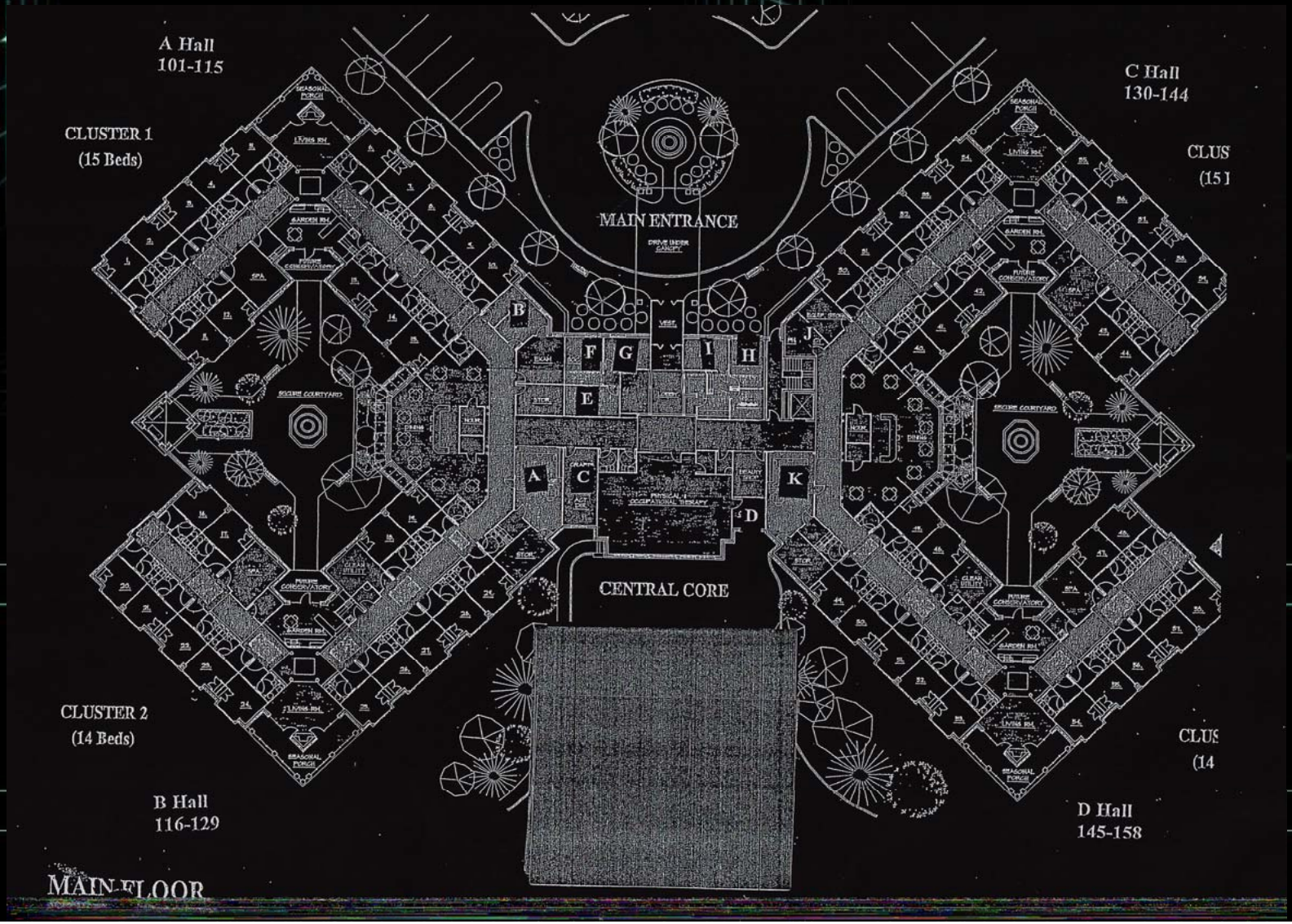

Zigbee Tracking System
Senior Project
Presented by

Outline of Presentation

- Idea Inspiration
- Background
- Project Goals
- What We've Done
- Hardware
- Software
- Testing/Results
- Future Consideration
- Questions

Original Inspiration

Carolina Village



Objective

-Design a RF Tracking System

- Tracking of potential patients, staff, or equipment
- Communication Methods
- Store Data for Reporting
- User-Interface

Methods Considered

- RFID Tags
- Infrared
- Radio Sensor Networking
- Ultrasound

Tracking System?

- Unique hardware IDs will be assigned & programmed to each device.
  - Why?
    - Allows monitoring for individual data
    - Personalized Alerts
    - Custom reporting
  - How?
    - Utilizing Zigbee to handle the routing of unique device IDs

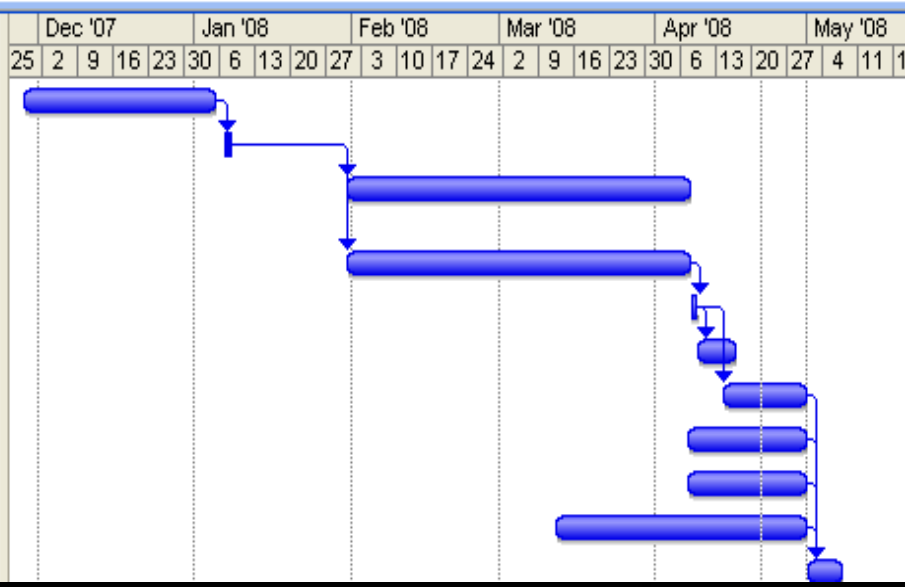
Data Storage

- Advantages
  - Tracks working habits of personnel
    - Performance Reviews
    - Alleviate family concerns
    - Ensures people are where they should be when they should be there
  - Tracks incidents
    - People continually accessing unauthorized areas
    - Helps diagnose behavioral deviation in people

- How?
    - Data will be stored locally on PC.
    - Distribution, access and encryption of stored data goes beyond the scope of this project.

Schedule

	Task Name	Duration	Start	Finish	Predecessors	Re
1	Ultrasonic decision	28 days?	Wed 11/28/07	Fri 1/4/08		
2	Switch to Zigbee	1 day?	Mon 1/7/08	Mon 1/7/08	1	
3	Evaluate Freescale Zigbee hardware	48 days?	Thu 1/31/08	Mon 4/7/08	2	
4	Evalaute Freescale software	48 days?	Thu 1/31/08	Mon 4/7/08	2	
5	Switch to Digi Xbee products	1 day?	Tue 4/8/08	Tue 4/8/08	4	
6	Learn Xbee hardware/software	6 days?	Wed 4/9/08	Wed 4/16/08	5	
7	Prototype Xbee hardware setup	13 days?	Mon 4/14/08	Wed 4/30/08	5	
8	Write microcontroller software	18 days?	Mon 4/7/08	Wed 4/30/08		
9	Test setup	18 days?	Mon 4/7/08	Wed 4/30/08		
10	Create presentation	36 days?	Wed 3/12/08	Wed 4/30/08		
11	Final Report	5 days?	Thu 5/1/08	Wed 5/7/08	7,8,10,9	



Project Goals

- Setup a wireless mesh/star topology network with Zigbee enabled devices.
- Demonstrate working communications between end points, routers, and coordinating station.
- Show data updated and stored in real-time

What We've Done

- Evaluated Zigbee development kit provided by Freescale
- Issues with fully accessing the development software (BeeKit and Codewarrior) led us to switch to hardware from Digi International
- Using Digi's Xbee hardware we have setup a network with end devices, two routers and a coordinating station.

What We've Done Cont.

- Utilized PIC microcontrollers on the routers and end devices to automatically send special modem commands over a RS-232 serial connection to the Xbee radio chips.
- Programmed a packet parsing program in LabVIEW to receive and store the data from the coordinating station.

System Block Diagram

Picture is on flash drive, if I get it Monday then ill place flow chart in here, if not then I will make this slide invisible until Wednesday night.

Xbee Radio Chips

- Digi International
- Operates on ISM 2.4GHz
- Two versions
  - Pro : 100mW TX power, 270mA TX current
  - Regular: 1mW TX power, 45mA TX current
- <10μA Power down current

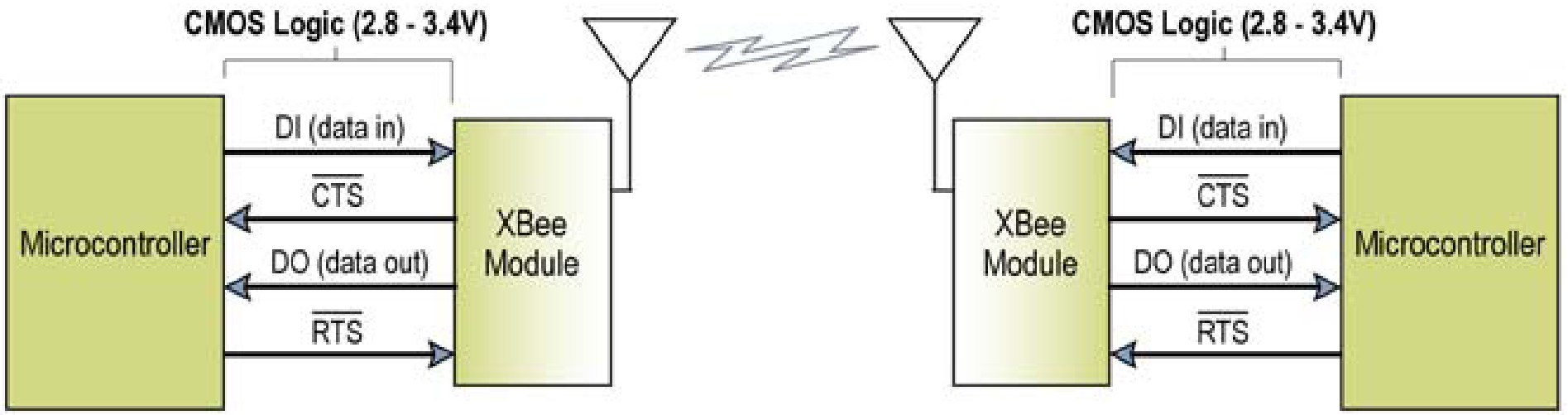
	Regular	Pro
Indoor	100 ft	300 ft
Outdoor	300 ft	1 mile

Xbee S2 Development Kit

- Onboard Microcontroller
- RS-232 or USB connection
- 20 pin connector for Xbee radio chip

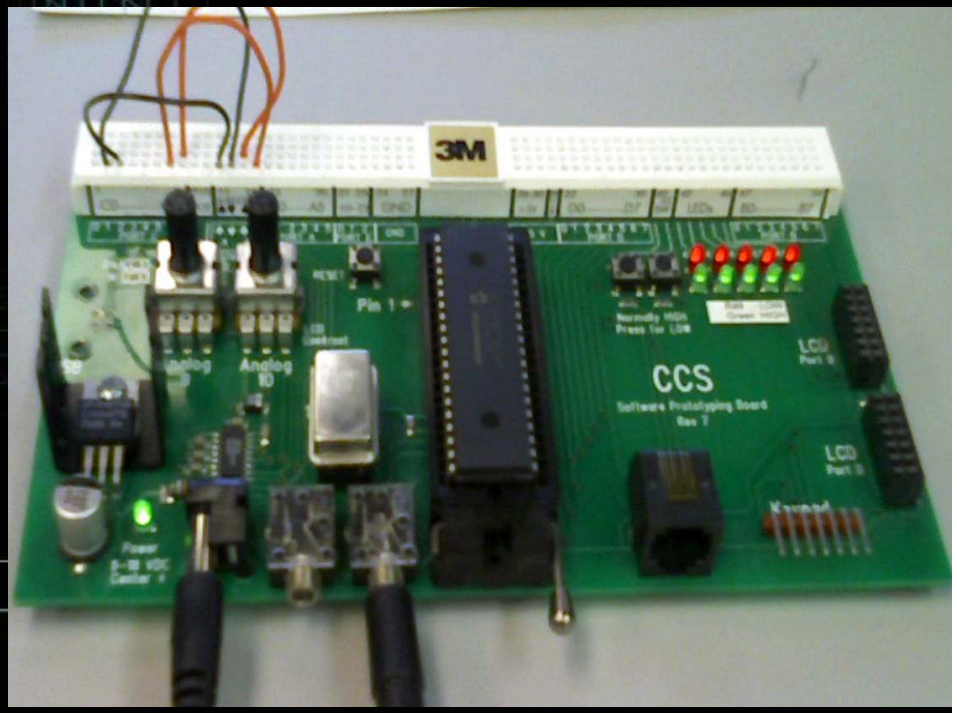
Hardware Cont.

- Xbee S2 development Board
  - Block diagram for the communications between Xbee radio and onboard microcontroller.



Microchip PIC16F877A

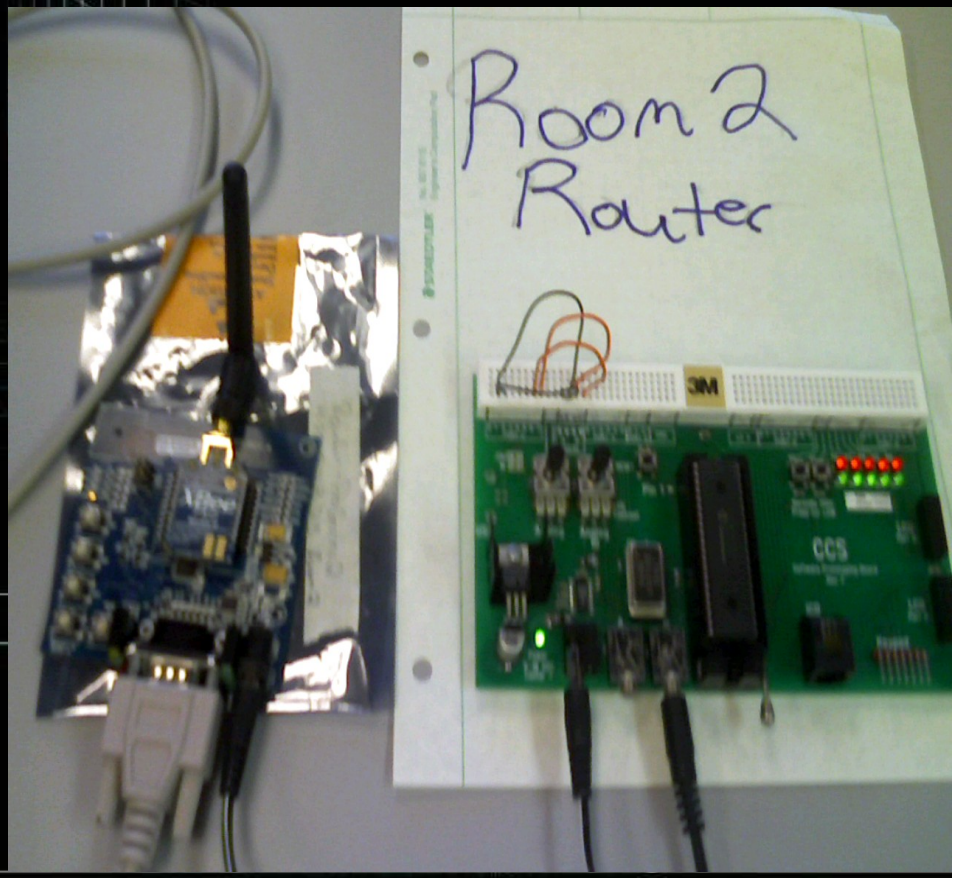
- Attached to serial versions of Xbee boards via RS-232
- Sends AT modem commands via the serial connection to radio in order to access embedded functions.



RS-232 to Xbee

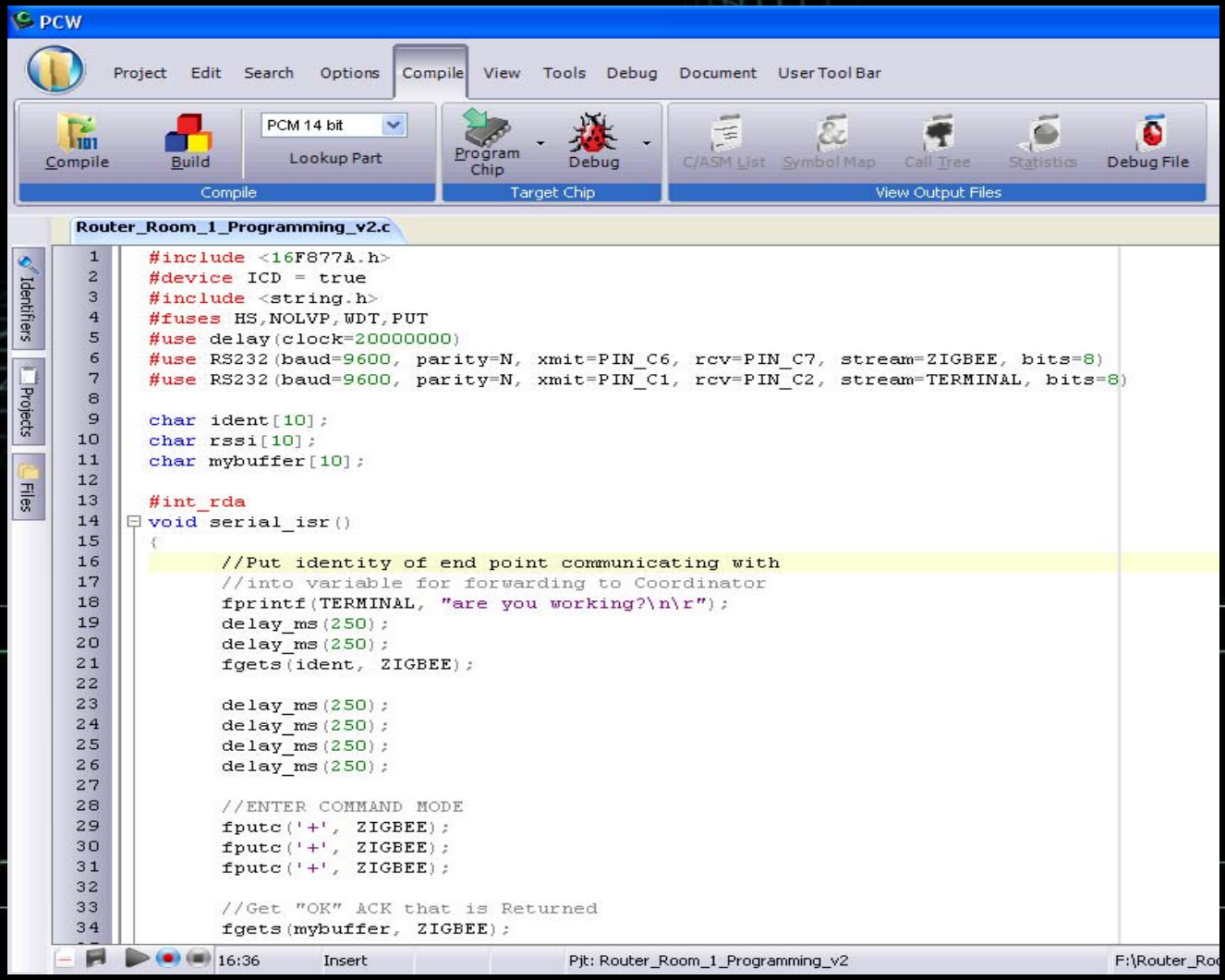
Router Hardware

- Router 2 hardware setup with PIC development board attached via the RS-232



CCS Compiler

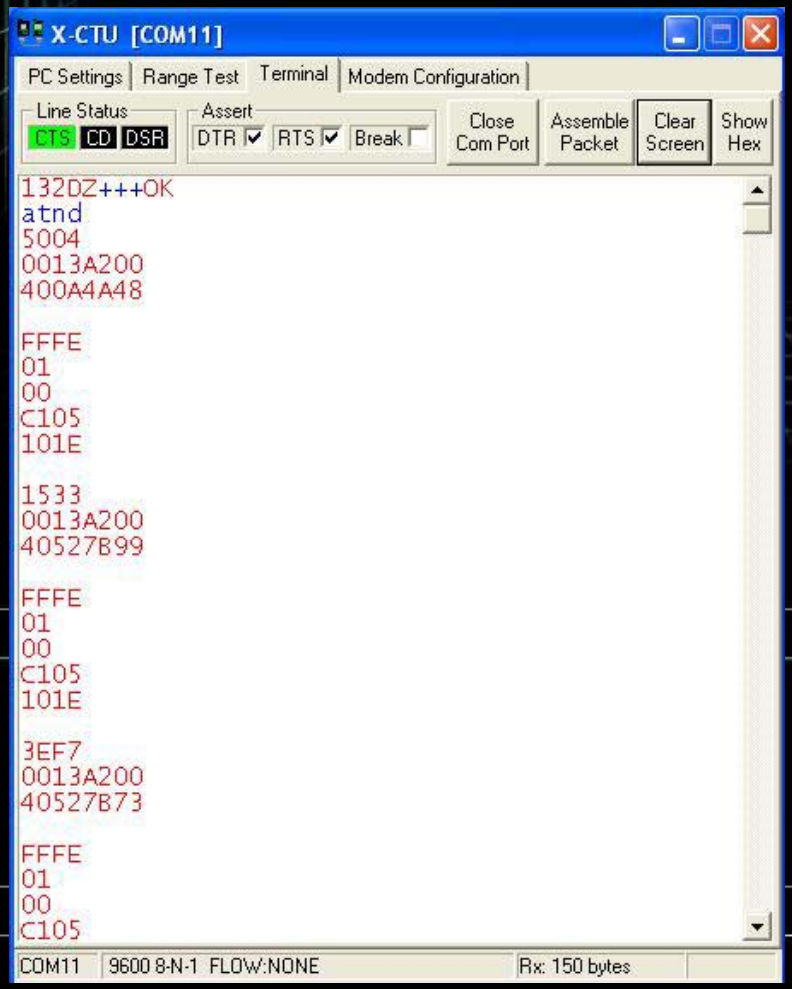
C compiler for Microchip PIC16F877A microcontrollers.

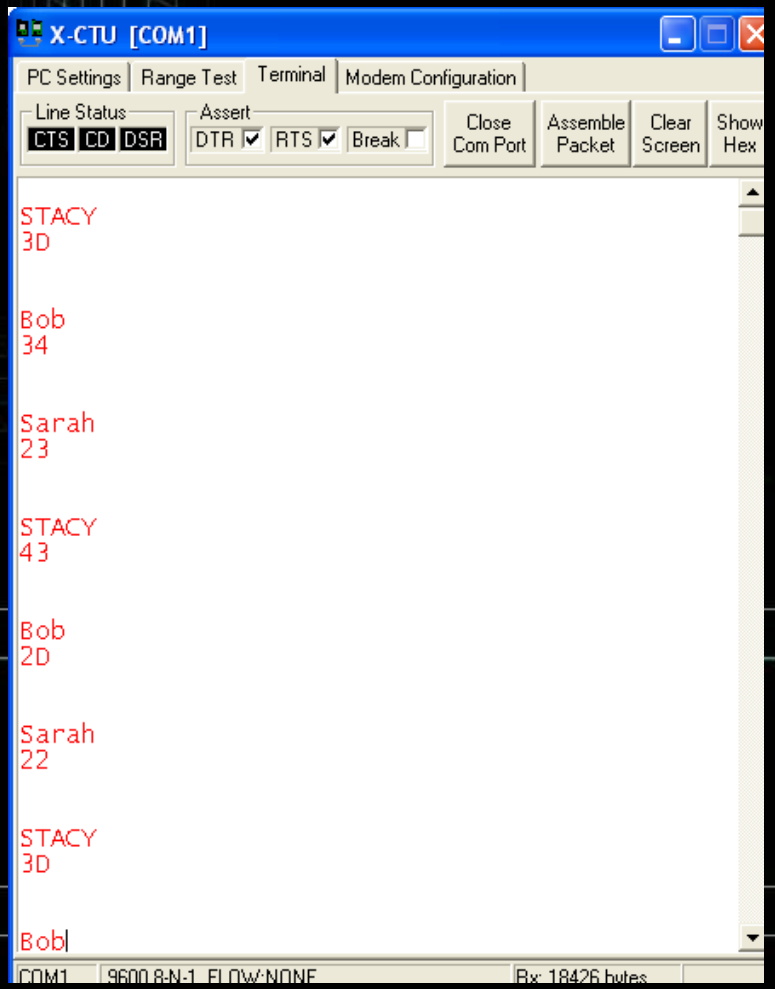


X-CTU

- Proprietary software by Digi.
- Easily configure and program Xbee products.
- Includes a terminal to show communication (PIC).

X-CTU Cont.

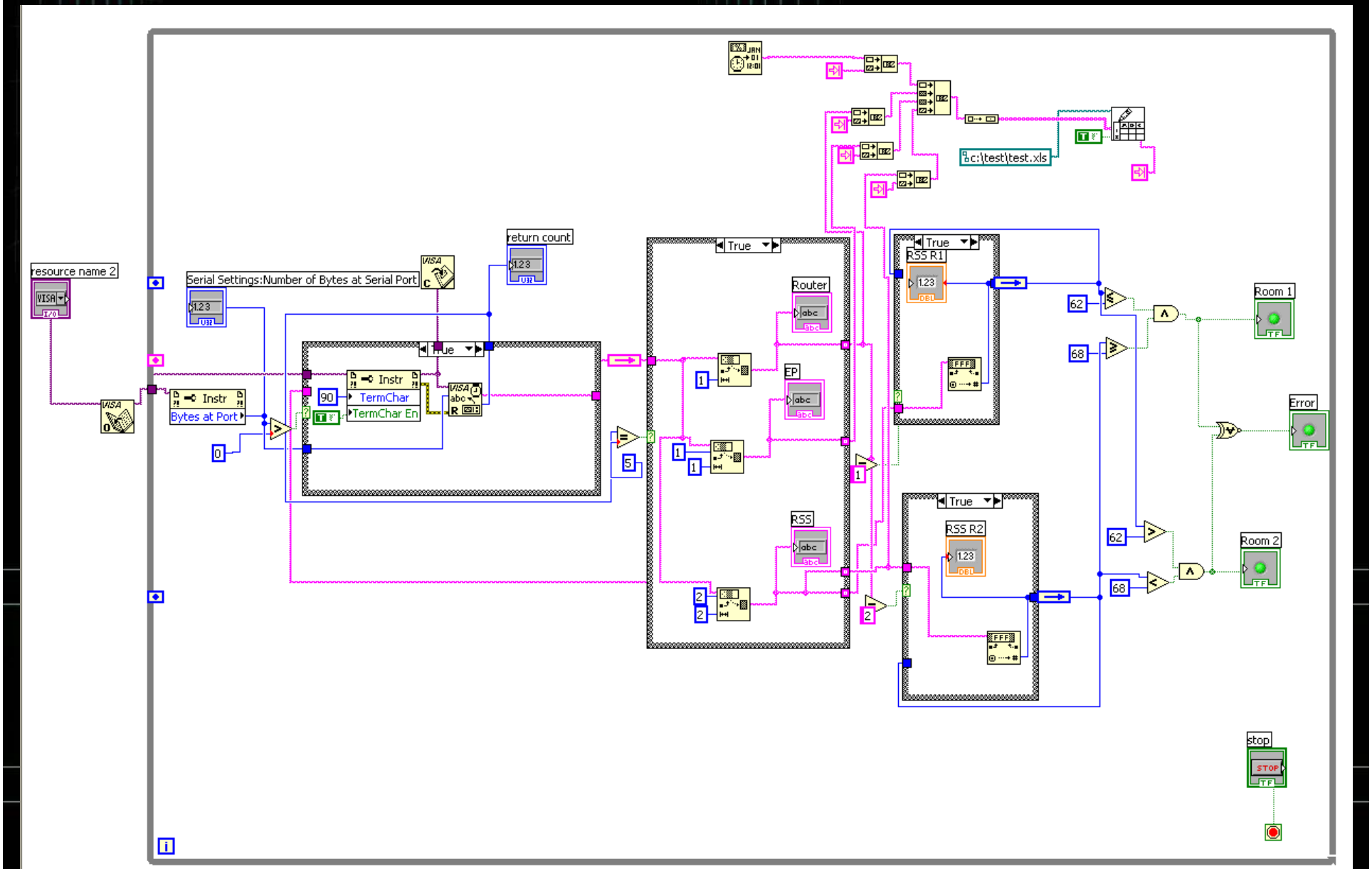

X-CTU [COM11]
PC Settings
Range Test
Terminal
Modem Configuration
Line Status
CTS CD DSR
Assert
DTR RTS Break
Close Com Port
Assemble Packet
Clear Screen
Show Hex
132DZ+++OK
atnd
5004
0013A200
400A4A48
FFFE
01
00
C105
101E
1533
0013A200
40527B99
FFFE
01
00
C105
101E
3EF7
0013A200
40527B73
FFFE
01
00
C105
COM11
9600 8-N-1 FLOW:NONE
Rx: 150 bytes


X-CTU [COM1]
PC Settings
Range Test
Terminal
Modem Configuration
Line Status
CTS CD DSR
Assert
DTR RTS Break
Close Com Port
Assemble Packet
Clear Screen
Show Hex
STACY
3D
Bob
34
Sarah
23
STACY
43
Bob
2D
Sarah
22
STACY
3D
Bob
COM1
9600 8-N-1 FLOW:NONE
Rx: 18426 bytes

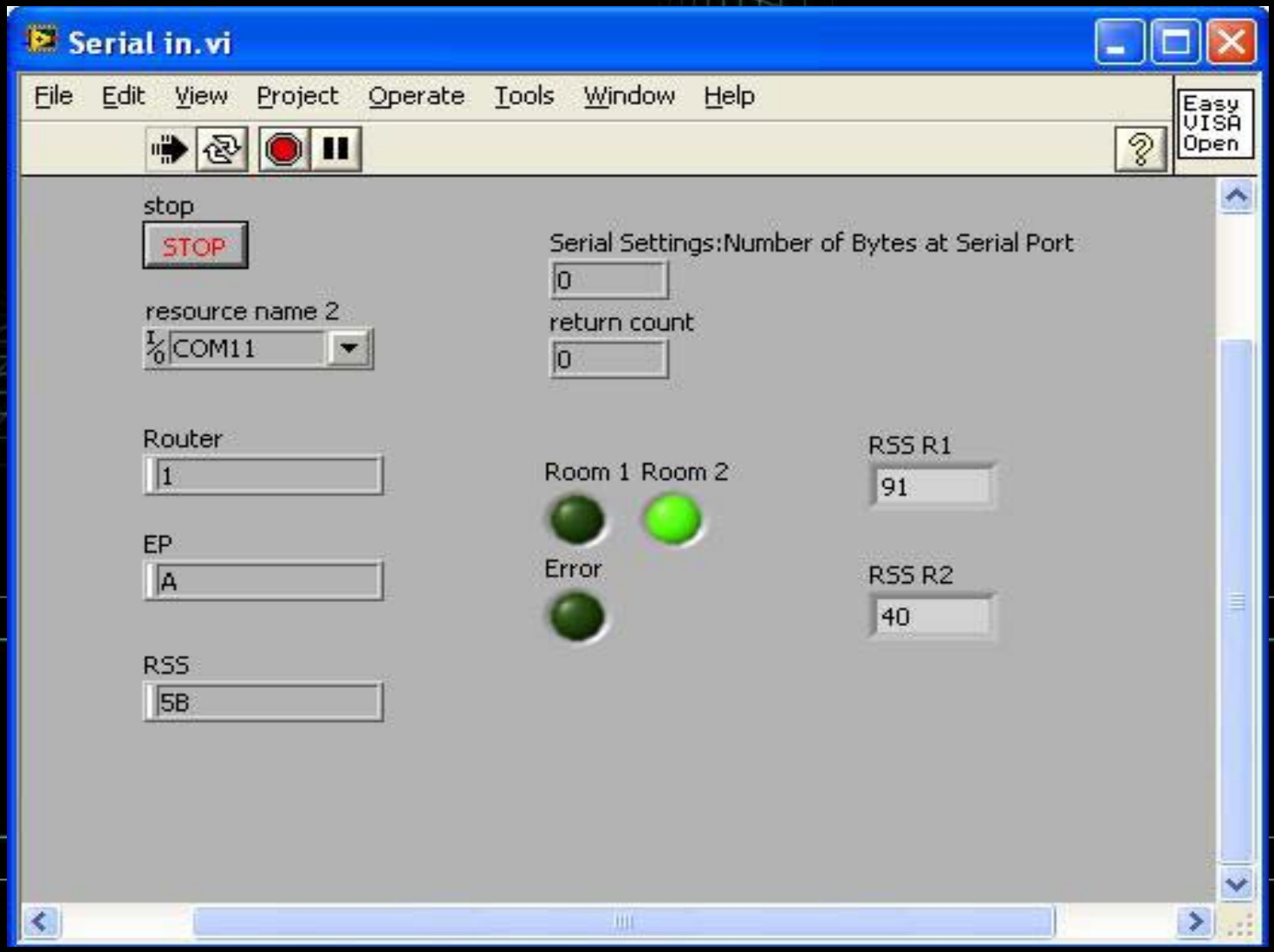
LabVIEW

- Graphical programming language that is commonly used for automation, controls, and instrumentation.
- Parses serial data coming from the USB port on the coordinating station to the PC.
- Writes date/time, end point ID and Received Signal Strength to Excel.
- Basic user interface to show room number that the end device is located in.

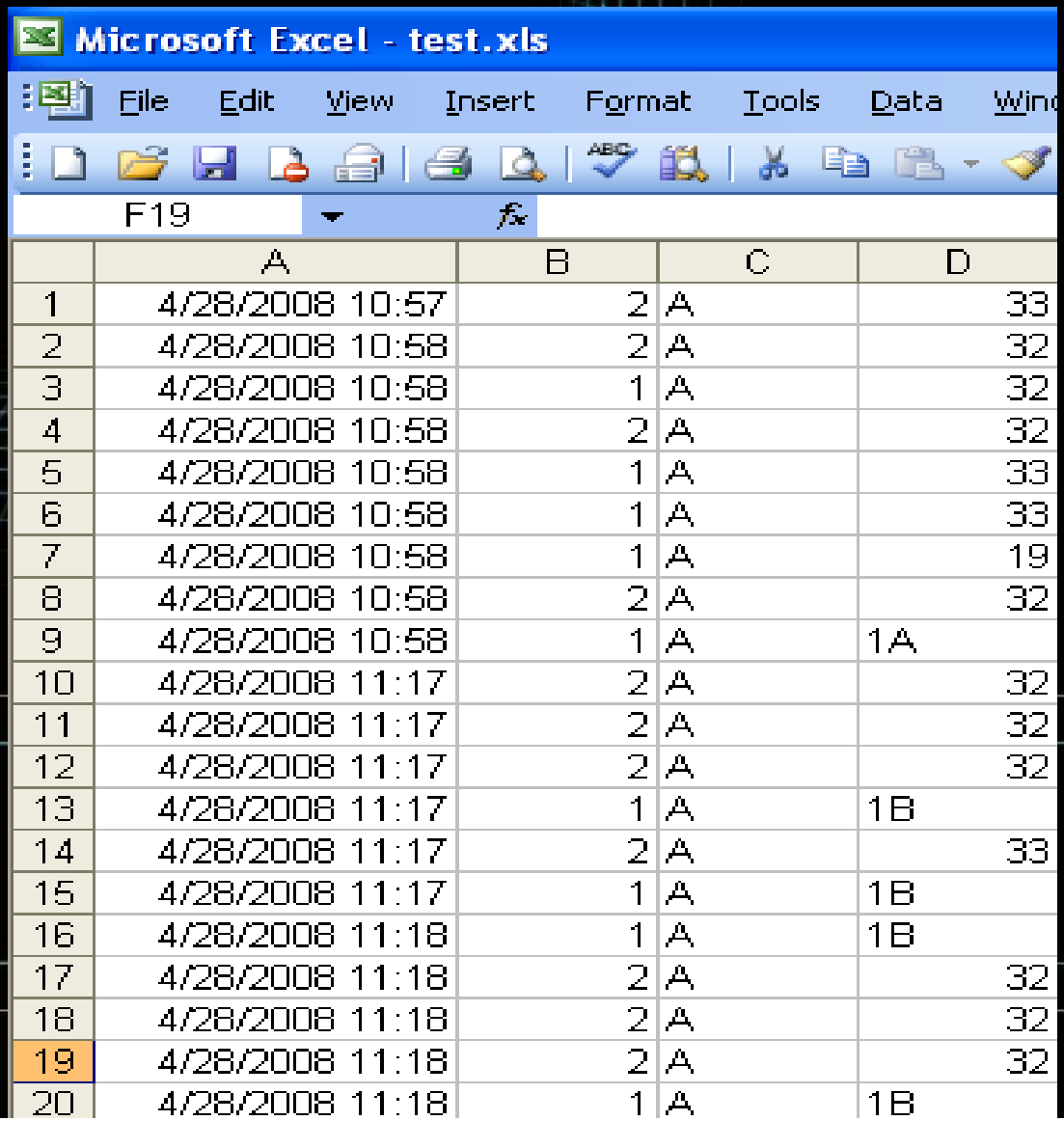
LabVIEW Program



LabVIEW User Interface



Data Storage in Excel



	A	B	C	D
1	4/28/2008 10:57	2	A	33
2	4/28/2008 10:58	2	A	32
3	4/28/2008 10:58	1	A	32
4	4/28/2008 10:58	2	A	32
5	4/28/2008 10:58	1	A	33
6	4/28/2008 10:58	1	A	33
7	4/28/2008 10:58	1	A	19
8	4/28/2008 10:58	2	A	32
9	4/28/2008 10:58	1	A	1A
10	4/28/2008 11:17	2	A	32
11	4/28/2008 11:17	2	A	32
12	4/28/2008 11:17	2	A	32
13	4/28/2008 11:17	1	A	1B
14	4/28/2008 11:17	2	A	33
15	4/28/2008 11:17	1	A	1B
16	4/28/2008 11:18	1	A	1B
17	4/28/2008 11:18	2	A	32
18	4/28/2008 11:18	2	A	32
19	4/28/2008 11:18	2	A	32
20	4/28/2008 11:18	1	A	1B

Xbee Modem Commands

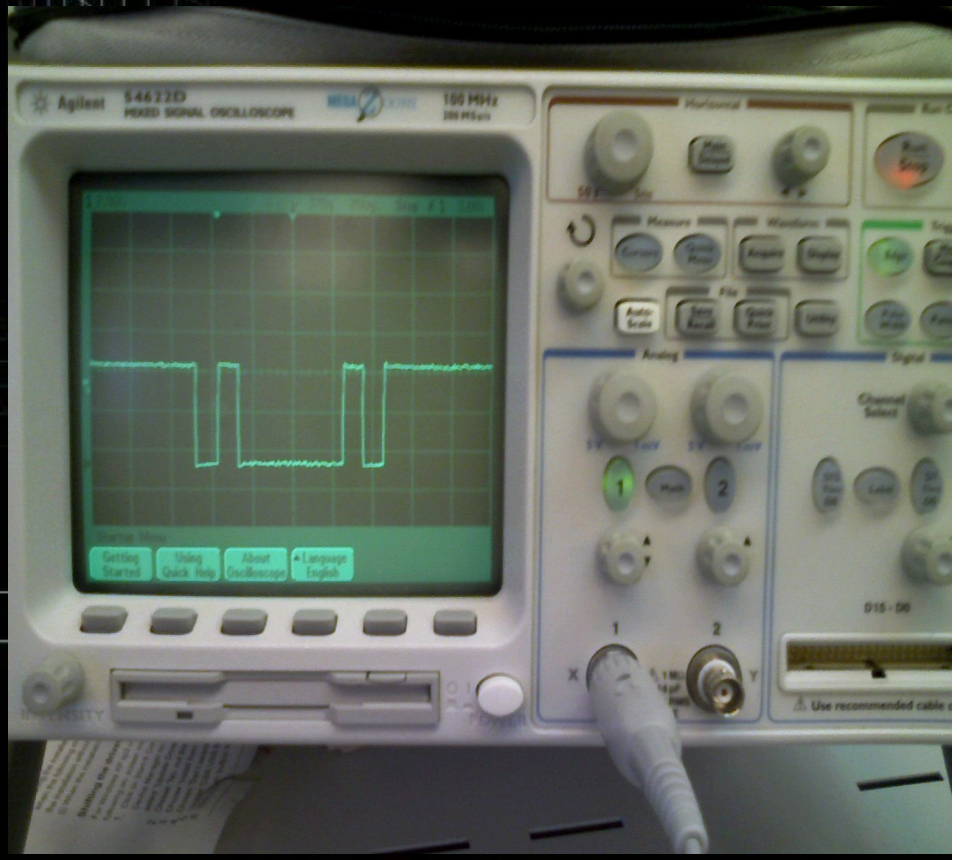
- Xbee supports AT and API modem commands to change configuration through terminal programs like the X-CTU software or with HyperTerminal.

- Examples are:

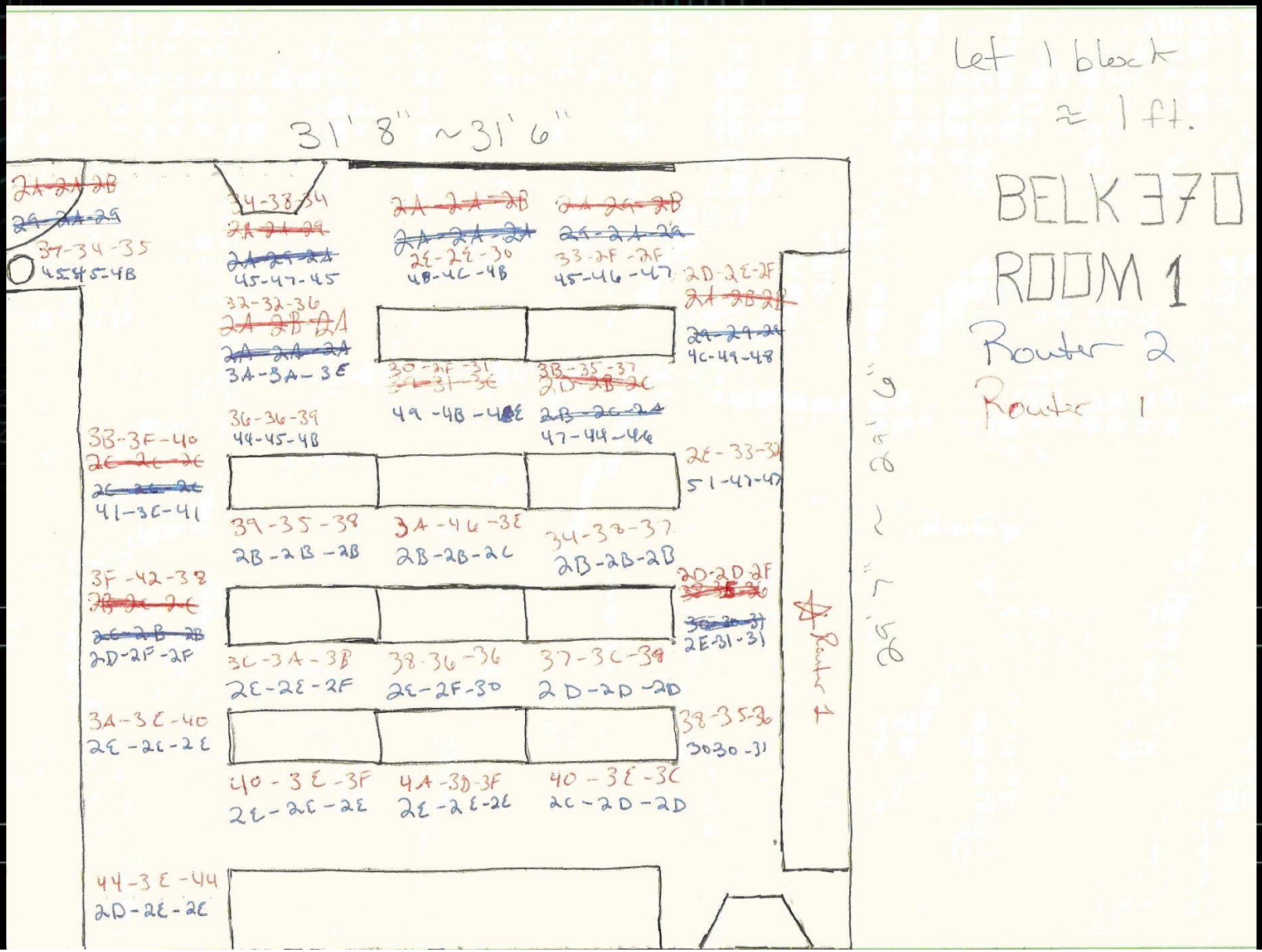
  - +++: Enter command mode
  - DB: Transmit receive signal strength
  - DH: Change destination high address
  - DL: Change destination low address
  - CN: Exit command mode

Testing/Results

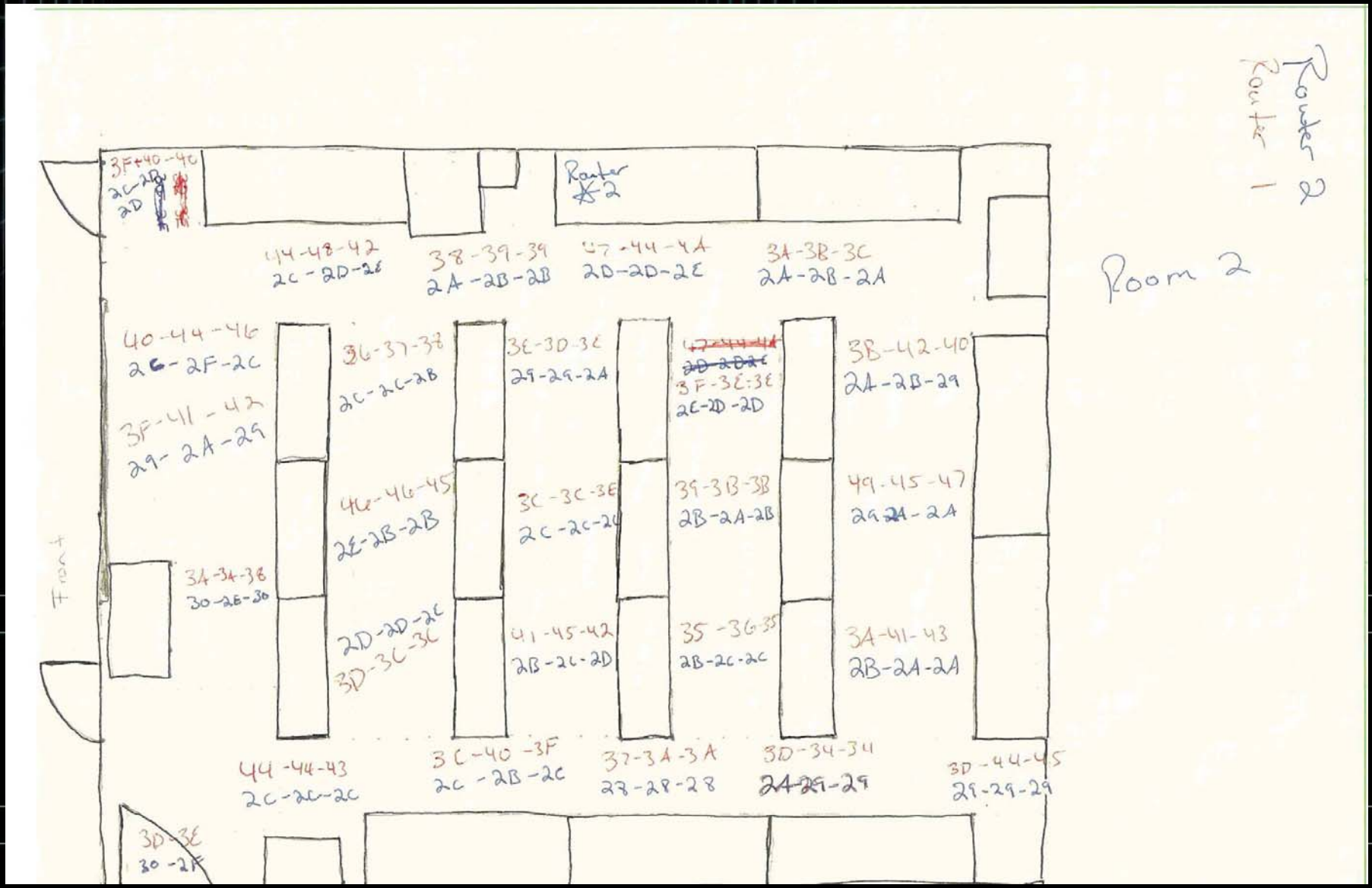
- Connected an Oscilloscope to the RS-232 pins to see received signal
- This picture is a end point transmitting an 'A' to Router 1



Range Testing



Range Testing cont



Battery Life

- Battery Life information to be added

Budget

- Budget information to be added

Future Considerations

- Create a graphical user interface to show end points in real time.
- Create dynamic alerts to be applied in the graphical user interface which can be modified by a user.
- Move to a database linked to the GUI instead of Excel.
- Expand the node density by creating an addressing scheme.
- Utilize ATND command with string comparison in C for further automation of network growth.
- Develop custom circuit boards to reduce size or use XBee onboard microcontroller.

Questions
&
Comments