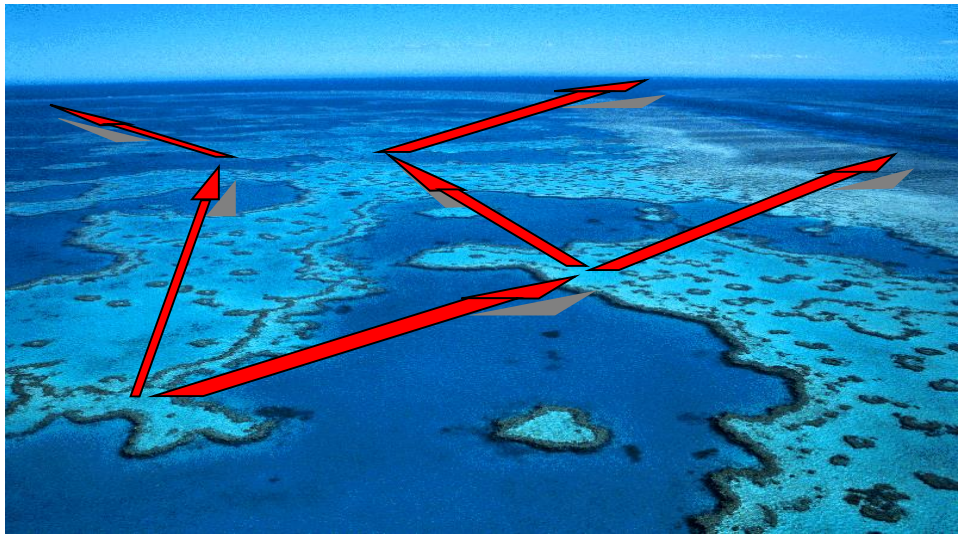
# Reef Ad Hoc Sensor Network

Continued from Nigel Sim (2003) and Steven Sloots (2004)

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# Summary

- Ad-hoc networking overview
- Problem Overview
- Previous work
- Project Scope
- Literature Review
- Progress
- Outcomes
- Questions

# Ad Hoc Networks

Main Entry: **ad hoc**

Function: *adjective*

**1 a :** concerned with a particular end or purpose

**b :** formed or used for specific or immediate problems or needs

<*ad hoc* solutions>

2 : fashioned from whatever is immediately available

Source: Merriam Webster Online Dictionary – www.m-w.com

In computer networking, **ad-hoc** is a connection method for wireless networks that requires no base station — devices discover others within range to form a network for those computers.

Source: Article on "ad hoc" at en.wikipedia.org

# What is an Ad-Hoc Sensor Network?

- **Independent nodes forming a distributed sensing network.**
- Self-configuring
- No fixed infrastructure or topology
- Nodes contain
  - Battery
  - Radio
  - Sensors
  - Microprocessor
- Static nodes
- Low data rate
- QoS not important
- Existing solutions:
  - Berkley Smartdust
  - Crossbow Motes

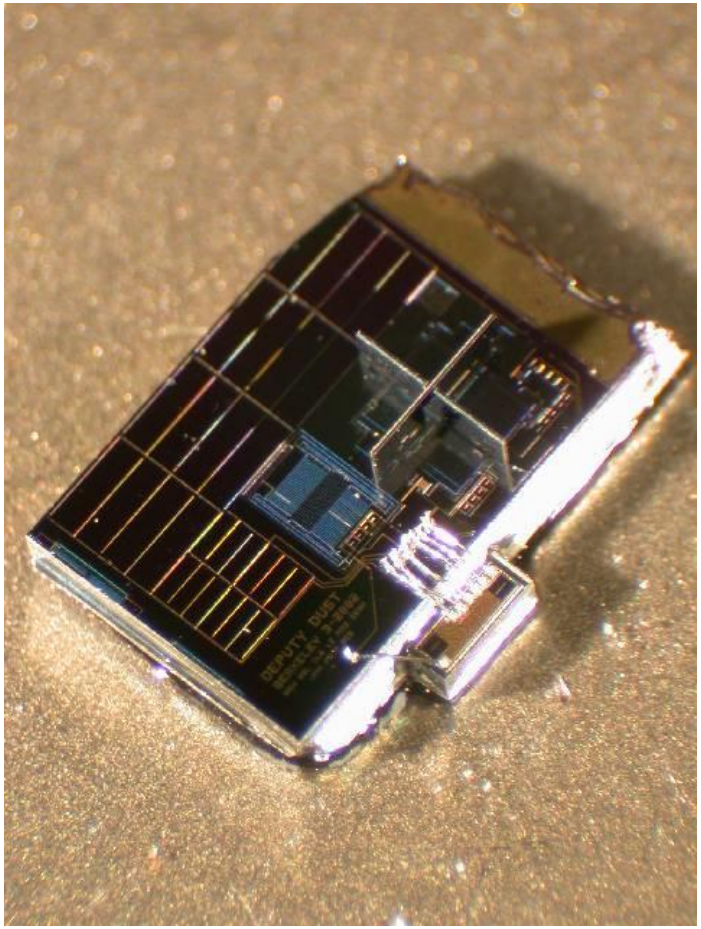


Image Source: http://www-bsac.eecs.berkeley.edu/archive/users/warneke-brett/SmartDust/

# Berkley Motes


Image Source: http://www-bsac.eecs.berkeley.edu/archive/users/warneke-brett/SmartDust/

# AIMS Reef Monitoring Network

- Monitoring Stations
- Data collection
  - long-range radio links
  - manual visits.
- Replace with ad hoc sensor network.
- Reduce
  - power consumption
  - maintenance.

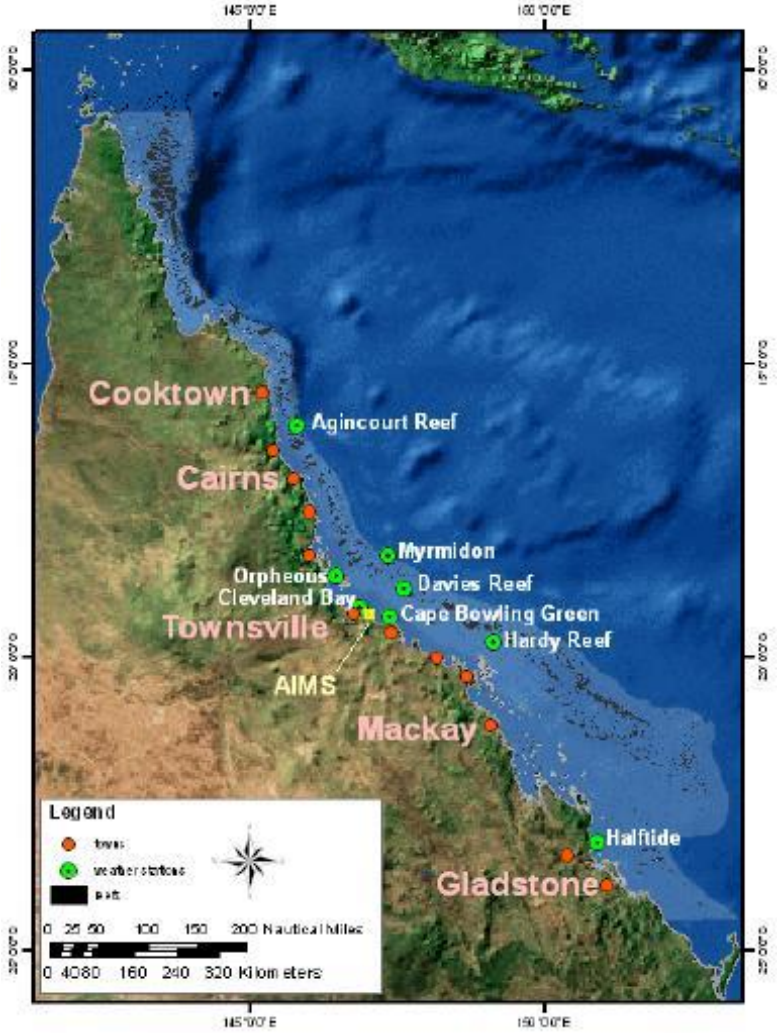
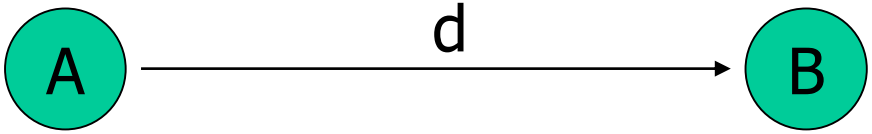
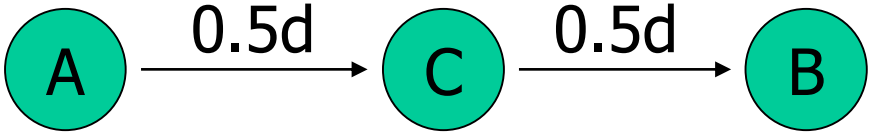



Image Source: "Sensor Networking the Great Barrier Reef", Kininmonth et al, AIMS Tsv QLD.

# Multi-Hop Power Savings




$$P = kd^2$$



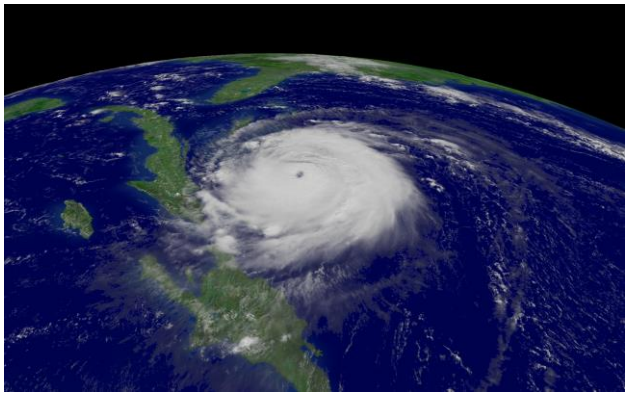

$$P = 2k(0.5d)^2 = 0.5kd^2$$

# A different scenario…

- Scenarios for existing technology:
  - Small geographical area.
  - Small hops (metres).
- Scenario for this network:
  - Very large geographical area.
  - Large hops (kilometres).
  - Remote locations.
- Similar applications:
  - Remote monitoring of water trough levels on a cattle property.

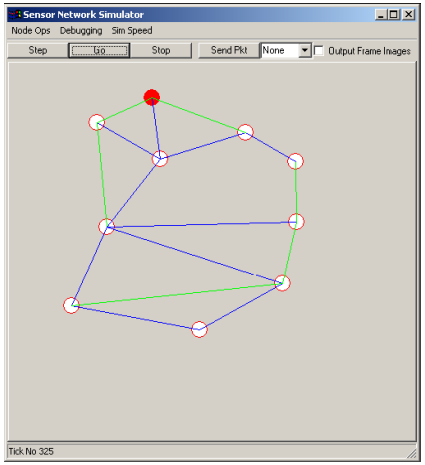
# Requirements and Challenges

- Minimal power consumption
  - Maximise battery life
  - Minimise maintenance
- Robust
  - Varying link quality
  - Nodes crashes
  - Temporary partitions
- Scalable
  - Maintain performance in larger networks
  - Minimise cost-per-node.

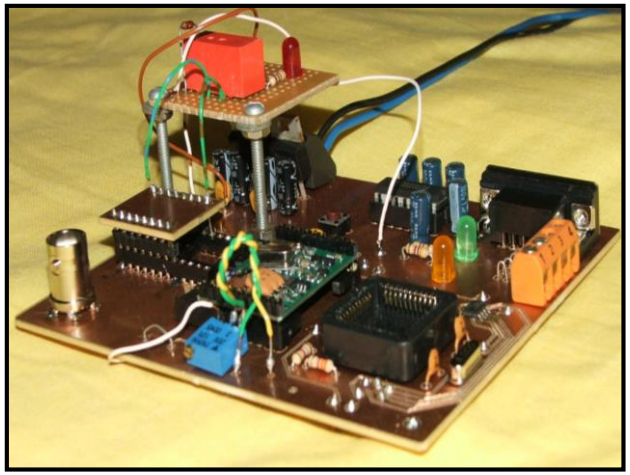


# Previous Work

- 2003 – Mr Nigel Sim
  - Basic Hardware
  - Research efforts focused on simulation

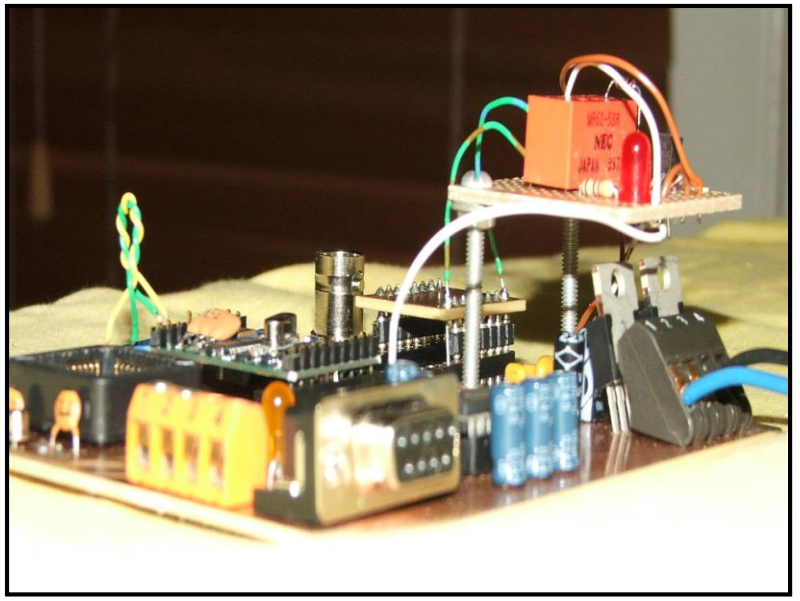



- 2004 – Mr Steven Sloots
  - New Hardware
  - Power Efficient Routing Protocol (DSR)



# Project Scope for 2005

- Hardware improvements
- Addressing Protocol
- Wakeup protocol (if time allows)
- Larger scale testing

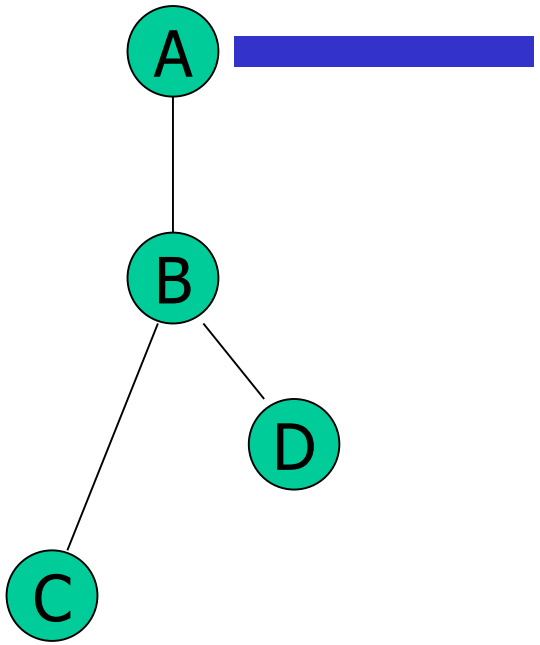


# Addressing Protocol

- #1 priority is maximising energy efficiency
  - Control overhead
  - Addressing overhead
- General Goals for Addressing Protocols
  - Dynamic Configuration
  - Timely allocation of unique addresses
  - Robustness
  - Scalability

# Addressing Techniques

- **Mitosis**
  - Nodes control address spaces
  - Low overhead
  - Robust
  - Address depletion problem
    - Proactive vs Reactive
- Other Techniques
  - Duplicate Address Detection
  - Leader Based



# Wakeup Protocol

- Allows nodes to sleep
- Why sleep the nodes?
  - X2010
    - Rx - 7mA (typ)
    - Tx - 8mA (typ)
  - PIC – 2.5mA (typ)
- Significant power savings

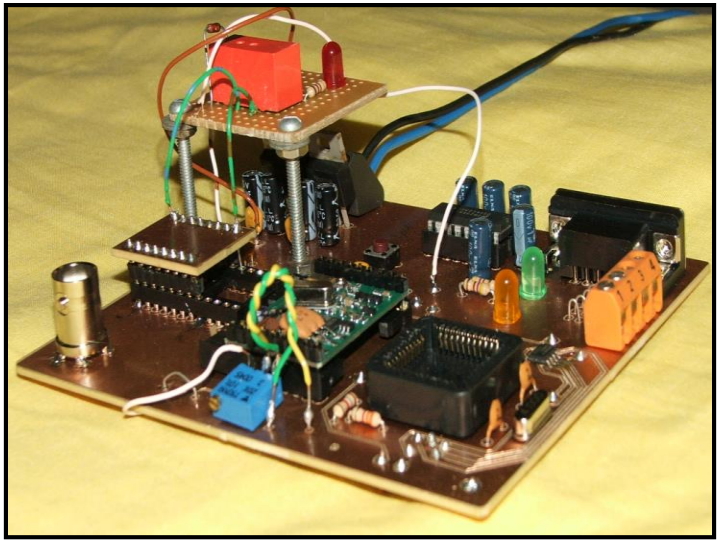
# Wakeup Mechanisms

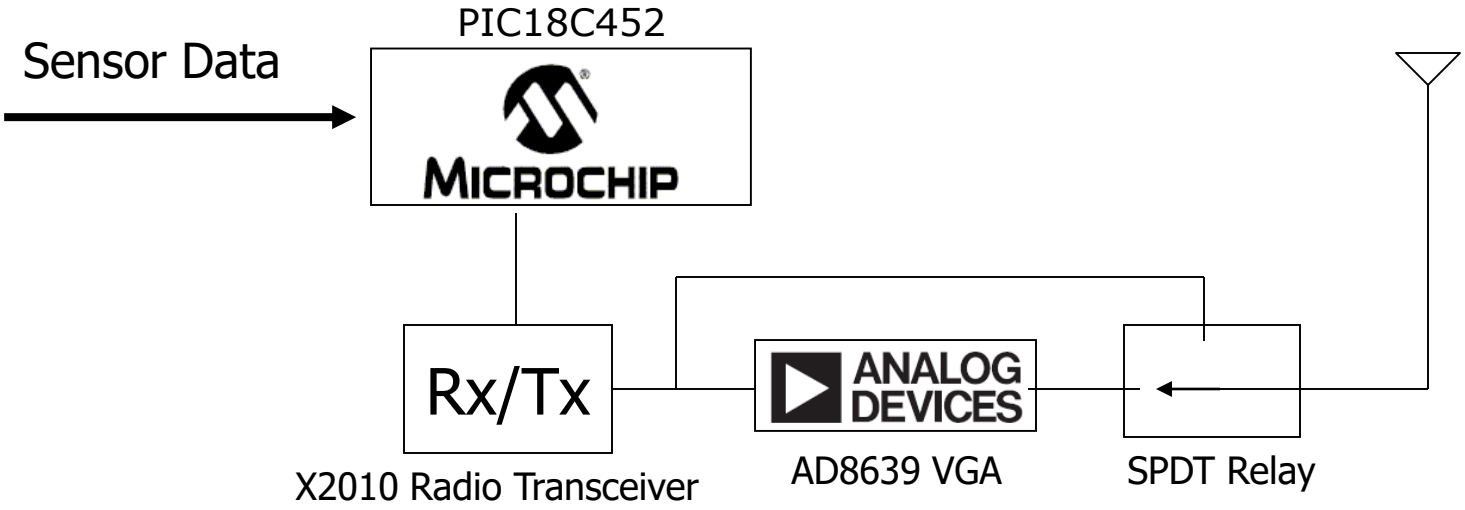
- **Asynchronous wakeup**
  - Individual overlapping wakeup schedules
  - Easy to implement
  - Robust

- Other techniques:
  - Scheduled Rendezvous
  - Out-band signalling

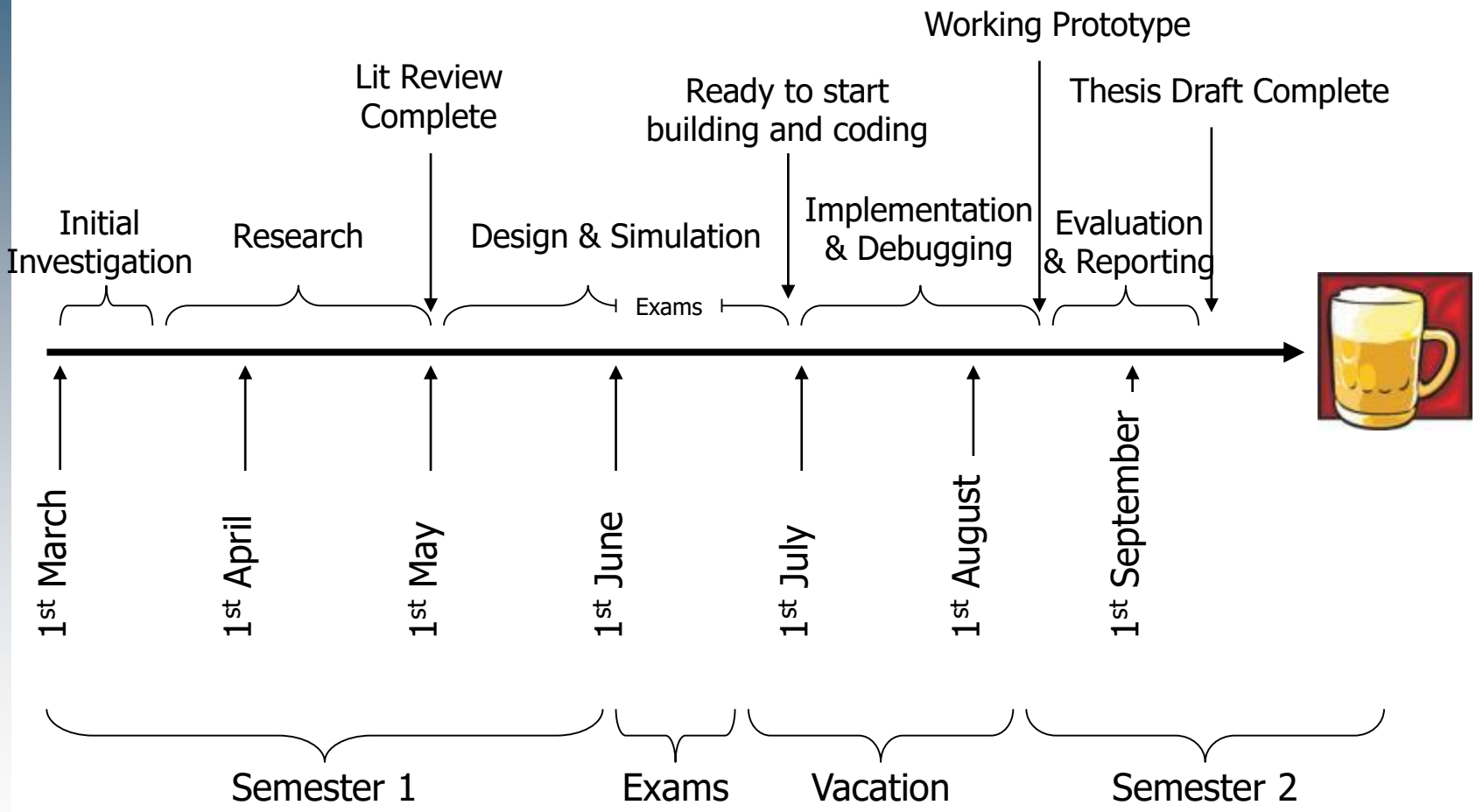
# Hardware

- PIC 18C452
- X2010 Radio Transceiver
- AD8639 VGA
- Bypass Relay
- DS1302 Timekeeping Chip





# Progress


Working Prototype
Lit Review Complete
Ready to start building and coding
Thesis Draft Complete
Initial Investigation
Research
Design & Simulation
Exams
Implementation & Debugging
Evaluation & Reporting
1st March
1st April
1st May
1st June
1st July
1st August
1st September
Semester 1
Exams
Vacation
Semester 2

# Outcomes

- Minimum:
  - Dynamic Addressing Protocol Developed
  - Wakeup Protocol Developed
  - 2 communicating, functional nodes
- Expected:
  - Working Addressing Protocol Implemented
  - Working Wakeup Protocol Implemented
  - Testing with several ( >2 ) nodes

# Questions

If there are no stupid questions, then what kind of questions do stupid people ask?

Do they get smart just in time to ask questions?

Scott Adams (1957 - )