Sociable Objects Workshop

Instructor: Rob Faludi

Introduction

- Sociable Objects
  - Connections are Collaboration
  - Networks
  - Mesh Networking
- Rob Faludi
  - Background
  - Motivations for this class

Plan for Today

- Introductions
- Syllabus Review
- Sociable Objects
- ZigBee
- XBees, adaptors and terminal programs
- Addressing
- Readings & Assignments

Introductions

- Name, graduation semester
- Projects from the last year
- What you'll do this summer
- What you wish you were doing this summer
- How you ended up in this class, hopes and plans

Syllabus Review

- Syllabus review
    - Class schedule
    - Assignments
    - Documentation
    - Grading
    - Office Hours
    - Projects

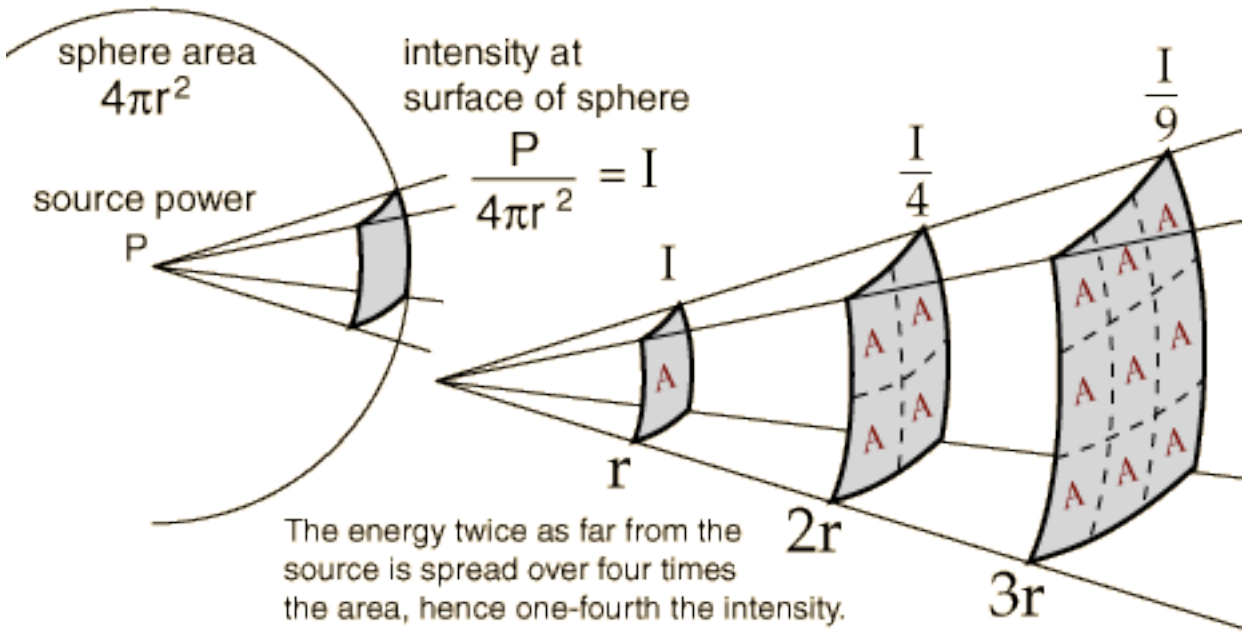
Radio Communications

- electromagnetic waves
- no medium required
- modulation

- Well-described mystery: “air waves” “wireless” “ethereal communication”

Inverse Square Law

- power needs increase exponentially with distance



ZigBee & 802.15.4

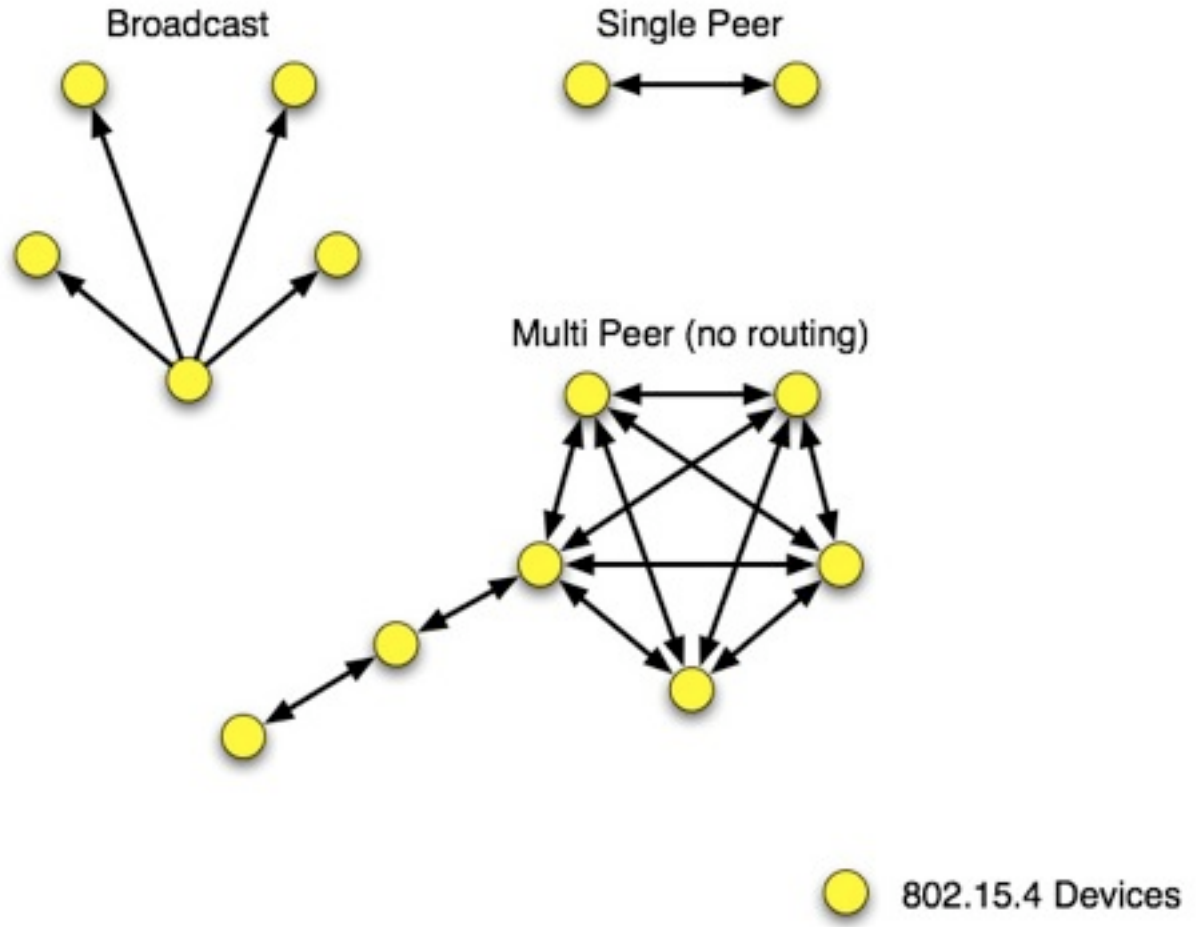
- ZigBee is built on top of the IEEE 802.15.4 protocol
- XBee radios can be purchased with or without ZigBee
- XBee 802.15.4 vs. ZNet 2.5 vs. ZB Pro vs. DigiMesh
- All ways are useful

802.15.4

- low power
- low bandwidth
- addressing
- affordable
- small
- standardized
- popular for DIY, easy to learn

802.15.4 Topologies

- single peer
- multi-peer
- broadcast



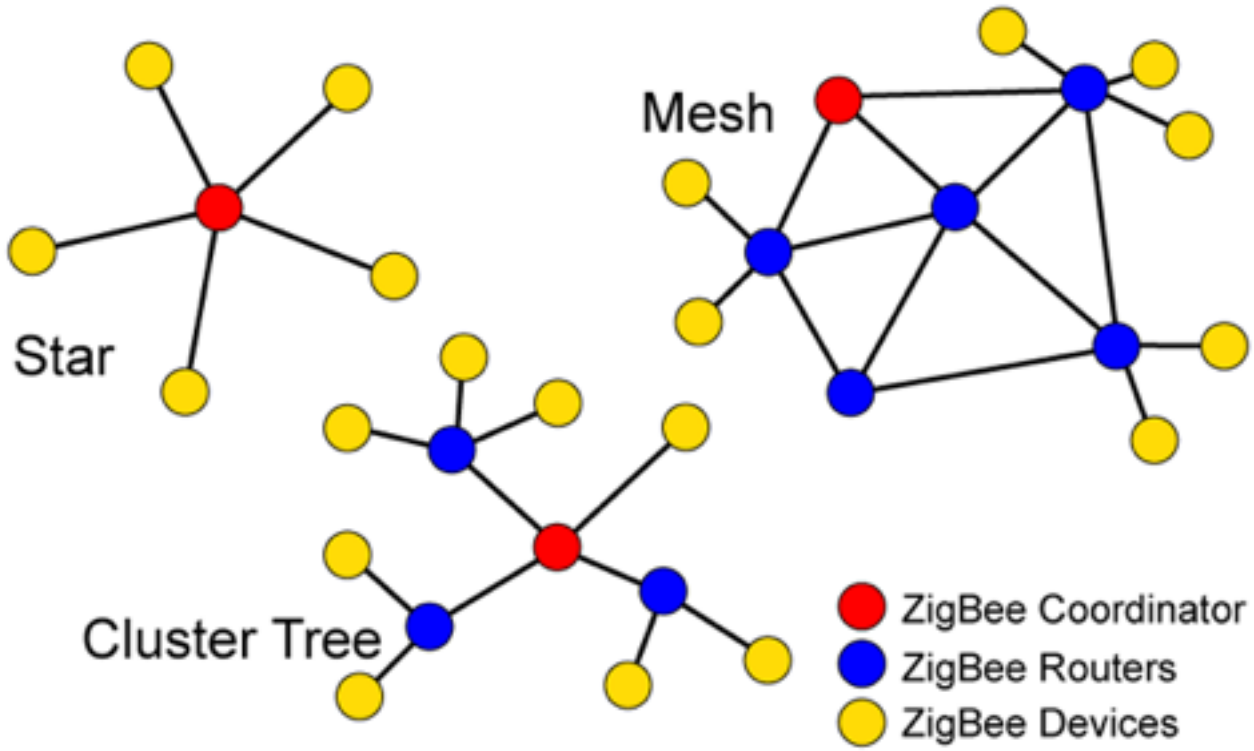
ZigBee

- routing
- self-healing mesh
- ad-hoc network creation

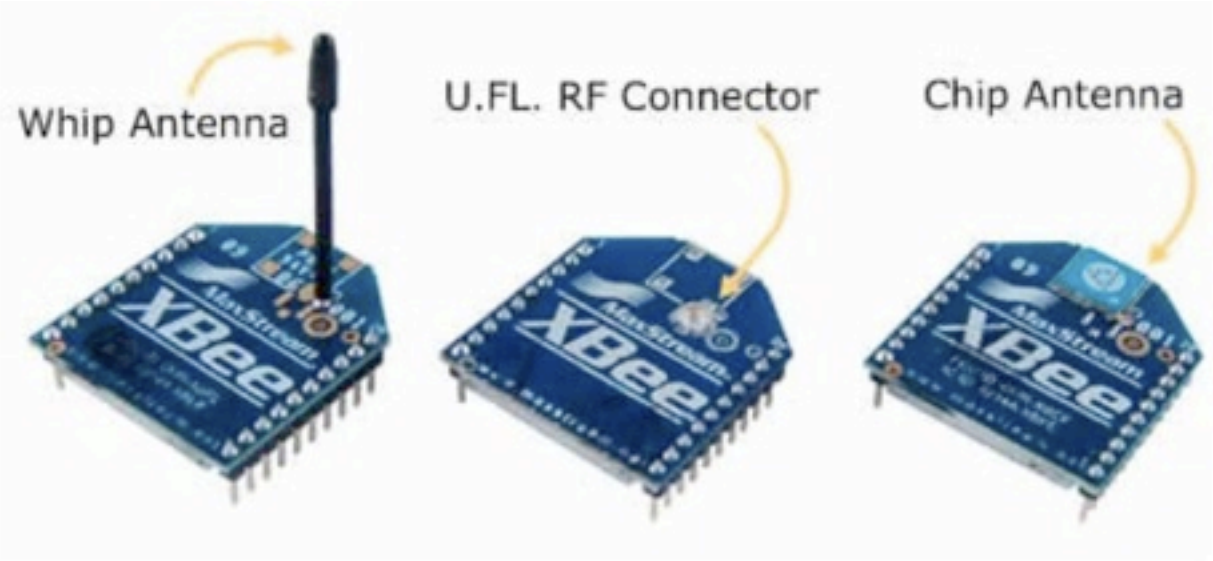
ZigBee™ Alliance

ZigBee Topologies

- peer
- star
- mesh
- routing

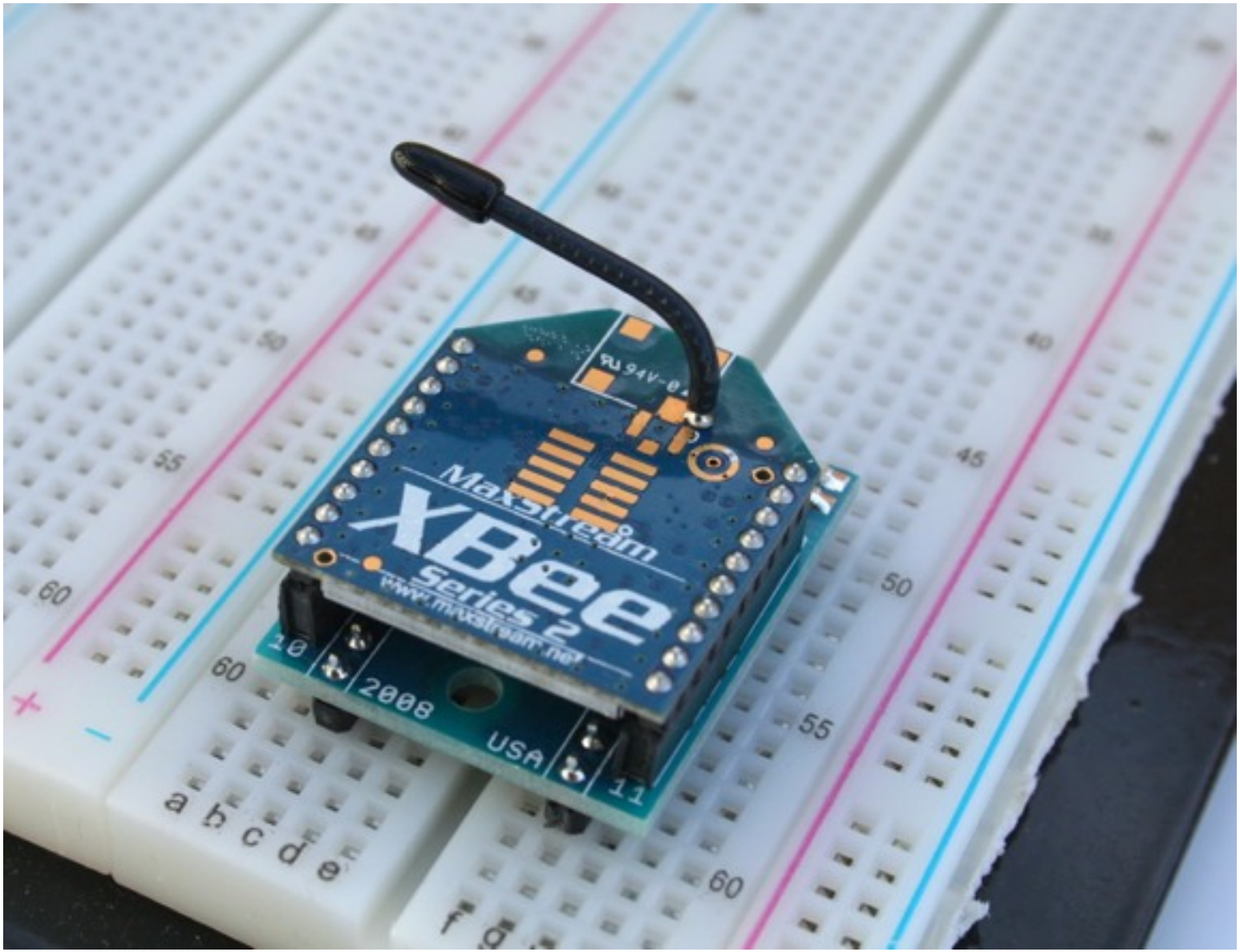


Antennas

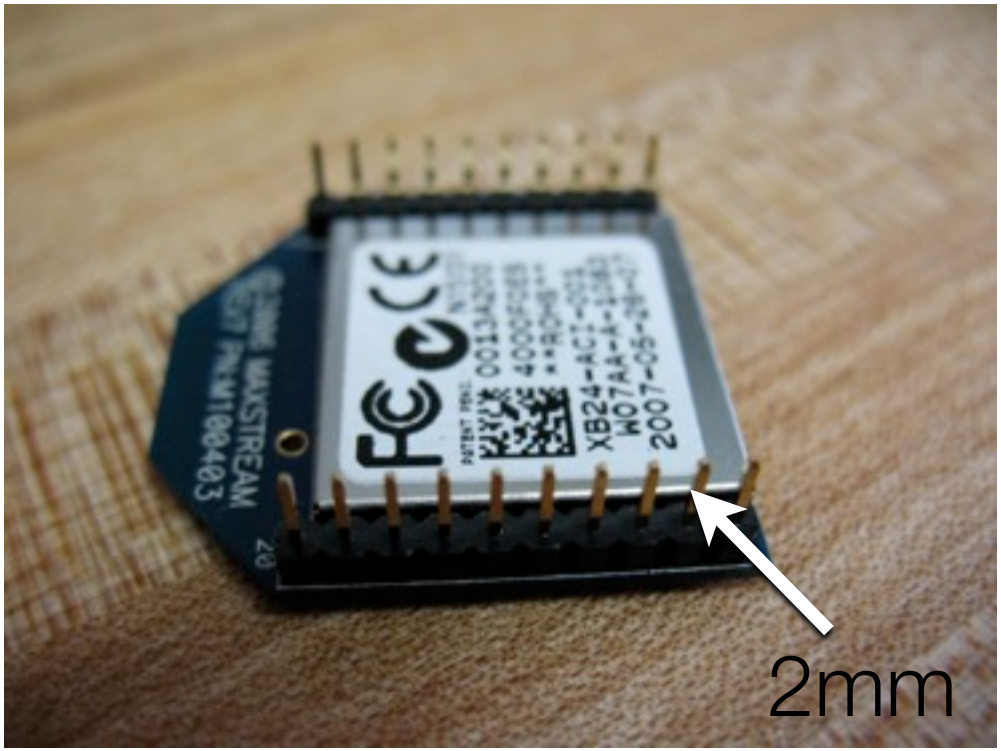


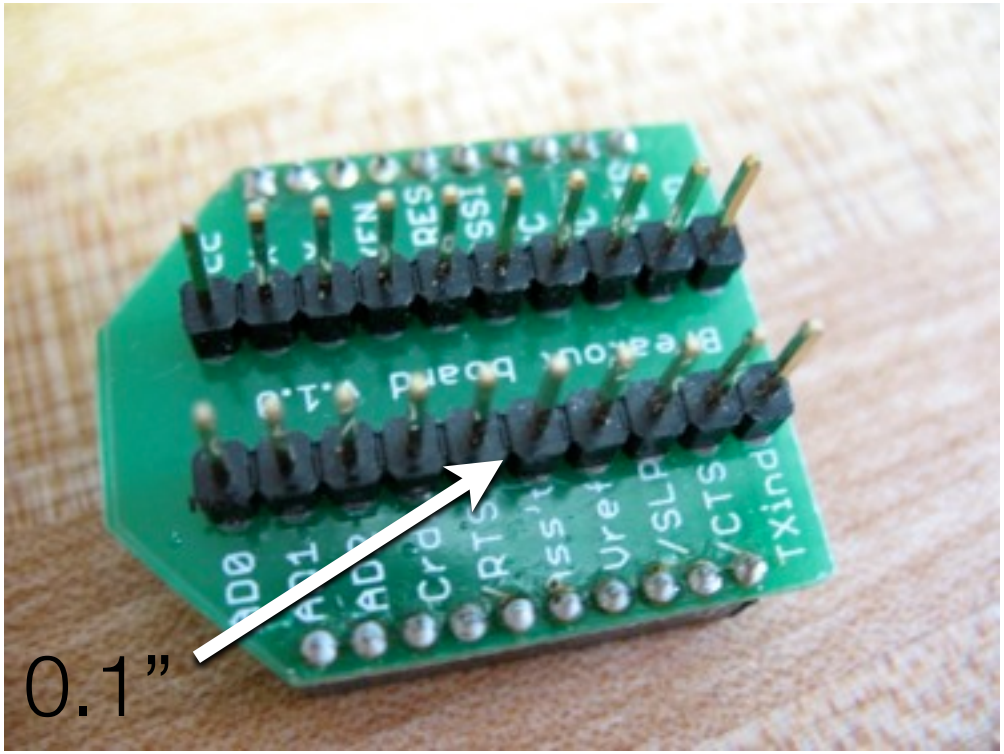
Chip Antenna on Pro

Breakout for Breadboards

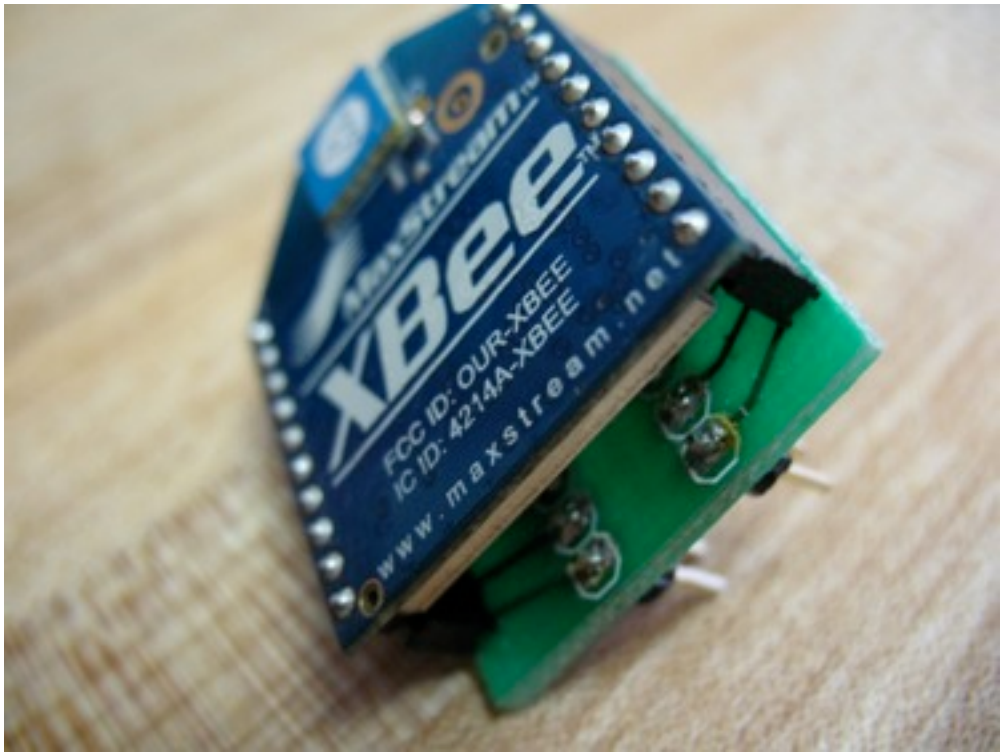


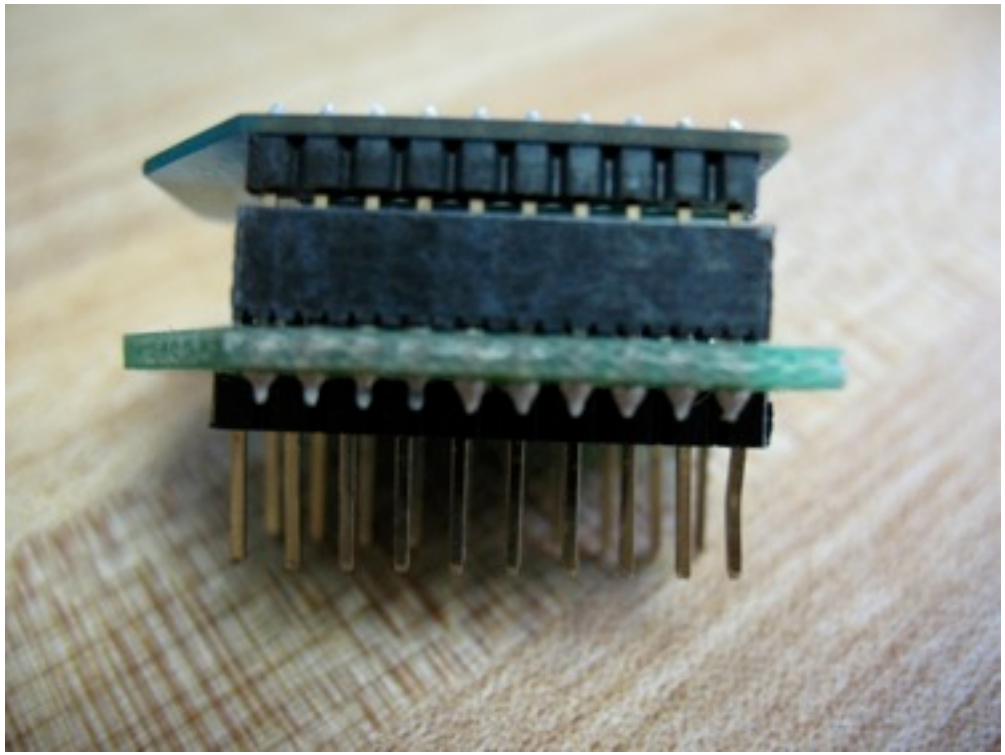
Breakout Boards for breadboarding



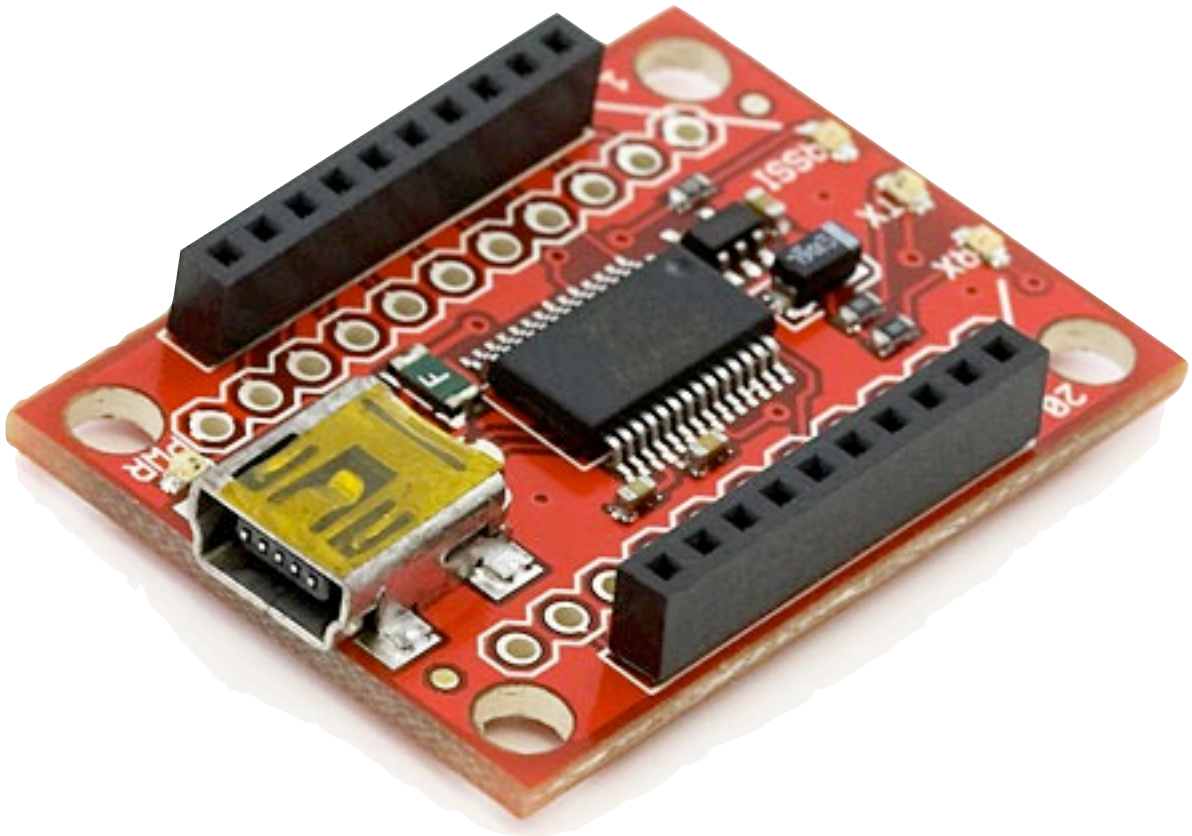


Soldering Breakout Boards: finished

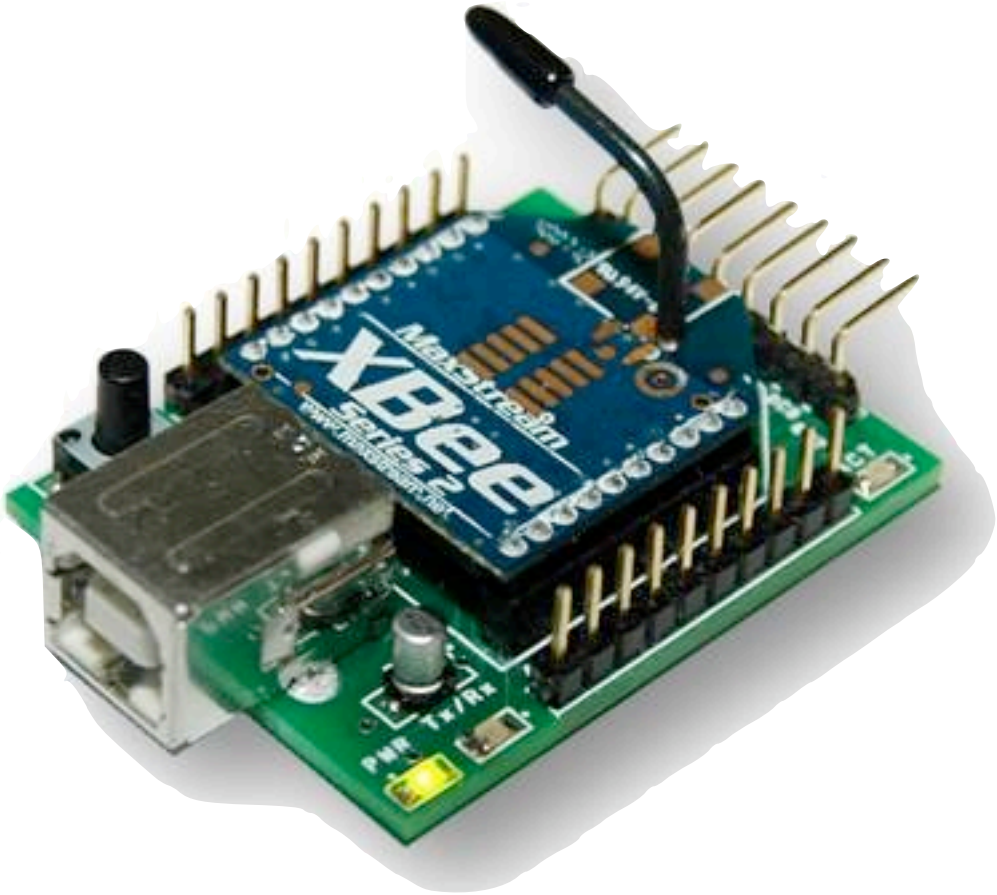




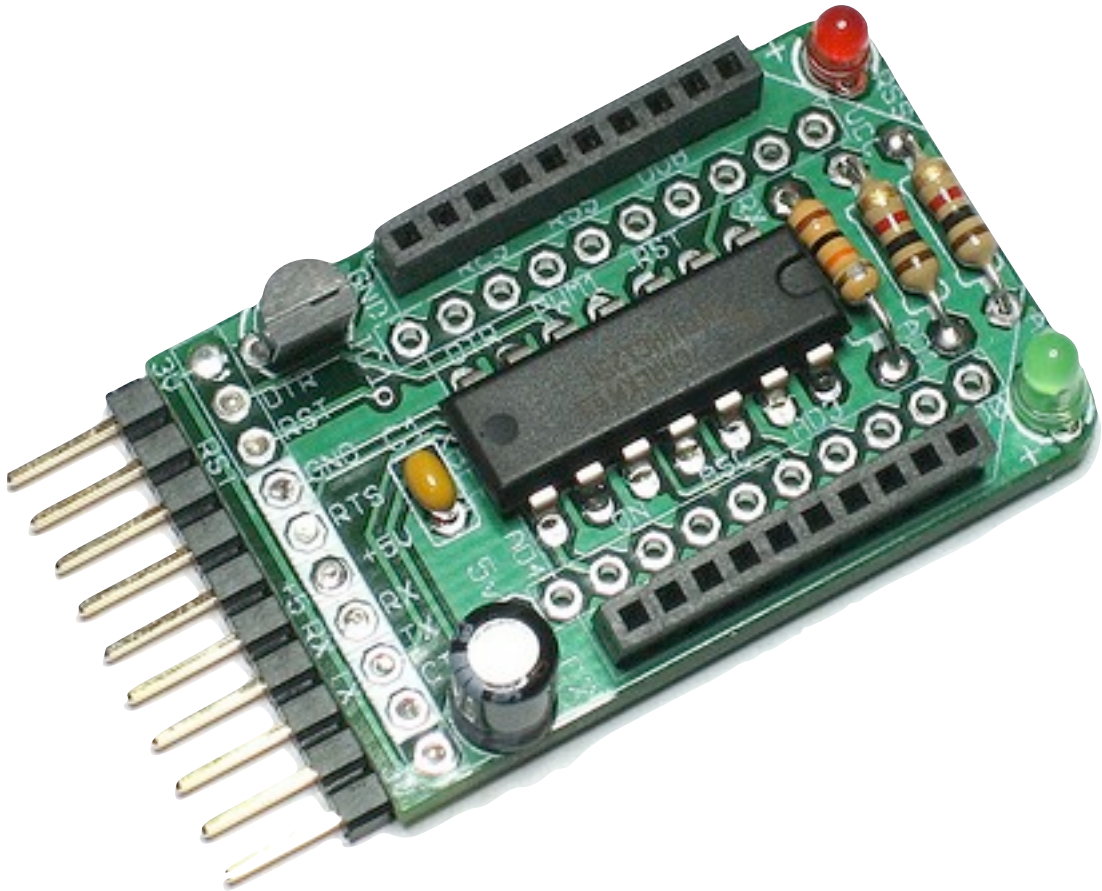
XBee Explorer from Sparkfun



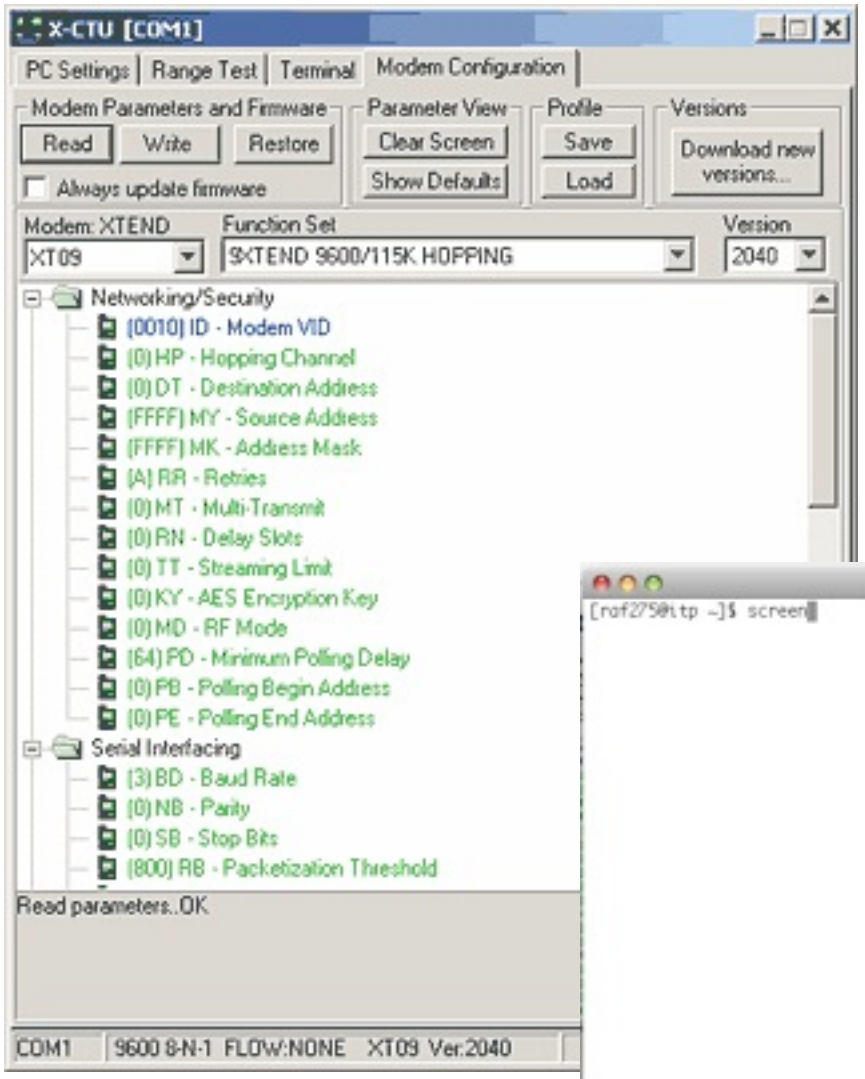
XBee Adapter from xbeeadapters.com



XBee Adapter kit from Adafruit



Serial Terminal Programs



Serial Terminal Programs

- X-CTU: http://www.digi.com/support/productdetl.jsp?pid=3352&osvid=57&tp=4&s=316
- Processing: http://www.faludi.com/projects/xbee-terminal-max/
- Z-Term: http://homepage.mac.com/dalverson/zterm/
- HyperTerm: Windows Start Menu, Accessories, Communication
- screen: Terminal program on the Mac (or Linux)
- plenty of others!
- settings: 9600 baud, 8 bits, no parity, one stop bit, no flow control

ZigBee Addressing

ZigBee Coordinator

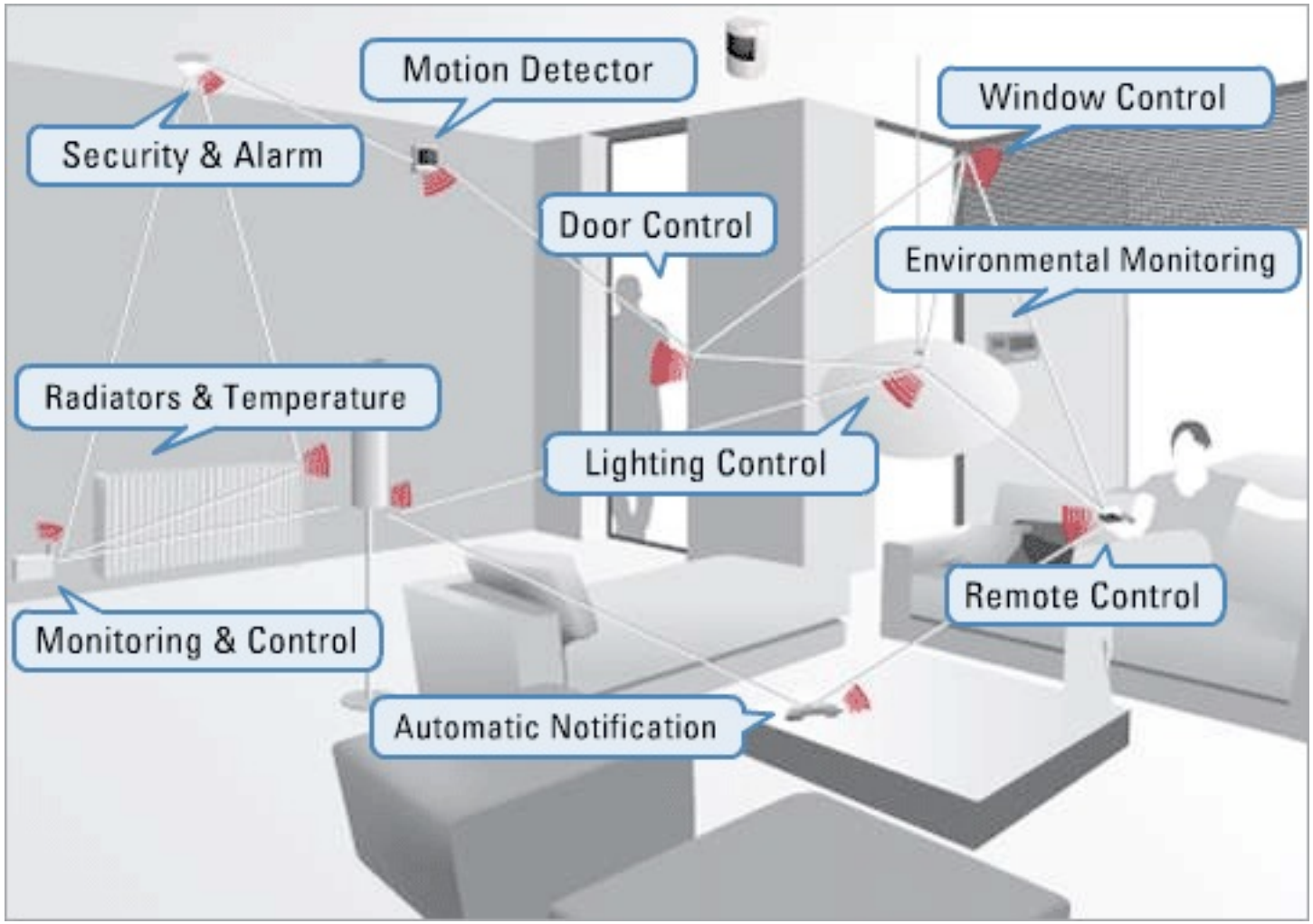
- Every ZigBee network must have a coordinator
- There can only be one coordinator
- Coordinator selects channel and PAN ID
- End devices and routers can then join the PAN
- Typically mains-powered
- Coordinator’s 16-bit address is always 0

ZigBee Router

- 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

- 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


Motion Detector
Security & Alarm
Window Control
Door Control
Environmental Monitoring
Radiators & Temperature
Lighting Control
Remote Control
Monitoring & Control
Automatic Notification

XBee ZB

- Coordinator Firmware
  - for AT commands or API
- Router and End Device Firmware
  - for AT commands or API
- ...so 6 different firmware combinations (you'll always use 2 at the same time)
- and two power levels, regular and Pro
- and 4 antennas! whip, chip, U.FL and RPSMA.

Addressing Basics

- channels
- PAN ID
- 64 bit addresses, aka serial numbers
- 16 bit addresses
- Node Identifier and Node Discovery
- endpoints and clusters

Readings and Assignments

- Readings
  - Weiser, M. The Computer for the 21st Century: http://www.ubiq.com/hypertext/weiser/SciAmDraft3.html
  - There Will Come Soft Rains – Bradbury: http://rob.faludi.com/teaching/cmn/readings/Bradbury_Soft_Rains_1950.pdf
- Assignments
  - Imagined Sociable Objects
  - Obtain two XBee ZB (series 2) radios and one XBee adapter
  - Pick a PAN ID now and document it