Timeline

ArcTech's Ice Tracker system is on schedule to be completed by its projected delivery time of early April 2011. As described in our original proposal, there are several key areas with specific timelines associated with them. Discussion with the client and some initial research allowed us to develop a functional specification which was delivered on February 16, 2011. The requirements outlined in this document were addressed and outlined in a design specification that was delivered on March 13, 2011. Design of the Ice Tracker system has thus been largely completed and the current stage of development is assembly and testing. This should be completed by the end of March. A brief outline of the progression of each major stage in the development process will be given along with a summary of the status of the project.

1. **Research**

   - *Housing*: We completed research on the housing material according to its suitability in terms of ease of machining, cost and robustness in a marine environment. We also addressed the issue of watertight sealing by considering various enclosure schemes. We chose 6061 grade aluminum for the material and a double end-cap radial O-ring seal design with threaded longitudinal rods to provide additional sealing and mechanical support.
   - *Hardware*: We researched and selected our environmental sensors, microcontroller and communication modules based on cost, performance at low temperatures, power consumption and availability of development software and/or breakout boards. For a full description of each sensor and why it was chosen, more information can be found in ArcTech's "Design Specification for GPS Ice Tracking System".
   - *Software*: A real-time operating system (RTOS) was chosen for use in our microcontroller over programming in assembly language in consideration of the fact that more than one ArcTech member will be involved in the software design, thus high-level programming capability is necessary. We researched several different operating systems and evaluated their suitability in terms of footprint, ease of programming and availability, e.g. licensing and royalties.

2. **Design**

   - *Housing*: As described, the double end-cap radial O-ring seal enclosure design was selected due to the possibility of implementation with limited machining of stock aluminum piping. An additional design choice that was not included in the design specification addresses the issue of internal humidity or condensation damaging the electronics: in addition to assembling the unit in a dry room, a desiccant will be included in the housing. Another option that may be considered is filling the enclosure with an inert gas such as nitrogen.
   - *Hardware*: We decided to split the electronics between an internal and an external printed circuit board (PCB). The internal PCB houses all electronics that do not need to be exposed to the environment, namely the microcontroller, accelerometer and communication modules as well as the fall through detection and power control circuitry. The external PCB houses the air temperature and humidity sensor, pressure sensor, communication antenna and the magnetic activation switch. This is in the interest of exposing as little of the electronics to the environment as possible to avoid potential problems.

- *Software*: We chose a free operating system called FreeRTOS with minimal footprint and support for programming in C++. The architecture of the control software is interrupt-based real-time task management which utilizes direct memory access (DMA) drivers to interface with a large number of external sensors.

3. **Assembly**

   - *Housing*: A completed mechanical drawing has been sent for fabrication. Any delays in this area have been at the request of the client for modifications in the interest of reducing cost. In particular, the most recent modification was made to take advantage of pre-fabricated components. Once the fabricated components have been received, a small amount of machining will need to be completed to install the threaded rods.
   - *Hardware*: We have received the PCB boards and are in the process of soldering surface mount components to the boards. A delay was encountered due to Digi-Key shipping the wrong components to us but this is in the process of being corrected. Once we receive the correct components the hardware should be completely assembled by the end of the week.
   - *Software*: This is the main task that remains before integrated testing can be performed. Code has been written for most of the sensors and much of the remaining work to be done involves the accelerometer and ice temperature sensor. The microcontroller's power down and wake up code is still in progress as is some of the main code dealing with drivers, interrupts and handling the message to be transmitted.

4. **Testing**

   Once we receive the housing components, we can test its ability to withstand a marine environment. Some testing of individual sensors has been completed, however integration testing of the sensors, microcontroller and communication modules has yet to be completed. As mentioned previously, much code remains to be written before integration testing can occur.

Outstanding Tasks

- *Housing*:
  - Pick up fabricated components from manufacturing facility
  - Machine holes for threaded rods
  - Install and test sealing mechanisms (nuts, radial O-rings) via immersion test
- *Hardware*:
  - Assemble prototype boards and finish testing individual components with microcontroller development software
  - Validate Iridium modem's inrush current limiting
  - Measure Iridium modem's power-down mode current consumption
- *Software*:
  - Write peripheral power-down code
  - Define structures sent by sensor tasks to central task
  - Implement central task's generation of outgoing message
  - Implement power-up of Iridium modem and sending of data packet

- Write code to calculate heave from accelerometer output
- Change microcontroller pin mappings to match PCB layout
- Modify drivers to support timeouts and prevent race conditions
- Modify code which calls drivers to handle timeout errors
- Test accelerometer code
- Test ice temperature interface code
- Test sleep mode and recovery

Summary

According to the timeline initially outlined in our project proposal, we are on schedule and should meet our delivery deadline of April 6, 2011. By maintaining communication with our client we have ensured that we are on budget and will continue to stay within it. Completion of software design and testing should be completed by the end of the week which will allow us to fully integrate the housing, hardware and software and perform integrated testing.

