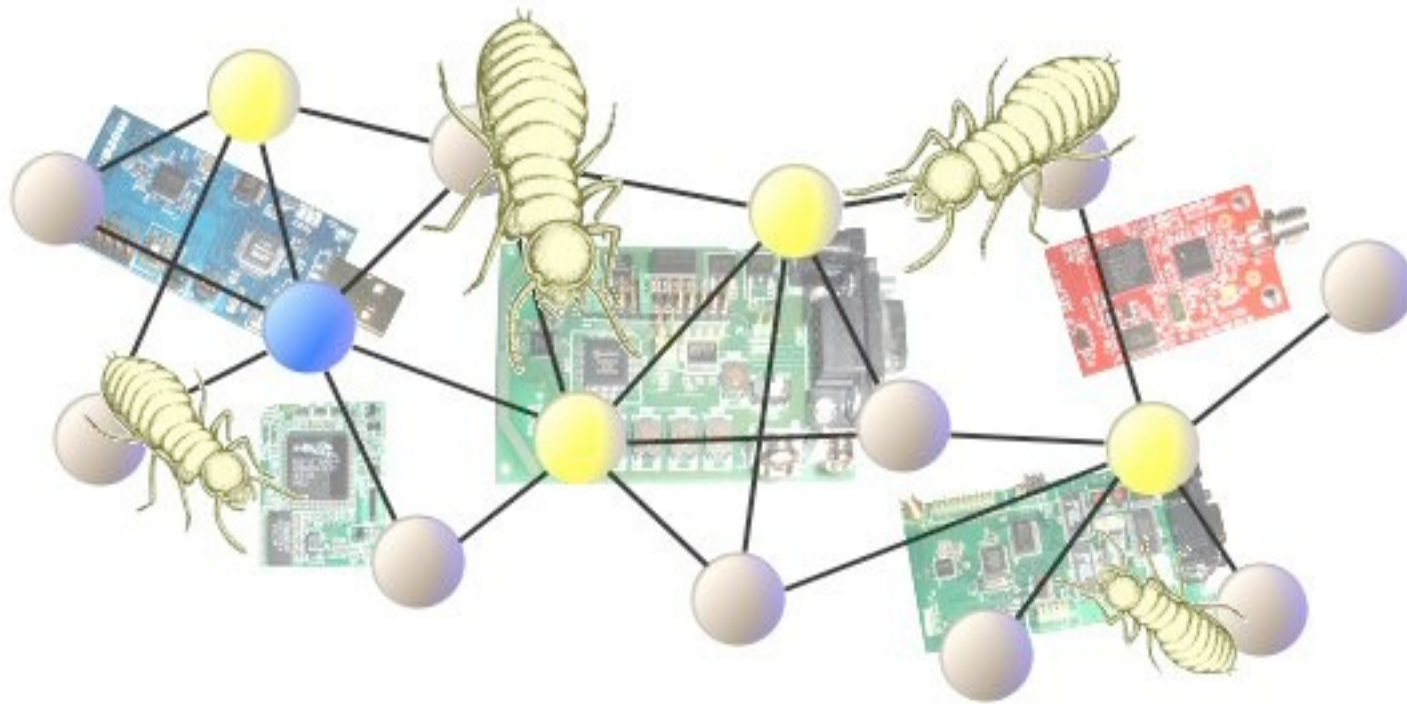


# ZigBee End Device

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- Optional to ZigBee networks
- Typically battery-powered
- Many can be on each PAN
- Issues a beacon request on startup to locate channel and PAN
- Automatically attempts to join a valid PAN
- End devices can only communicate directly with their parent
- 16-bit address assigned by coordinator



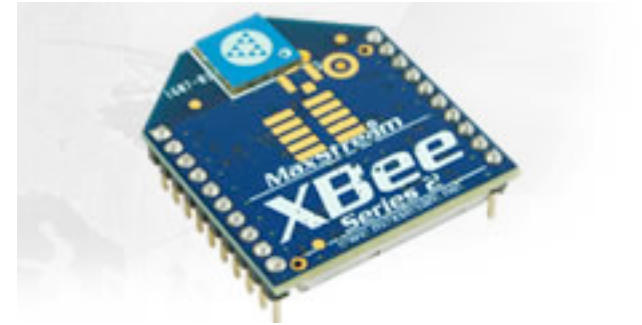


[http://www.stg.com/wireless/ZigBee\\_Termites.html](http://www.stg.com/wireless/ZigBee_Termites.html)

# XBee Series 2

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- Coordinator Firmware
  - for AT commands or API
- Router/End Device Firmware
  - for AT commands or API
- ...so 4 different firmware combinations (you'll always use 2 at the same time)
- and 4 antennas! whip, chip, U.FL and RPSMA.



# Special Features

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- Remote AT commands
  - send an AT command request to another node
  - only works in API mode, which means using API version of firmware
- Loopback: ATZA1,CI12,SEE8,DEE8 and then pick a destination node
- Join Indicators: ATJN to send a notification to the coordinator on join
- Battery Monitoring: AT%V for value then  $(\text{value}/1023*1200 = \text{mV})$

# Starting Up an XBee ZigBee Network

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- Coordinator:
  - scans and selects a channel
  - picks a PAN or uses a predetermined one
  - Associate light blinks, ATAI is set to zero (or a value indicating error)
- Router or End Device
  - scans for PANs on each channel
  - selects a PAN to join (often the predetermined one)
  - sends a beacon request to join to a parent router or coordinator
  - Associate light blinks, ATAI is set to zero (or a value indicating error)

# Transmitting Data

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- Read a list of all nodes on the network using ATND

MY<CR>

SH<CR>

SL<CR>

NI<CR> (Variable length)

PARENT\_NETWORK\_ADDRESS (2 Bytes)<CR>

DEVICE\_TYPE<CR> (1 Byte: 0=Coord, 1=Router, 2=End Device)

STATUS<CR> (1 Byte: Reserved)

PROFILE\_ID<CR> (2 Bytes)

MANUFACTURER\_ID<CR> (2 Bytes)

<CR>

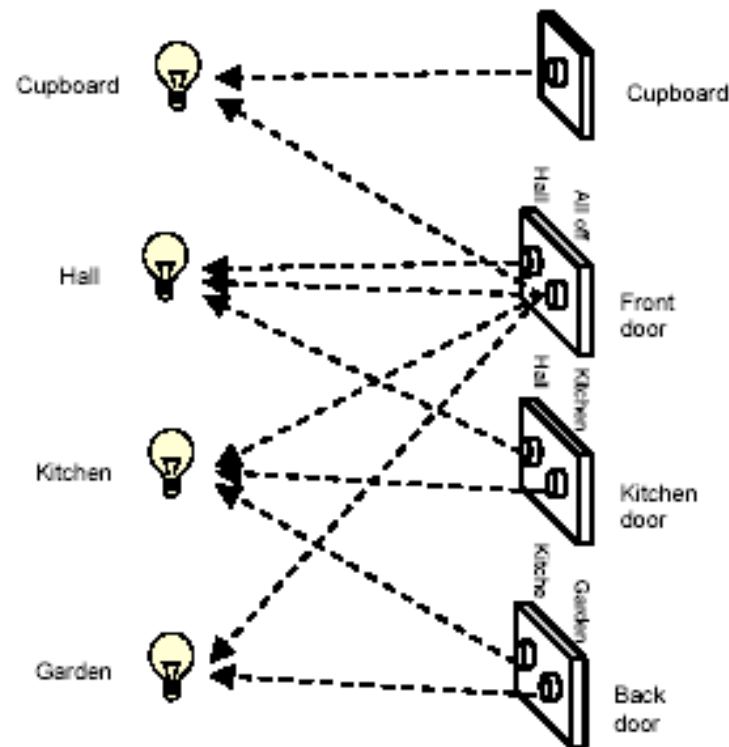
- Set the Destination Node using ATDN



# Endpoints, Clusters and Bindings

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- Another addressing scheme for defining groups of radios and actions, typically for home networking.
- Beyond the scope of this class and not immediately useful to us.



# Readings and Assignments

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- Assignment
  - Final Projects DUE NEXT WEEK

# I/O Workshop

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- Set up input and output radios with sensors
- Transmit values without any external microcontroller