Department of Electrical and Computer Engineering

Fiber 2 Ethernet: Proposal

Howard University
Fall 2011

Team Name:
Damola Alabi
Andrew Hillocks
Montaque Jones
Jasmine Little

Advisor Name	Signature	Date
Class Instructor Name	Signature	Date

Table of Contents

Introduction

Objective

The objective of this proposal is to outline the details of the proposed design challenge. The goal is to produce a general purpose interface between a high speed fiber and a gigabyte Ethernet and demonstrate a workable solution to the problem statement.

Background

There have been times where you have a network that utilizes the conventional type of Ethernet cables and another network that uses the faster and more reliable fiber optic cables and there is a need for these networks to communicate. To allow multiple networks that are using different kinds of cables to communicate with each other, a fiber optic Ethernet converter connects an Ethernet cable at one end into a fiber optic cable at the other end. Another use is within the same network if multiple computers are using different technologies or not all of them have the capability to use fiber optic cables.

Outline

In this proposal, we will define the root cause of the problem described in the problem definition. We will also describe the design requirements and constraints of our final solution. We will provide some insight on similar products existing in the market today. Next, we will go into detail about our proposed solution and explain its advantages over alternative solutions. The tasks & deliverables outline the specific steps that must be completed in order to implement our proposed solution design. It will include a breakdown of our timeline and budget as well. An *Appendix* and a list of *References* are provided for more information on our Fiber to Ethernet (F2E) project.

Problem

Problem Definition

The problem we are faced with is as follows: to design a system that can handle data at high rates (preferably 6.2Gbps) for the purpose of testing receivers in factory and is more cost effective than the MIL-SPEC hardware that Northrop Grumman is using right now.

Assumptions

In deciding the range of this project, the following assumptions were made:

- The adapter must be able to work on older (but relevant) generation computers.
- The adapter must be made in align with IEEE standards of technology.
- The adapter must be made for small scale use in a home or office.
- The adapter must be able to withstand interference from other electronic devices.
- The adapter must be able to handle 10BaseT to 1000BaseT speeds.
- The adapter must have LED indicators to inform about functionality.
- The adapter must have an Electro-Static Discharge of up to 15kV.

Design Requirements

1. Overall Function:
    a. The unit should receive data, convert it back into 32-Bit words, buffer a large quantity of these words, and then upon request transfer the data block over a LAN interface to a requesting computer.
    b. The data comes in as serial data encoded in the Xillinx 64B/66B protocol.
    c. Real-time conversion from fiber to LAN is not required.
2. Compliance
    a. F2E should meet the electrical requirements as stated in most recent version of the following standards
        i. IEEE 802.3 Ethernet standards
        ii. Fibre channel physical and signaling standard
        iii. ANSI X3.230-1994
        iv. ISO 14165-1

Current Status of Art

Ethernet-Fiber Converters enable connections of Ethernet equipment over a fiber optic link to take advantage of the benefits of fiber which include;

- Extending links over greater distances using fiber optic cable
- Protecting data from noise and interference
- Future proofing your network with additional bandwidth capacity
- Increasing the overall speed of the network

Ethernet connections are limited to a data transmission distance of only 100 meters when using unshielded twisted pair (UTP) cable. By using an Ethernet to fiber conversion solution, fiber optic cabling can now be used to extend this link over a greater distance.

Currently there are no commercial products that have the ability to do on demand conversations.

The most common type of Ethernet-Fiber Converter is one that is a standalone device (managed or unmanaged) with its own power adapter.

Current devices on the market:

As stated before there are no commercially available products that have to ability to do an on demand conversion. Currently, the only products available are MIL-SPEC hardware. This hardware is very expensive and is not for commercial sale.

The only products available on the market are as follows and can help our team how conversion works.

Single-mode Fast Ethernet fiber optic media converter - SC, 1310nm, 15Km, SNMP support - FIB1-10/100S-SC15F - $80.00

FIB1-10-100S-SC15F is a singlemode Fast Ethernet fiber optic media converter with SNMP management support, working on 15Km distance single-mode 9/125um fiber. Currently, media converter can be ordered with SC type of fiber optic connector. ST or FC optical connectors are available on demand. FIB1-10-100S-SC15F single-mode converter operates on 1310nm, with autonegotiation 10/100 and MDI/MDI-X features for the Fast Ethernet RJ45 UTP interface. The equipment support link-loss forwarding function (LLF), loopback test and remote monitoring. Used with their family of FRM301 fiber optic chassis they also support SNMP management and GUI applications.

http://www.buy.com/retail/product.asp?sku=209897263&sellerid=20544488

10/100M Ethernet to Fiber Optic Converter – SM - $69.95

The SerialComm ETH-FIBER-SM (Single Mode) is a high quality standalone, panel or rack mounted bi-directional externally powered 10/100M Ethernet to Fiber Optic Converter enclosed in a heavy-duty steel enclosure with static and surge protection. The Ethernet Media Converter comes with either ST or SC Connectors. The superior quality and reliability of the fiber optic converters are designed for the most demanding commercial and industrial applications and is backed by our 30 day risk-free money back guarantee and 5 year replacement warranty. The multi-functional Ethernet to fiber optic converter (fiber optic modem) supports data communication between 10/100BaseTX and 100BaseFX fiber optic links.

http://www.rs232-converters.com/ethernet_fiber_optic_converters.htm

Relationship:

In relation to this project, the current F2E don't have the capacity to handle data at rates up to 6.2Gbps and convert it like what this project is meant to do. One might ask why engineers haven't made a commercial product that can handle such data in such a way. The answer is simple. There hasn't been a market that demanded so much data to be converted at once. Essentially, this system of ours can be made but it's more of a custom thing depending on what the consumer/customer wants.

Initial Solution Idea

Our initial solution is to create an effective Ethernet to fiber optical converter. This device will be both cost efficient and operate at an optimal level. The converter will be backwards compatible between optical links and Ethernet cables.

General/system level structures with schematics

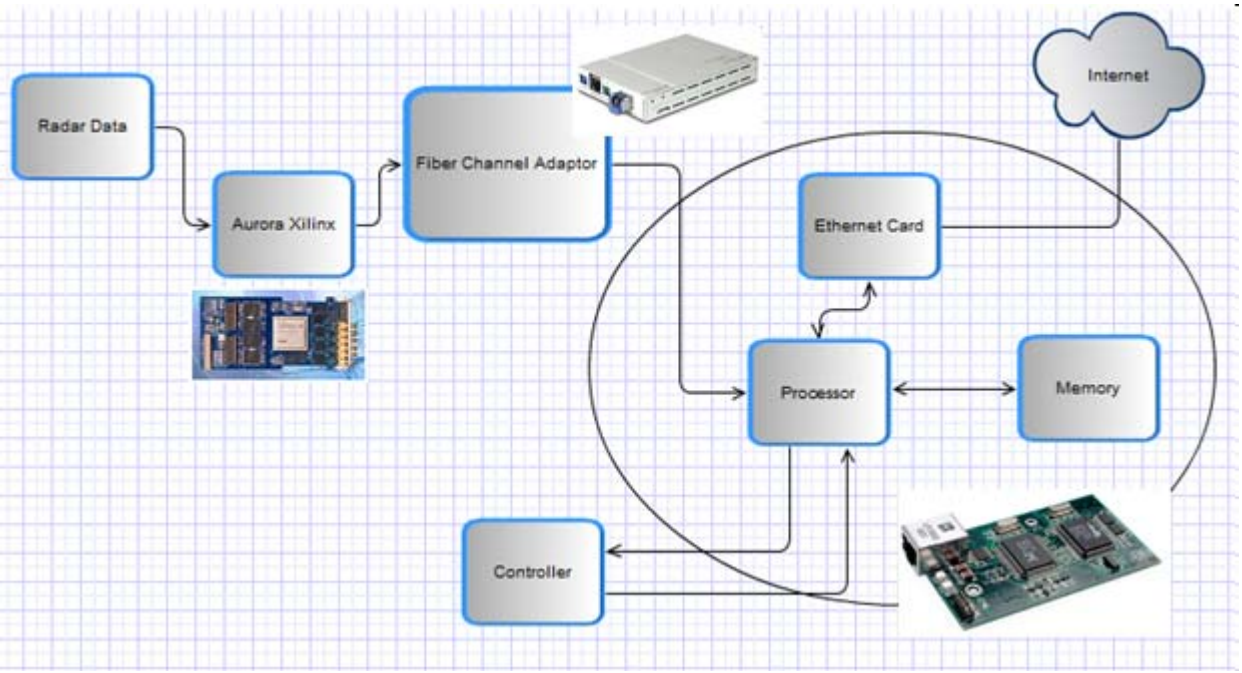

Diagram of our converter solution

Possible alternative solution Approaches

A possible alternative approach to our solution could be similar to the original method but slow the speed of the data so that it could work but that would not be conducive to the design requirements.

Systematic Process/Approach to reach at the desired solution

1. An external controller commands a box to attain X words (commands come over the LAN interface).

2. Box acquires data on fiber interface and buffers it in memory.

3. Box reports completion or is polled by controller.

4. External controller requests data acquired to be transferred over LAN (FTP or other standard TCP protocol required.

5. Box transfers data.

6. Box awaits next command.

Knowledge to be learned for the solution

As a whole we will learn the importance of the design process as well as efficient product and time management. We also will learn from any mistakes we encounter and carry this experience with us for future projects.

Knowledge & Coursework

This design makes use of the knowledge we have already acquired and that which will need to be acquired during the design process. An overall understanding of Telecommunications is needed. The design of the processing system makes use of the skills learned in Digital Systems and Advanced Digital systems design. Converting the signals to digital signals will make use of principles we learned in Signals and Systems, Communications Theory and Electronics.

Scenario Considerations

General Scenario1

One company that makes radars that bring in lots of data needs the most reliable and fastest way to test that the radars that it makes are functioning correctly. However, there are no commercial products that can process lots of data coming in at fast speeds and the non-commercial products are very expensive. Our Fiber to Ethernet system will have many advantages over commercial and non-commercial products:

- It can handle data up to speeds of 6.5Gbps
- It is not as costly as MIL-SPEC hardware
- It is very customizable
- It hasn't been built yet so it can serve as a business venture for the company
- System reliability and ease of maintenance

With all of the advantages these advantages, our system would be the best to use for this case and cases similar to this.

Testing & Verification Plan

In order to achieve the engineering solutions, we have decided to take the following steps:

- We intend to meet with our advisor and present our proposed solution in hopes of feedback that will be received and necessary revisions will be made. This step will be repeated as many times as necessary until we are given the ok to begin building.
- As a team, we are to analyze our individual approaches and merge the solutions to design a single efficient solution.

In designing our prototype, test strategies will also be designed. It will be necessary to design a suite of tests to ensure that our components are working as expected. At each stage of the construction, the appropriate tests will be run and if the test is passed, we will move on to the next step. For example, we shall test each of the sensors as a single unit, then as a collection of units, then as a complete system of units.

Task & Deliverables

Tasks

As a group we are to design an interface that will help close the generation/technology gap by enabling the use of optical technology on Ethernet enabled technology by means of an adapter. Ethernet connections are limited to a data transmission distance of only 100 meters when using unshielded twisted pair (UTP) cable. By using an Ethernet to fiber conversion solution, fiber optic cabling can now be used to extend this link over a greater distance. We are to come up with a way to build this converter so we can be able to close this gap in technology.

Since there are dealing with Ethernet and fiber optic cables we divided the research up:

- Montaque and Andrew will focus on the Ethernet portion of the project
- Damola and Jasmine will handle fiber optics portion of the project.

Even though research on each side is done separately we still we all will have a full understanding of both fiber optics and Ethernet. From the knowledge and information we gathered, we will then collaborate and be able to form a solution to the problem statement.

Deliverables

At the concluding end of this project, we expect that our deliverable meets the desired specific requirements and have a working prototype to test and demonstrate.

Timeline and milestone

Milestone	Scheduled Date
Initial Proposal : Version I	October 2011
Initial Proposal Presentation	October 2011
Written Proposals: Version II	October 2011
Written Proposal: Version III	October 2011
Final Proposal Presentation	November 2011
Evaluation/Selection of Design	November 2011
Final Written Proposal	November 2011
Peer Evaluations	November 2011
Finalize Design	November 2011
Ordering of components/Parts	December 2011
Commencement of the development of the design	December 2011
Completion of project prototype	January 2012
Testing of project	February 2012
Documentation of project	March 2012
Presentation slide	March 2012
Project Presentation	April 2012

Safety

Along with following the safety protocols of the Institute of Electrical and Electronic Engineers (IEEE), we intend to add a surge protector to the design in case of times when that is needed.

Resources and Budget

We aim to use any free resource that we have within our grasp to proceed with this project. If we could use any tools that our university or department hands to us for our disposal, it will be done. We intend on getting as much help as we can from our advisors at Northrop Grumman as well as Dr. Kim. In the case that we cannot get all the materials free, we (Ethernet to Fiber Converters) (Ethernet to Fiber Optic Converters) (Pidgeon) (Freudenrich, Ph.D.) have provided a tentative budget chart below to help us visualize what is needed physically and monetarily to go forward with the project.

Item	Unit Cost ($)	Quantity	Cost ($)
Rabbit Core 2100 PCM Kit	280	1	280
Fiber to Ethernet Converter	150	1	150
Aurora Interface Kit	60	1	60
Miscellaneous			150
Cables	20	2	40
Total Cost			680

Conclusion

To reiterate, the ability to have multiple networks using different kinds of cables to communicate with each other, a fiber optic Ethernet converter will be the best way to do that. Fiber optic cables that continue to work after being converted from an Ethernet cable have a range that is measured in miles. There are so many other benefits as well. Converting from Ethernet to Fiber protects investments in existing copper Ethernet-based hardware, allows the benefits of fiber without making wholesale changes. With so many benefits and such a large demand for this type of converter our team was faced with designing, building and demonstrating a Fiber to Ethernet converter.

We strongly believe that our design solution will accomplish our goal of implementing the concept of a reliable Fiber to Ethernet converter.

References

Bashar, Shabbir A. Fiber-Optic Telecommunication. 2002. <http://www.betelco.com/bd/bdstel/icee.pdf>.

Ethernet to Fiber Converters. n.d. <http://www.perle.com/products/Ethernet-to-Fiber-Media-Converter.shtml>.

Ethernet to Fiber Optic Converters. n.d. <http://www.data-converters.com/index.php?main_page=page&id=8>.

Freudenrich, Ph.D., Craig. How Fiber Optics Work. 2001. <http://communication.howstuffworks.com/fiber-optic-communications/fiber-optic1.htm>.

Pidgeon, Nick. How Ethernet Works. 2000. <http://computer.howstuffworks.com/ethernet.htm>.

Why Do You Need Fiber Optic Ethernet Converters? n.d. <http://ethernetconverter.webs.com/>.