

# Project Proposal for DeLynn

## **SUPERB Summer 2002**

### **Background:**

The PicoRadio project is a research effort exploring dense networks of very small low-power embedded System-On-Chip (SOC) devices. These devices communicate with each other via radio links. The application space for PicoRadio includes numerous types of sensor networks and anything else that requires large numbers of inexpensive devices producing relatively low-bandwidth data in a decentralized way.

In particular, we are exploring the concept of a “smart building”, where environmental control over space will be very fine grain; temperature control in the immediate vicinity of a workstation, for example, or a section of a room. The most obvious advantages are significant energy savings and greater comfort for people in the building.

We are currently deploying the first generation of a PicoRadio network using PicoRadio Test Bed wireless nodes. These nodes have been designed for evaluation of network protocols and applications that are intended for use with the ultimate PicoRadio goal: a tiny, single-chip, ultra low power sensor node.

Since the single-chip PicoNode solution will be utilizing these protocols and applications, it's essential that we understand how they behave in the “real-world” in detail. There will be many aspects of chip design that will be influenced by knowledge of the environment in which they will operate. For instance, how much programmability should we plan for, or how much memory will we need?

In order to understand the behaviour of the network, we need to extract and analyze information available from the network. This includes packet routing traces, drop rates from various causes, power consumption profiles, and error detection/correction effectiveness. We have some of the techniques and mechanisms for doing this but more are needed. We also need to collect and analyze network data.

The platform you will use is called the PicoRadio Test Bed (PRTB). This is a collection of programmable communicating devices made from off-the-shelf components. Each device (a node), contains a StrongARM 1100 microprocessor, a Xilinx Field Programmable Gate Array (FPGA), a Bluetooth 2.4GHz radio, various sensors, power supplies, and other miscellaneous stuff.

## **Project Outline:**

This project will be to develop a plan for taking measurements of network activity, implement the plan, and analyze the resulting data. You'll have access to a lot of help in all of these areas and you will be working as a member of a team, but the project will be tailored as a one person job. There will probably be quite a bit of brand-new and complex stuff that you'll be exposed to, but you will have access to whatever help you need.

### **It will follow these steps, more-or-less:**

1. Get a general understanding of networks, particularly wireless networks.
2. Learn how to use the PicoRadio TestBed.
3. Understand the PicoRadio network and datalink protocols in detail.
4. Determine which parameters to measure.
5. Design a test strategy, for instance, decide how to extract metrics (data points) from the nodes, how to transport them over the network, and how to store them.
6. Implement the strategy using 'C' code and possibly FPGA digital circuit designs.
7. Run a series of data collections.
8. Analyze the data using whatever means appears appropriate, for instance, graphs of time-varying trends.

We will work closely together on most of these steps. Some of the steps will be partially completed when you arrive as a side-effect of other work, and we'll probably modify the sequence somewhat during the summer.

### **What you will learn, among other things:**

1. How a new generation wireless network operates.
2. How to write code for embedded systems.
3. Principles of network protocols.

