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October 16, 2000

Dr. Andrew Rawicz
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Re: ENSC 340 Project Project Proposal

Dear Dr. Rawicz:

The following package contains the function specification of our ENSC 340 project Syndeo. The purpose of our project is to design and implement a wireless file transfer system. The system allows file transfer between a PC and another system or device wirelessly without the dependence of compatible operating systems. This is accomplished through the use of a browsing device that acts at the middleman file manager between the device and the PC. This document outlines the functionality of the system, and the specifications of each component within the system. The systems consists of the following components: a wireless transceiver at the PC, and a browsing device that includes a wireless transceiver, user interface and interface to the remote device / system.

Our team consists of four energetic and dedicated fourth-year engineering students – Andrew Morning-Smith, Ryan Lee, Savio Lau and Veljko Jovanovic. If you have any questions or concerns about our project or this document, feel free to contact us by phone or by email at ensc340-vars@sfu.ca

Sincerely,

Savio Lau

Enclosure: Functional Specfication

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Syndeo Module Functional Specification

Proprietary and Confidential

Version 1.3
10/16/00

Executive Summary

You have a PDA, MP3 player or a digital camera and you want to transfer files to/from your PC. What would you have to do? You first have to drag out the synchronization cable, and then fire up the proper transfer software. This is fine when you have only one or two devices, but what happens when you have more? What if you don't want the hassle of tangled cables?

Portable devices such as Personal Digital Assistants (PDAs) and MP3 players have been gaining momentum in the last few years. As the price of PDAs decrease, many people wish to keep connected even when they are away from their computers. Although computer notebooks are cheaper than ever, they are very cumbersome to carry around. Portable MP3 player sales are also booming because of their light weight and small size in addition to their anti-skipping capability in comparison to CD players. Because of this, PDAs and portable MP3 players have been gaining popularity. However, the portability of these devices is sometimes very inconvenient, as they all require special software, cradles or cables to update or synchronize the data.

Adjungo Wireless is in the process of developing a next generation product that will allow communication between a PC and a remote, portable device, wirelessly. We hope to use the new wireless standard, Bluetooth™, as the primary means of wireless communication. This product will eliminate the need for cables or synchronization cradles that are currently used with the most portable devices. As an example of this wireless flash writer, our current project is to build the above mentioned wireless file transfer device and integrate it with a portable MP3 player called the iDAC.

Adjungo Wireless, through the design of this product, is establishing new grounds for mobile devices. The days of untangling messy cables and installing synchronization software are over with our product, the Syndeo Module. This next generation wireless transfer device aims to replace the needs for cradles altogether. By choosing to use the Syndeo Module in their designs, companies will have a clean, tested Bluetooth interface with decreased time-to-market. This following document outlines the different components of the Syndeo module, and the product's different modes of operation. In addition, future expansion, usage and improvements will also be discussed.

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Glossary

Table 1: List of acronyms

HSD	**Host Side Device (the PC-based Bluetooth device typically responsible for providing files)**
iDAC	**Internet Digital Audio Cassette (the MP3 player developed by the DAE group during ENSC 340 1999-3)**
Kbps	**Kilo Bits Per Second**
LCD	**Liquid Crystal Display**
MP3	**A compressed music format**
PDA	**Personal Digital Assistant**
PSD	**Portable Side Device (the module that uses Bluetooth to support writing to the mobile device's flash)**

1 Introduction

The Syndeo Module is a wireless flash writing add-on utility that operates using Bluetooth wireless technology. This device will be integrated with existing portable devices to make them Bluetooth enabled, their flash memories available for wireless modifications. Adjungo Wireless plans to develop a prototype device integrated with the iDAC MP3 player as an example application. Miniaturized, cost effective versions of the module will follow in the near future.

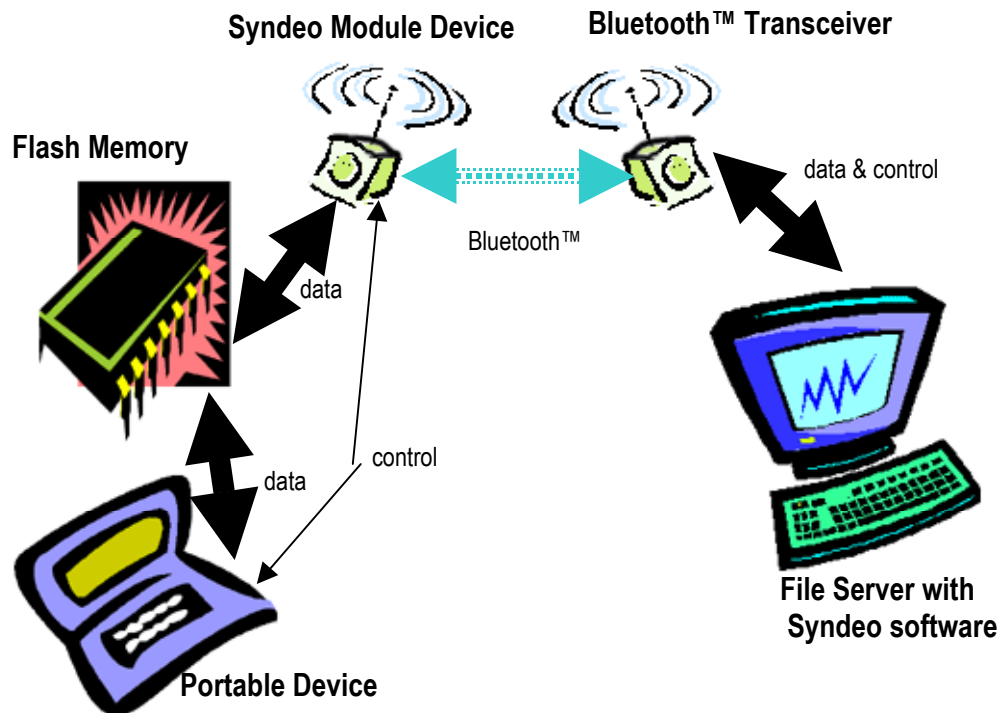**Figure 1: Syndeo Wireless Flash Writer Overview**

1.1 Scope

This document describes the functional requirements to be met by the Syndeo Wireless Flash Writer Module.

1.2 Intended Audience

The intended audience for this paper is our executive committee (Dr. Andrew Rawicz, Mr. Steve Whitmore, Mr. James Balfour and Mr. Jason Rothe), as well as Adjungo Wireless' team of design engineers.

1.3 Objectives

The following notations are used throughout this document:

[R#.#]   A functional requirement.

To denote the prioritization of requirements, the symbol *(n)* is appended to the beginning of each requirement, where *(n)* means:

(1)   Requirement will be met in the prototype device.

(2)   Requirement will be met in the commercial version of the module.

Adjungo Wireless will demonstrate the use of the Syndeo module in conjunction with the iDAC audio player. All requirements that are iDAC specific will have a –i noted beside the requirement designation.

1.4 Bluetooth Background

Bluetooth is a standard and specification for small-form factor, low-cost, short-range radio links between portable devices. A Bluetooth wireless flash writer is more than just a cord replacement. Some advantages a Bluetooth wireless flash writer can provides over a cable interface include:

- **Built in connection:** users need not worry about forgetting cables or having the hassle of carrying them. Computer clutter is also removed.

- **Universal interface:** any Bluetooth enabled device can change its software to communicate with any other device. Problems with incompatible protocols or connectors are eliminated.

- **Multiple connections***:* a single server computer could provide transfers to multiple devices at once, each on a different frequency. This is seldom possible with corded devices where each needs its own socket.

- **Line of Sight:** Portable devices in different rooms could transfer data between themselves without having to run long cables through the walls.

2 System Overview

The Syndeo system is composed of two main components, the host side device (HSD) and the portable side device (PSD). The host side device consists of a Windows™ operating system based computer on which desired files are located. The HSD also contain a wireless transceiver, transceiver drivers and user level software that facilitates downloading of files to the PSD.

The PSD, on the other hand, receives data from the HSD and writes such data to the Flash memory that is in the mobile device. The PSD consists of a browsing device and an interface to the Flash memory. The browsing device consists of a wireless transceiver, an LCD, interface buttons and a micro-controller. The micro-controller is needed to facilitate the communication between all the different devices in the PSD.
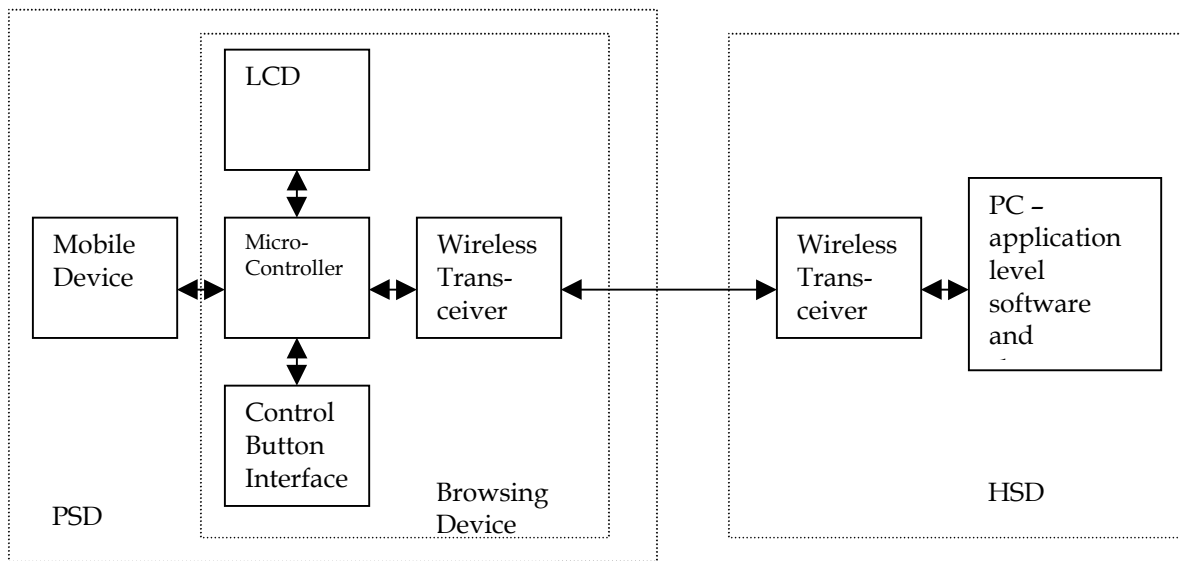
Figure 2: Syndeo system overview block diagram

Figure 2 describes the overall design of the Syndeo system. A more in-depth functional decomposition of each sub-block is discussed in the subsequent sections.

The combination of the above subsystems should satisfy the functional requirements of Syndeo in the following ways:

- Interface between a HSD and a PSD and facilitate wireless file transfer between the two devices

- Provide a LCD and control buttons on the PSD to allow the selection and transfer of files

- Provide a user interface in the form of an application on the HSD to allow selection and upload of data

- Light weight and small in size

2.1 Host Side Device

Figure 3: Host Side Device block diagram

2.1.1 Wireless Transceiver

The wireless transceiver is the sole means of communication between the HSD and the PSD. It uses an industry standard communication protocol to provide easy development and expansion capabilities. On the HSD side, the wireless transceiver are connected to a common interface such as USB, PCI or Serial Port (RS-232).

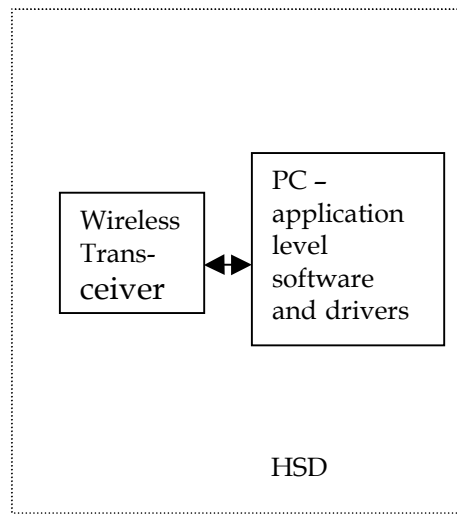### 2.1.2 PC – application level software and drivers

The personal computer has drivers that facilitate the communication between the wireless transceiver and the operating system. In addition, there is a user level application that would allow uploading / downloading of data to /from the portable device connected to the PSD.

2.2 Portable Side Device
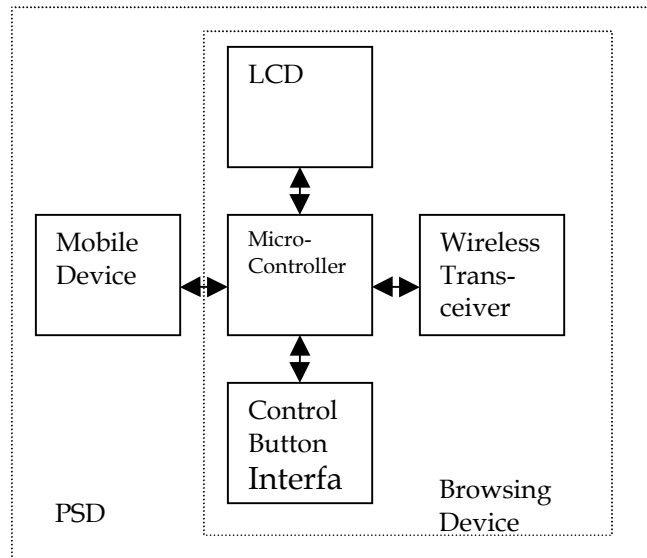
Figure 4: Portable Side Device block diagram

2.2.1 Mobile Device

The mobile device is the portable device that contains the flash memory. This can be any device that has an interface for writing and reading to the Flash memory.

2.2.2 Browsing Device

2.2.2.1 LCD

The LCD is the main form of feedback to the user. The user uses the LCD to view the command options and select the desired files for upload and download in conjunction with the control button interface. The desired LCD should be large enough to view a set of commands and the file names at the same time.

2.2.2.2 Control Button Interface

The control button interface is the main form of user input. This interface allows the user to select and to upload /download desired files. The interface works in conjunction with the LCD to provide the primary set of user interface.

2.2.2.3 Wireless Transceiver

The wireless transceiver is the sole means of communication between the PSD and the HSD. It uses an industry standard communication protocol to provide easy development and expansion capabilities.

2.2.2.4 Micro-controller

The micro-controller is the heart of the PSD. It facilitates the communication between all the other devices that are in the PSD (LCD, control button interface, wireless transceiver, mobile device). The micro-controller reads user input and does the appropriate output such as updating the screen, requesting / sending file from / to HSD, and writing / reading to / from Flash memory.

3 System Requirements

The Syndeo device is used in conjunction with a portable device. Thus, all operating conditions of the portable device will have to be met by the Syndeo device.

[R1]   General Requirements

[R1.1]   (1) The unit shall be able to perform self test as required by the host computer including:

   [R1.1.1] The HSD will transfer data to the portable device.

   [R1.1.2] The HSD will receive data from the portable device.

   [R1.1.3] The portable device will be able to transfer data to the HSD.

   [R1.1.4] The portable device will be able to receive data from the HSD.

[R1.2]   (1) The unit shall be able to able to warn users of terminated transfers and delete all unusable data pertaining to the terminated transfer.

[R1.3]   (1) The device will be able to operate properly after a power failure.

[R2]   Physical Requirements

[R2.1]   (2-i) The Syndeo device will be able to reside in the form factor of a normal audiocassette tape along with the iDACs components.

[R2.2]   (1) The HSD will attach to a PC via a USB cable.

[R2.3]   (2) The Syndeo HSD will be smaller than 10*10*10 (h*w*l) cm^3.

[R3]   Performance Requirements

The Syndeo device will be used in a variety of consumer environments including areas with excessive noise.

[R3.1]   (1) The device will be able to upload and download data to and from the HSD at a minimum sustained data rate of 100 Kbps (>500Kbps for the commercial version).

[R3.2]   (1) The unit will be able to perform error checking to ensure that the transmitted data has not been corrupted.

[R3.3]   (1) Graceful termination after a terminating event (e.g.: power failure, loss of connection) will not alter system functionality after the unit has been restarted.

[R3.4]   (2) The Syndeo module shall continue to operate correctly in the presence of vibrations with a force of up to 9 times that of the gravitational pull of the Earth (9 Gs).

[R3.5]   (2) The Syndeo module shall not be harmed by shocks of up to 50Gs.

[R3.6]   (2) The Syndeo module shall operate correctly at temperatures from -20° to $+50^{\circ}$C.

[R3.7]   (2) The Syndeo module and portable device shall operate from internal power for eight hours before recharging is required.

[R4]   Compatibility Requirements

The Syndeo device's HSD program will have to run on existing computer platforms.

[R4.1]   (1) The Syndeo device will meet all Bluetooth™ specifications for operation.

[R4.2]   (1) The HSD software will run on the following platforms:
    [R4.2.1] Windows 95/98
    [R4.2.2] Windows NT/2000
    [R4.2.3] Windows ME

[R5]   Reliability Requirements

The device will have to be able to last as long as the portable device is able to function correctly.

[R5.1]   (2) The unit shall be able to transmit 50,000 files to and from the HSD. This equates to data being changed four times a day for thirty years.

[R5.2]   (2) The unit shall meet a MTBF (mean time between failure) of 5,000 hours.

[R5.3]   (2) The hardware of the Syndeo device will be able to operate continuously for up to 8 hours.

[R6]   Serviceability Requirements

The unit shall be able to identify internal errors and relay that information to a user.

[R6.1]   (1) The Syndeo module will be able to alert the user that a HSD / Syndeo device is in communication range.

[R6.2]   (1) The Syndeo module will alert the user if the connection has been terminated.

[R6.3]   (2) The self-test shall identify sub-systems at fault and relay the information to the user.

[R7]   Syndeo Operational States

The unit shall be able to operate in the following states.

[R7.1]   (1) The HSD and Syndeo module shall have a transmit mode.

[R7.2]   (1) The HSD and Syndeo module shall have a receive mode.

[R7.3]   (1) The Syndeo module shall have a browse mode (view contents of HSD).

[R7.4]   (1) The Syndeo module shall have a "no connection" state.

[R7.5]   (1) The Syndeo module will have an ignore HSD state.

[R8]   HSD Interface

The HSD interface will be modeled after an FTP (file transfer protocol) program interface.

[R8.1]   (1) The HSD user interface shall be a graphical interface.

[R8.2]   (1) The HSD shall allow users to select directories where appropriate files can be transferred to the portable device.

[R8.3]   (1) The HSD shall allow the hiding of files so they cannot be uploaded to portable device.

[R8.4]   (1) The HSD will define an upload directory where all files uploaded files will reside.

[R8.5]   (2-i) The HSD will be able to group files together into *playlists* that can be uploaded all at once.

[R9]   Syndeo Module User Interface

The Syndeo device's user interface details the interaction between the user and the device.

[R9.1]   (1) The Syndeo user interface will be text based.

[R9.2]   (1) The Syndeo user interface will show the presence of a HSD within communication range.

[R9.3]   (1) The Syndeo user interface will show the contents of the HSD that can be downloaded to the portable device.

[R9.4]   (1) The Syndeo user interface will be able to mark specific files for upload at a later time.

[R9.5]   (1) The Syndeo user interface will allow users to upload data to the HSD.

[R9.6]   (2) The Syndeo user interface will allow the user to view file descriptions.

[R9.7]   (2) The Syndeo user interface will allow users to download data from the HSD to the portable device.

[R10]   Regulatory Requirements

The Syndeo module will have to meet all requirements of the portable device as well as regulations for wireless communication devices.

[R10.1]   (2) The system shall comply with the following standards for wireless communications:
   [R10.1.1] AR1B STD - T66
   [R10.1.2] ETS 300 328
   [R10.1.3] ETS 300 826
   [R10.1.4] FCC CFR 47 Part 15
   [R10.1.5] IC RSS 139
   [R10.1.6] IC RSS 212
   [R10.1.7] IEC-60950
   [R10.1.8] UL-1950

[R10.2]   (2) Electromagnetic Compatibility Standards:
   [R10.2.1] EN 55011:1991/CISPR 11:1992 +A2:1992 (Group 1, Class A)
        –   RE/CE
   [R10.2.2] EN 50082-1:1997 – Radiated, EFT/Burst, ESD Surge, Conducted, Voltage dips/interrupts

[R10.3]   (2) Safety Standards:
      [R10.3.1] CSA C22.2 No 1010.1-92
      [R10.3.2] IEC 1010-1:1990 +A1:1992 +A2:1995
      [R10.3.3] UL 3111-1

[R10.4]   (2) Environmental Standards:
      [R10.4.1] HP Class C1 device.
      [R10.4.2] HP 757 – Temperature
      [R10.4.3] HP 758 – Humidity
      [R10.4.4] HP 759 – Vibration
      [R10.4.5] HP 760 – Shock

[R10.5]   (2) The Syndeo Module will be approved according to the CE/FCC requirements.

[R10.6]   (2) The Syndeo Module will be approved according to the CSA requirements.

[R10.7]   (2) The Syndeo Module will be certified according to the Bluetooth qualification for Bluetooth products.

[R11]   Cost Requirements

The following list the financial constraints placed on the system

[R11.1]   (2) The development costs shall be minimized to reduce price increases in the final product.

[R11.2]   (1) The PSD code will be structured such that it can be run on the portable device's own microcontroller/microprocessor with minimal modifications, if desired for cost savings.

[R11.3]   (2) The additional costs added to the portable device, to add the Syndeo Module, shall not exceed $15 (normalized to year 2000 dollars) if a microcontroller is not included or $22 if a microcontroller is included.

[R11.4]   (2) Integration with other technologies must be well defined in order to have a large market share for the product.

4 Training

4.1 System Integrator Training

The integrator of the Syndeo system to mobile devices should be familiar with the basic system design, especially the interface between the micro-controller and the Flash memory. In addition, the system integrator should also be able to program the micro-controller to suit the particular design / interface specification of the Flash memory in the mobile device. For this purpose, a detailed interface and design manual will be written outlining the functionality and the usage of such interfaces. Furthermore, sample code algorithms for writing to the Flash memory will be given. The manual and the algorithms for the micro-controller will also be available on the Adjungo Wireless Inc. website for future reference. Moreover, a 5 days a week 9-5 technical support through email and by phone will also be available to assist the system integrators.

4.2 User Training

The user of the Syndeo system should be familiar with the application interface on the HSD and the button / LCD interface of the PSD. For this purpose, a manual will be written outlining the functionality and usage of the two interfaces. This manual will also be available on the Adjungo Wireless Inc. website for future reference. In addition, a help file will be integrated into the HSD application. Furthermore, basic button usage will be displayed on a label on the PSD to aid the user.

5 Potential System Limitations

The Syndeo System will be limited by the following factors:

- The user interface of the Syndeo Device is limited to four lines of text. Too many files on the HSD will result in excessive amounts of scrolling.

- Excessive electromagnetic noise may inhibit the maximum transfer rate of the system.

- Power consumption of the portable device will be increased. This will reduce effective battery life.

- The HSD computer will be required to have a USB port.

- The HSD program will have to be running in order to transfer files between it and the portable device. This will reduce the amount of system resources on the HSD computer. This may reduce the performance of slower computers.

6 Testing

In order to ensure that all the requirements for a functioning prototype are met our team is planning to perform rigorous testing. Each independent component will be tested before integration with the prototype and, as each new component is added to the system, extra tests will be performed to confirm proper interfacing between the system and the newly added parts. The main requirements to be tested in the prototype include:

- **Dual way communications:** tested by repeated data transfers from the HSD to the portable device and vice versa.

- **Data transfer rate:** the test uploads/downloads will be timed in order to confirm that the minimum average data transfer rate of 100Kbps is maintained. A large number of tests will be performed in different environments to ensure the requirement is met fully.

- **Connection stability and reliability:** we hope to demonstrate the stability and reliability of the HSD to portable device connection through long high volume data transfers in several different environments.

- **Detection of devices within range and broken connections:** the effective range of operation will be confirmed during test runs by moving the portable device in and out of range of communication with the HSD.

- **Graceful recovery:** several factors may lead to corrupted data or incomplete file transfers including power failures and broken connections due to a device moving out of range. We intend to simulate a power failure by powering down the module during transfer. Handling of broken connections will be demonstrated by moving the HSD and portable device out of range.

- **Power consumption:** will be monitored often by measuring the voltage and current used by the Syndeo module while in operation. It is crucial to ensure parts are not damaged during development and that it will be possible to power the portable device for a reasonable amount of time before the battery would need recharging/replacement.

- **Functionality of LCD and buttons:** the functionality of this part of the portable device will be demonstrated by controlling uploads/downloads between the portable device and the HSD on the portable device side.

- **User friendliness:** in order to ensure ease of use several test runs are planned with non-engineering students and people with a non-technical background.

7 Conclusion

This document has detailed the functional requirements for building an operational prototype for a wireless flash writer. The Syndeo wireless flash writer will be designed based on the functional specifications described in this document.

The requirements labeled by a (1) will be implemented as part of the prototype device which is to be completed by December of 2000. The remaining requirements, labeled by a (2) will be implemented as part of the future development of the commercial product.

8 Sources and References

1) Sigma Comtec, http://www.comtec.sigma.se/

2) Bluetooth Solutions from Ericsson, http://bluetooth.ericsson.se/

3) Ericsson, http://www.ericsson.se/

4) Engineering Science Communications Handbook: Module 3 7th Edition, S. Stevenson, S. Whitmore, 1999.

5) *Syndeo Module Project Proposal*, A. Morning-Smith, R. Lee, S. Lau, V. Jovanovic, September 25th, 2000.

6) Specification of the Bluetooth System, Volume 1 – Core, v1.0 B, December 1st 1999[i]

7) Specification of the Bluetooth System, Volume 2 – Profile, v1.0 B, December 1st 1999

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[i] The Bluetooth specifications can be found at www.bluetooth.com .