



# Wireless Embedded Systems and Networking

## Lab Day 1: Part 2: Build a self-organized mesh over a physical extent.

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## Deploying Sensor Nodes

- Discuss as a group where to place your nodes in the lab and in its vicinity.
- Identify interesting places to sense. In addition to the environmental sensors, you can imagine adding open/close sensors, tilt, or other inputs.
- Draw a rough sketch of the floor plan of the space that you will cover and indicate where you will place the nodes. Use all but one of the nodes, so we one set aside for later.
- Discuss what you will be able to observe through the sensors.
- Discuss what you think the wireless connectivity will be among the nodes.
- Discuss how you think information will get routed to the server.



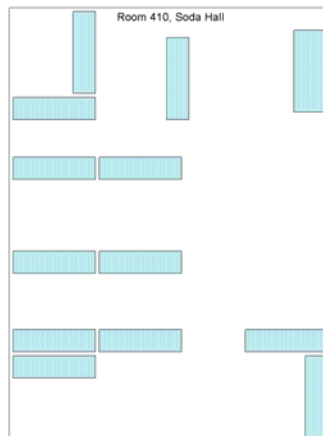
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## Sketch

- Upload your sketch, either by scanning it in or by rendering it in PowerPoint or your favorite drawing program to create a jpeg.



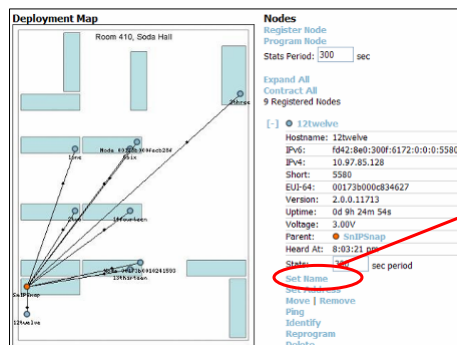
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## Placing nodes

- Select up to 5 nodes to place at the intended spots in your lab space.
  - Continue to use an accelerated rate.
- For each one
  - name it in your network
  - Place it at the point of interest.
  - Place its representative at the corresponding point on your map.



Name:

Group (optional):

Physical Coordinates (optional)

X:

Y:

Z:



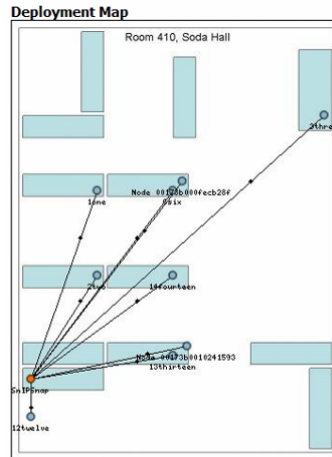
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## Check all the nodes

- Observe whether all the nodes are part of the mesh. Are any missing?



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## Connectivity

- Study the connectivity by going to the connectivity page. Study the map view. What is routing through which? Go to the list view. See the RSSI and link quality.

### Connectivity

Rebuild Routing Tree  
Ping All Nodes  
Request Heartbeat Report from All Nodes  
Survey All Nodes - [list prior surveys]

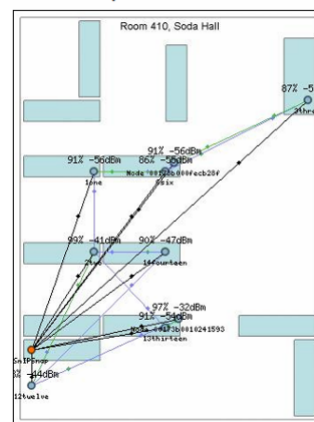
List View Map View Chart View

Name	Last Stats	Depth	Parent	Link Success	Signal
12twelve	8:28:44 pm	1 hop	SnIPSnap	Link Success	Signal
Alternate 1		2 hops	Node 00173b0010241593	Link Success	Signal
Alternate 2		2 hops	2two	Link Success	Signal

Neighbor	Depth	Link Success	Signal
SnIPSnap	0 hops	Link Success	Signal
Node 00173b0010241593	1 hop	Link Success	Signal
2two	1 hop	Link Success	Signal
14fourteen	1 hop	Link Success	Signal
13thirteen	1 hop	Link Success	Signal
3three	1 hop	Link Success	Signal
1one	1 hop	Link Success	Signal
6six	1 hop	Link Success	Signal
Node 00173b0010241593	1 hop	Link Success	Signal

List View Map View Chart View



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## Site Survey

- Run a site survey from each of the nodes.

### Connectivity

Rebuild Routing Tree  
Ping All Nodes  
Request Heartbeat Report from All Nodes  
Survey All Nodes - [list prior surveys]

List View Map View Chart View

Refresh Data

Name	Last Stats	Depth	Parent	Link Success	Signal	
12twelve	8:28:44 pm	1 hop	SnIPSnap		..ll.	Ping OK Survey
Alternate 1		2 hops	Node 00173b0010241593		..ll.	
Alternate 2		2 hops	2two		..ll.	

Neighbor	Depth	Link Success	Signal
SnIPSnap	0 hops		..ll.
Node 00173b0010241593	1 hop		..ll.
2two	1 hop		..ll.
14fourteen	1 hop		..ll.
13thirteen	1 hop		..ll.
3three	1 hop		..ll.
1one	1 hop		..ll.
6six	1 hop		..ll.
Node 00173b000fecb28f	1 hop		..ll.



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## Connectivity and Mesh Routing

- Discuss how the connectivity compares to your expectations.
- Discuss how the mesh routing to the server compares to your expectations.
- Network too sparse => add a node to fill it in.
- Network too shallow => extend with a node farther out.



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## Reliability

- Use the reliability page. Reset the reliability statistics. Let it go for a bit.

### Reliability

Reset Reliability Statistics

List View Chart View

Select a Metric: Overall Success Rates

Name	Last Update	Event Success	Link Success
All Nodes		99.5%	99.741%
12twelve	8:33:46 pm	100%	100.029%
13thirteen	8:32:53 pm	100%	100.024%
14fourteen	8:32:53 pm	100%	96.2%
1one	8:32:53 pm	99.1%	99.797%
2two	8:32:53 pm	99.694%	99.921%
3three	8:32:53 pm	100%	93.653%
6six	8:32:53 pm	99.566%	94.079%
Node 00173b000fecb28f	8:33:08 pm	97.693%	91.228%
Node 00173b0010241593	8:33:42 pm	99.595%	95.565%



## Mobility, Obstruction and Connectivity

- Move nodes around, move them on the map. See how the connectivity remains.
- Try to obstruct it and see how the routing changes.



## Energy Status

- Go to the energy page and see the duty cycle. Adjust the sample rate to something more typical, more typical, say 300s.

### Energy

List View Map View Chart View Refresh Data

Name	Last Voltage	Value	Low Battery	MCU Duty Cycle	Radio Duty Cycle
12twelve	8:33:46 pm			0.46%	1.08%
13thirteen	8:37:54 pm			0.44%	1.09%
14fourteen	8:35:48 pm			0.47%	1.07%
1one	8:37:40 pm			0.46%	1.07%
2two	8:36:27 pm			0.45%	1.11%
3three	8:35:14 pm			0.45%	1.09%
6six	8:35:22 pm			0.48%	1.05%
Node 00173b000feeb28f	8:33:08 pm			0.46%	1.11%
Node 00173b0010241593	8:33:42 pm			0.46%	1.18%



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## Lab wrap up.

- Place nodes where they can run over night. Verify that the network is robust. Turn on data warehouse. Reset stats. Let them run till tomorrow.



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