

# Workstation Fax

## Problem Statement

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## Introduction

Facsimile image transmission - now often called fax - has already been used for a long time, in fact since 1854, but the transmission was always slow because it was based on analog representation of the image. In the early 1980s, a digital standard called CCITT T3 or short @i(group 3 fax) was established by CCITT, an international standards committee based in Geneva. It provided better data compression, higher transmission speeds (up to 9,600 baud) and sharper images than the analog standards. With the definition of the Group 3 fax standard, fax machines have established themselves all over the world. Every major hotel now has a fax machine. In fact, in connection with a portable telephone, fax machines are even offered to the busy executive who is stuck in the morning traffic jam while on his way to the office.

Here at CMU we are also interested to make use of fax. The idea is to incorporate the fax technology into Andrew, a campus wide information network system currently being developed at the Information Technology Center (ITC). The idea is simple to formulate: Let's give each Andrew user (the illusion of ) a personal fax machine, that is, given an Andrew workstation, the user can send/receive fax images to/from any place in the world.

## Fax System Configurations

To interface a workstation to the fax world, several alternatives are available: A fax machine, a fax modem or a fax board.

Many Fax machines have advanced features built into their hardware, such as automatic dialing, group distribution and polling. However, they provide little security: A document received by a fax machine is visible to anybody who has access to it.

A Fax modem is similar to a data modem, but it follows a different communication standard (Double duty modems that combine a 1,200 baud data modem with a 4,800 baud fax modem are available). Compared with a fax machine, it provides higher security and lower maintenance, but much higher printing times. A fax board is similar to a fax modem, except that it can be inserted into one of the extension slots in the workstation.

Fax modems and boards must have software support to provide tasks such as automatic dialing, group distribution and polling.

A fax board with access to the bus of the workstation is faster than a fax

modem. When transferring a fax image over the phone line, the data rate is about 600/bytes per seconds, so the RS232 line is not a bottleneck. However, because the board software can access workstation memory directly, images can be manipulated more efficiently internally. Some new fax machines have a serial port and a builtin modem.

## The Problem

In the following problem description we are referring to the configuration of figure @ref(Lab-FAX). The right hand side of the figure is installed in the lab room (WeH 3422). It shows a PC with an extension board with the capabilities of receiving/sending fax images. The fax images are copied to/from the VICE file system from where they are accessed by a Andrew workstation. Images and text created on Andrew workstations are represented in a format called @i(raster format). Fax images are in group 3 fax format.

```
@begin(figure)
@center(
@graphic(width= 5.33 inches, height= 3.25 inches,
    PostScript = "/usr/bob/se/SPMP/fax.ps")
)
@caption(Workstation Fax Project)
@tag(Lab-FAX)
@end(figure)
```

The two basic problems are: 1) routing incoming fax images to the appropriate receiver and 2) sending a fax image to a software/hardware component which delivers it to a phone number.

We would like you to implement these two problems as a real project. As simple as it initially sounds, a solution to this problem is complex and requires a multi team effort. We have decomposed the problem into projects described below to be solved by individual groups. We suggest the formation of four groups working on the individual projects. At the end of the course the results of the four groups will be integrated into a single software system to be delivered to the ITC. Mark Sherman from the ITC has agreed to be our client. He will give a description of his needs at the beginning of the project. At the end he will serve as the recipient of the complete software system.

Each project consists of the following parts:

```
@begin(description)
@b(Requirements):@\Precise specification of what has to be done.
```

```
@b(Design):@\
    Description of the problem on
    block diagram level. Identification of major components and
    communications paths between the components.
```

```
@b(Project Plan):@\A detailed schedule for individual milestones of the
    project.
```

```
@b(Functional specification):@\
    A description of the functions and data types that
    constitute a solution to the problem. To ensure the system
    integration each group indicates the data types and functions exported
    to other groups (PUBLIC).
```

```
@b(Implementation):@\Coding the functions and data types. Code review.
```

```

@b(Testing):@\
    Provision of a test bed that enables the individual group
    to proceed independently from the progress of the other groups.

@b(Documentation):@\A set of documents consisting of the following:
    @begin(format)
    > Requirements document (The following topics could be part
    of the requirements document:
    Multiple page support, automatic retry, scheduled delivery,
    billing information, group send, specification of
    project acceptance test).
    > User's manual (Overview, dependencies on the environment,
    how to use the system).
    > Functional specification.
    > Online documentation: Functions and shell level commands.
    > Test bed documentation: How to run the tests, simulations,...
    @end(format)
@end(description)

```

## The Individual Projects

The hardware configuration provided for the course consists of a fax board with software and PC-server software. It converts texts into group 3 fax images before or during transmission. It also places fax images into a PC directory, from where they must be picked up and placed into the Andrew File System (VICE) for communications with the other components of the project.

The @i(Workstation Fax) problem consists of the following projects:

- Fax Sender
- Fax Receiver
- Fax Cover Sheet
- Fax Administration

## Fax Sender

**Core task:** A collection of Andrew text images located in a well defined VICE directory, a phone number and a cover sheet, convert the image into a group 3 Fax image and send it to the number.

### Optional tasks:

- Provide pagination for multiple page documents.
- Send Andrew raster images instead of Andrew text images.
- Package multiple documents (enveloping): Wrap up all fax documents scheduled to be sent at a certain time in one envelope.
- Phone companies have different rates for different times of the day (business rates, night rates, ...). Provide a priority scheme that permits a user to indicate how urgent the document is. Provide scheduled transmission (for example at midnight).
- Provide auto-redial: Redial if the recipient phone is busy.

## Fax Receiver:

The receiver problem is symmetric to the Fax Sender problem, but delivery is more difficult.

**Core task:** Receive a collection of group 3 fax images from the fax modem convert it to a raster format image and send it to a well defined Andrew mail address.

**Optional tasks:**

- Provide polling: Call a remote fax station and request a transmission.
- Provide Auto-answer: Automatically pick up the phone when a ring is detected and establish a connection with the remote fax station.
- Provide scheduled reception (for example at midnight).

## Fax Cover Sheet Generator:

**Core task:** Convert an Andrew message into a group 3 Fax message and the phone number of the recipient.

**Optional tasks:**

- Provide a background page for the cover sheet.
- Build a library of cover sheets.
- Make the software portable: Separate site specific information and provide it in a separate file.
- Design a broadcast fax facility, so a fax can be sent to multiple people.

## Fax Administration:

Users should be able to continue work as soon as they have submitted their fax job. We will use the Andrew message system as a fax image spooling facility.

**Core task:**

- Provide administrative information about the use of the fax machine.
- Write a user billing record:
- Determine what kind of billing information is needed.(How should retries be billed?)
- Determine user uptime (how much time is spent online?)
- Lists all documents sent to and received from fax stations, including any problems that were encountered.
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**Optional tasks:**

- Provide a phone directory, that is, a data base of names and phone numbers that have access to the fax service. The phone directory should allow aliases for groups of people or fax stations.
- Provide an authentication scheme.
- Provide the sender with confirmation, for example return status information about the sent fax.

## System Integration

In addition to the steps to be performed by the individual projects, the next two steps must be done together with the other groups:

**System Integration:** A set of tests to ensure correct performance of the whole system.

**Client acceptance test:** The software system is acceptable, if it runs the following „loop test“ (see figure @ref(LAB-FAX)):

An Andrew text message A is converted into a Fax image with a CMU cover sheet and sent to the Fax machine in the Lab room from a workstation. The received fax image is fed back to the Fax machine and sent to the phone number of the sender shown on the fax image cover sheet. This fax image is received by the workstation and converted back to an Andrew text image B. The two text images A and B should be (fairly) identical. A summary of the fax transactions is printed out by the Fax Administration software.