Collaborative Mesh Networking

Instructor: Rob Faludi
Week 9

ZigBee Mesh Project

- Presentation of mobile mesh project ideas for each group

Readings

- Startup eyes battery-free wireless sensor nets: http://eetimes.eu/showArticle.jhtml?articleID=202400294

- Tinker: A Tool for Designing Data-Centric Sensor Networks, Jeremy Elson, 2006: http://research.microsoft.com/nec/publications/spot6613-elson.pdf

- Zigbee: "Wireless Control that Simply Works": http://rob.faludi.com/teaching/cmn/readings/Zigbee_Wireless_That_Works-ZMDAmerica.pdf

XBee Series 1 vs. Series 2

- **SERIES 1**

  - 802.15.4 only

  - ADC & Digital I/O

  - point-to-point networking

  - unicast or broadcast

  - low power with good range

  - mature

- **SERIES 2**

  - ZigBee only

  - I/O not available yet

  - Full ZigBee mesh networking

  - unicast, broadcast or multicast

  - slightly better range & power

  - new & less well-known

802.15.4 Topologies

- single peer
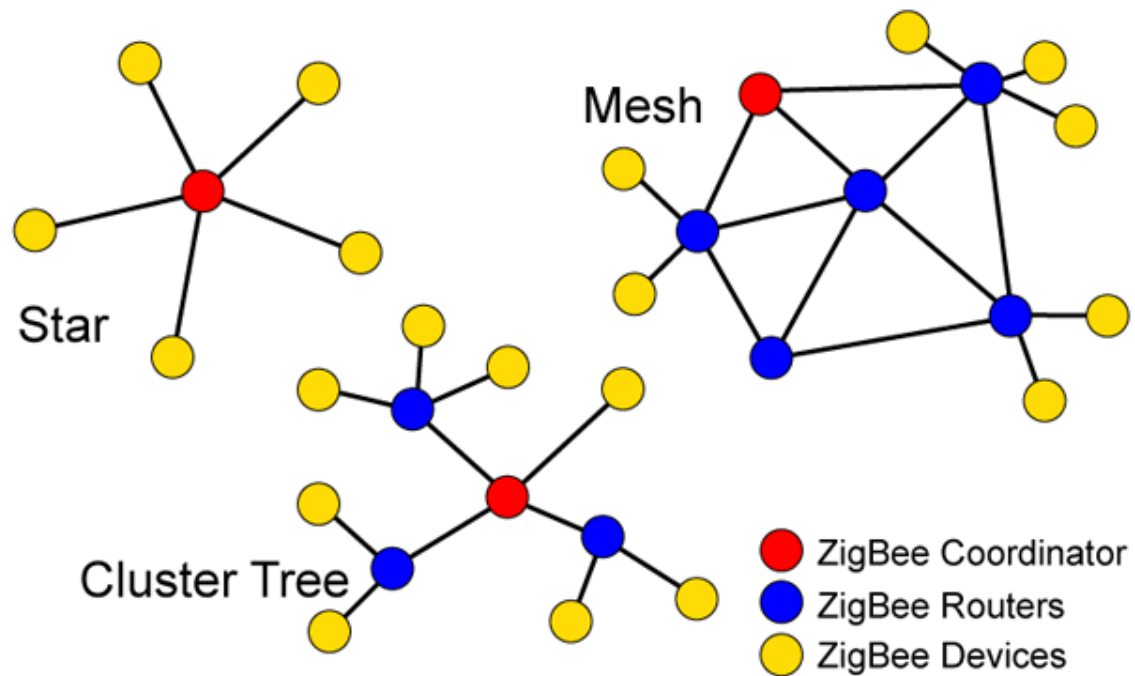
- multi-peer

- broadcast

Broadcast

Single Peer

Multi Peer (no routing)

802.15.4 Devices
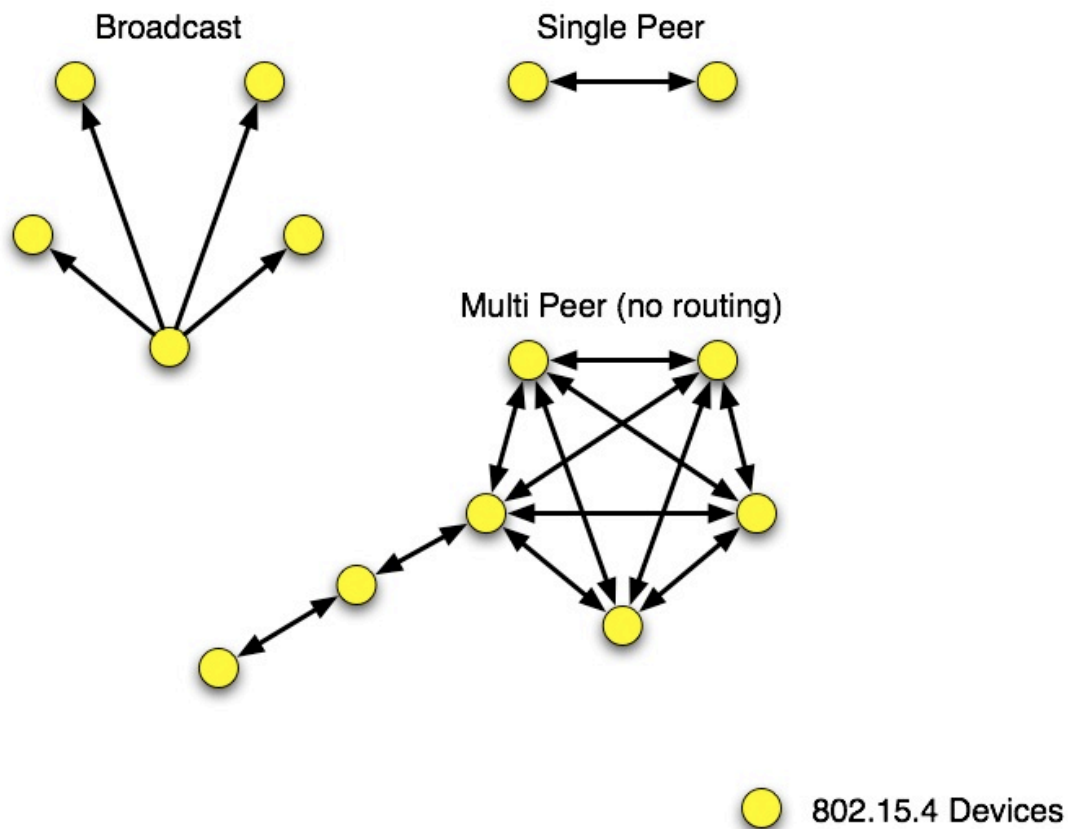
ZigBee Basics

- Coordinator

- Routers

- End devices

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

ZigBee Topologies

- peer

- star

- mesh

- routing
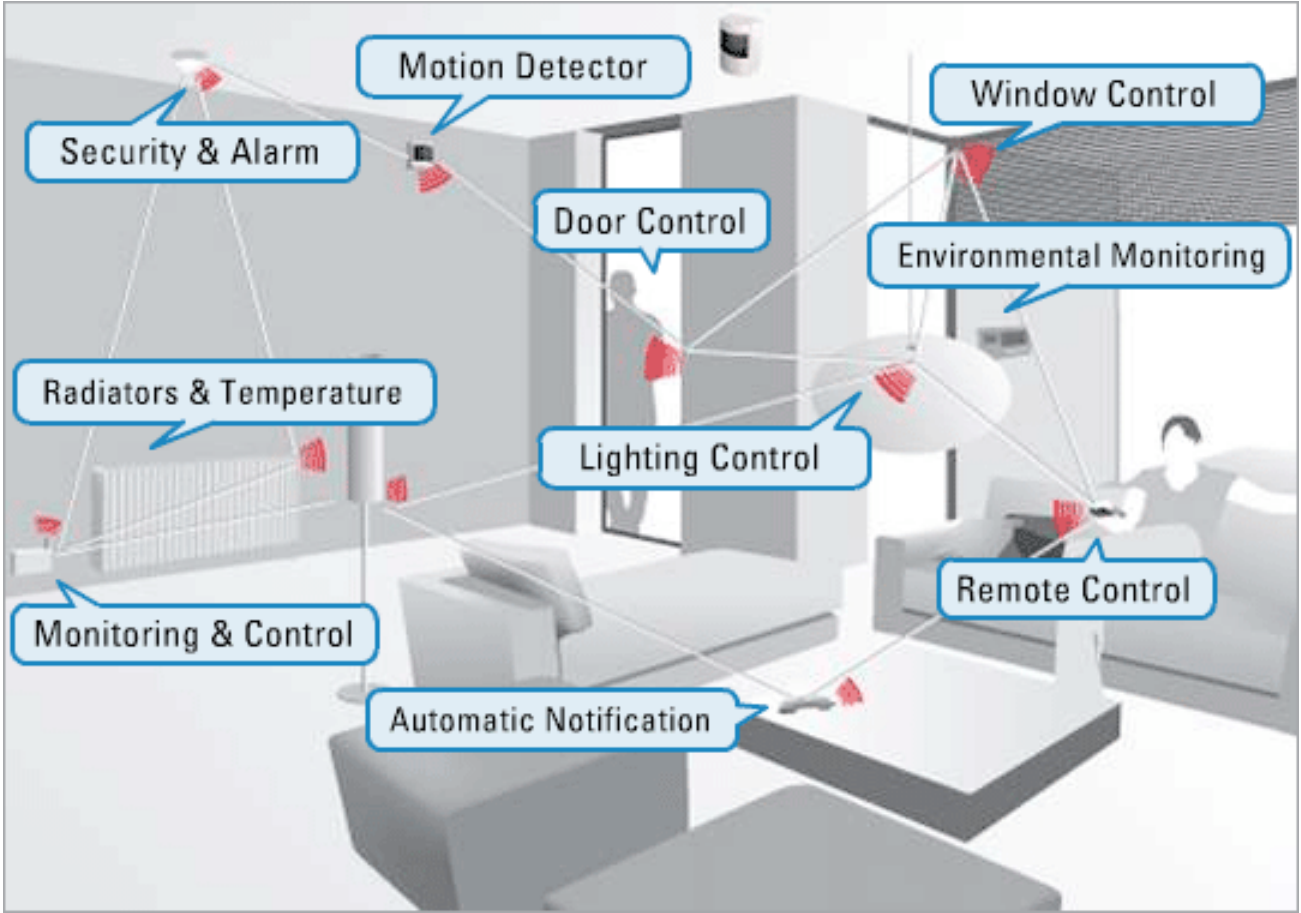
ZigBee Coordinator

- Every ZigBee network <u>must</u> have a coordinator

- There can only be <u>one</u> coordinator

- Coordinator selects channel and PAN ID

- End devices and routers can then join the PAN

- Typically mains-powered

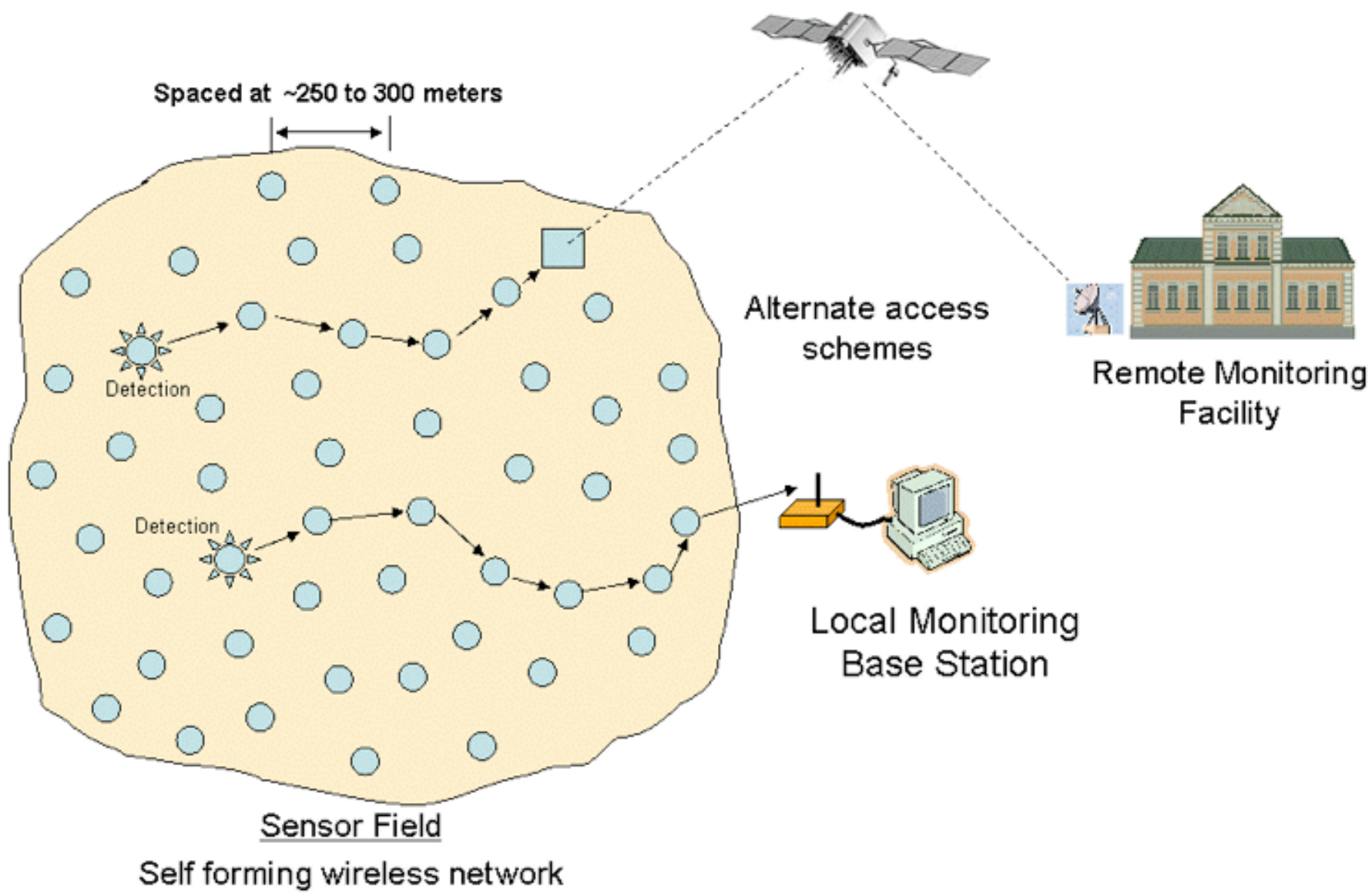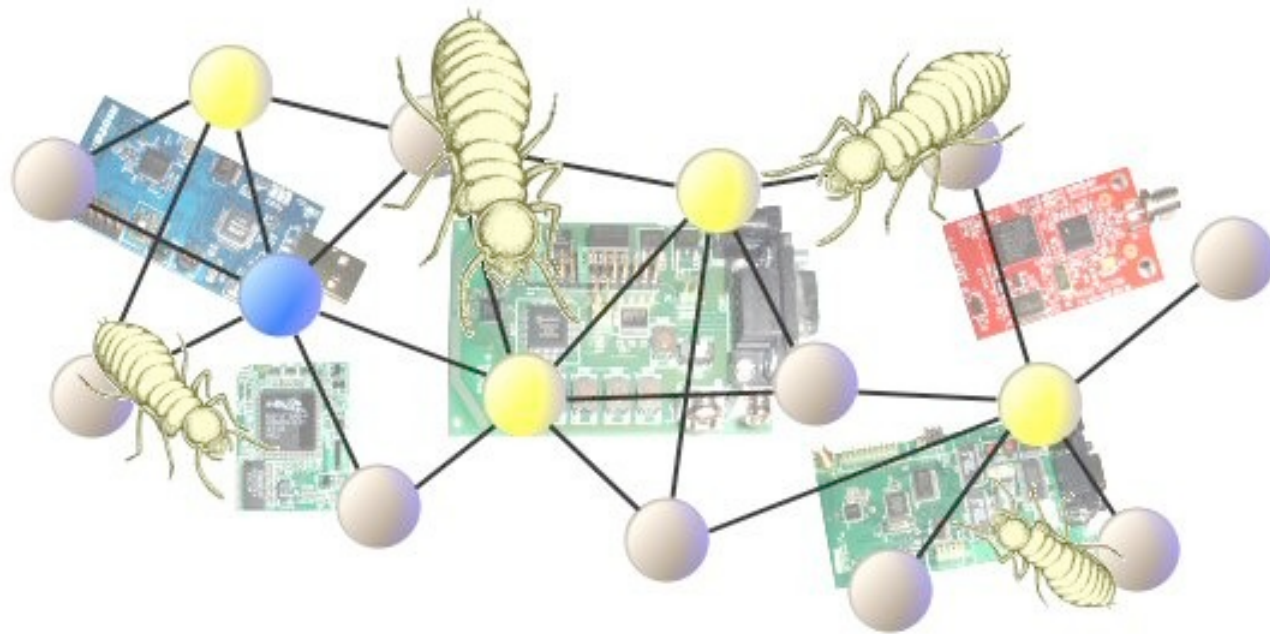- Coordinator's 16-bit address is always 0

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

Spaced at ~250 to 300 meters

Detection

Detection

Sensor Field
Self forming wireless network

Alternate access schemes

Remote Monitoring Facility

Local Monitoring Base Station

http://www.stg.com/wireless/ZigBee_Termites.html

XBee Series 2

- 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.
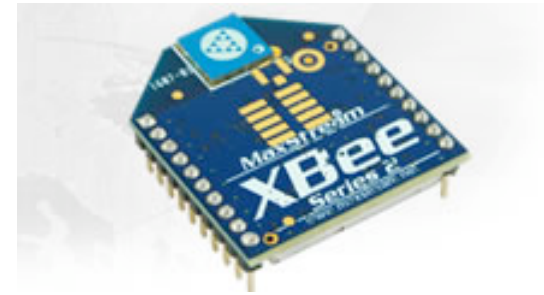
Special Features

- 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 (value/1023*1200 = mV)

Starting Up an XBee ZigBee Network

- 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

- 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)
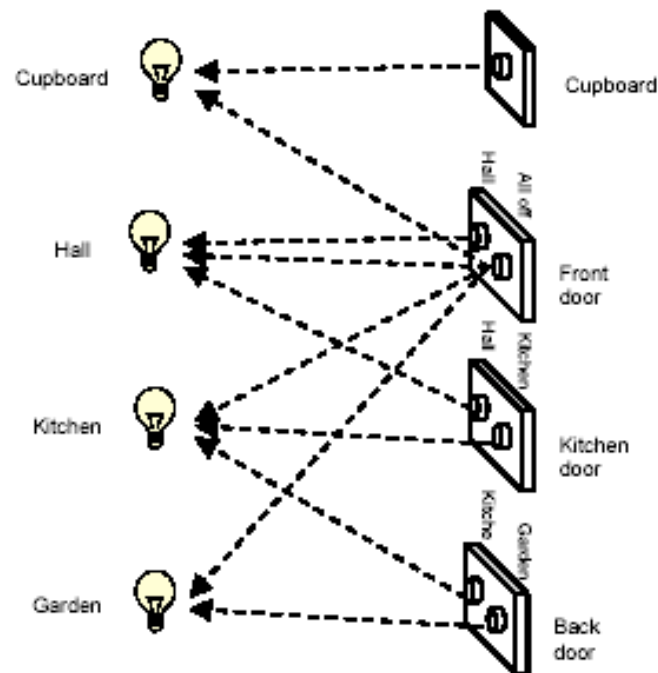 STATUS<CR> (1 Byte: Reserved)
  PROFILE_ID<CR> (2 Bytes)
  MANUFACTURER_ID<CR> (2 Bytes)
  <CR>

- Set the Destination Node using ATDN

Endpoints, Clusters and Bindings

- 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.

Group Genius

- At the beginning of this class I promised detailed technical information

  - There's more if you need it

- In the second half, we're going to think more broadly, while you build:

  - How and why do people collaborate?

  - Can this inform our devices, projects and artworks?

- Learning how collaboration works is going to be persistently useful

Group Genius

Readings and Assignments

- Readings

    - Group Genius by Keith Sawyer, Part 1 Read critically!
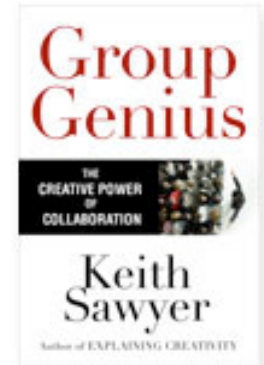
- Assignment

    - Saturday Workshop 12:30 - 3:30

CLICK TO PURCHASE