

09/21/00
Jc772 U.S. PTO

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Approved for use through 01/31/2001. OMB 0651-0037
Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53 (c).

INVENTOR(S)					
Given Name (first and middle [if any])		Family Name or Surname		Residence (City and either State or Foreign Country)	
Warren Steve		Roach Williams		Colorado Springs, CO Colorado Springs, CO	
☒ Additional inventors are being named on the _____ separately numbered sheets attached hereto					
TITLE OF THE INVENTION (280 characters max)					
AN AUTOMATIC REAL-TIME FILE MANAGEMENT METHOD AND APPARATUS					
Direct all correspondence to: CORRESPONDENCE ADDRESS					
☐ Customer Number				→ Place Customer Number Bar Code Label here	
OR Type Customer Number here					
☒ Firm or Individual Name		CAHN & SAMUELS, LLP			
Address		2000 P Street, NW Ste. 200			
Address					
City		Washington	State	DC	ZIP 20036
Country		US	Telephone	202-331-8777	Fax 202-331-3838
ENCLOSED APPLICATION PARTS (check all that apply)					
☒ Specification Number of Pages		286		☒ Small Entity Statement	
☐ Drawing(s) Number of Sheets				☐ Other (specify)	
METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT (check one)					
☒ A check or money order is enclosed to cover the filing fees				FILING FEE AMOUNT (\$)	
☐ The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number:				75.00	
The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.					
☒ No.					
☐ Yes, the name of the U.S. Government agency and the Government contract number are: _____					

Respectfully submitted,

SIGNATURE

Frederick N. Samuels

Date

9/21/00

REGISTRATION NO.
(if appropriate)

34715

TYPED or PRINTED NAME Frederick N. Samuels

TELEPHONE 202-331-8777

Docket Number:

166.0001P

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. The information is used by the public to file (and by the PTO to process) a provisional application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the complete provisional application to the PTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, D.C., 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Box provisional Application, Assistant Commissioner for Patents, Washington, D.C., 20231.

DROPBOX EXHIBIT 1028
Dropbox v. Datanet
IPR2024-00078

PTO/SB/10 (12-97)

Approved for use through 8/30/00. OMB 0651-0031

Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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**STATEMENT CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) & 1.27(c)) – SMALL BUSINESS CONCERN**Docket Number (Optional)
155.0001PApplicant, Patentee, or Identifier: Warren Roach, et al.

Application or Patent No.: _____

Filed or Issued: _____

Title: AN AUTOMATIC REAL-TIME FILE MANAGEMENT METHOD AND APPARATUS

I hereby state that I am

- ☐ the owner of the small business concern identified below;
☒ an official of the small business concern empowered to act on behalf of the concern identified below;

NAME OF SMALL BUSINESS CONCERN Integrity PC Innovations, Inc.ADDRESS OF SMALL BUSINESS CONCERN 1220 Lake Plaza Drive, Colorado Springs, Colorado 80906

I hereby state that the above identified small business concern qualifies as a small business concern as defined in 13CFR Part 121 for purposes of paying reduced fees to the United States Patent and Trademark Office. Questions related to size standards for a small business concern may be directed to: Small Business Administration, Size Standards Staff, 409 Third Street, SW, Washington, DC 20416.

I hereby state that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention described in:

- ☒ the specification filed herewith with title as listed above.
☐ the application identified above.
☐ the patent identified above.

If the rights held by the above identified small business concern are not exclusive, each individual, concern, or organization having rights in the invention must file separate statements as to their status as small entities, and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization having rights in the invention is listed below:

- ☒ No such persons, concerns, or organizations exist.
☐ each such person, concern, or organization is listed below.

Separate statements are required from each named person, concern, or organization having rights to the invention stating their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

NAME OF PERSON SIGNING WARREN P. ROACHTITLE OF PERSON IF OTHER THAN OWNER PRESIDENTADDRESS OF PERSON SIGNING 1220 Lake Plaza Drive, Colorado Springs, Colorado 80906SIGNATURE Warren P. Roach DATE 9/20/2000

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

Fujitsu AccuSafe™ Prototype Walk-through

1220 Lake Plaza Drive
Colorado Springs, CO 80906
719-579-9734

Confidential

**All information in this briefing is
confidential to Integrity PC
Innovations, Inc.**

**This information is provided under
Non-Disclosure Agreement (NDA).**

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Prototype

This software accompanying these slides is a prototype version, intended to prove/demonstrate major technical elements, and therefore technical feasibility of the AccuSafe product.

As such...

- Features are missing and/or incomplete
- The user interface is incomplete
- Performance does not match final plans
- Defects, known and unknown, exist

Please report all problems, questions and comments

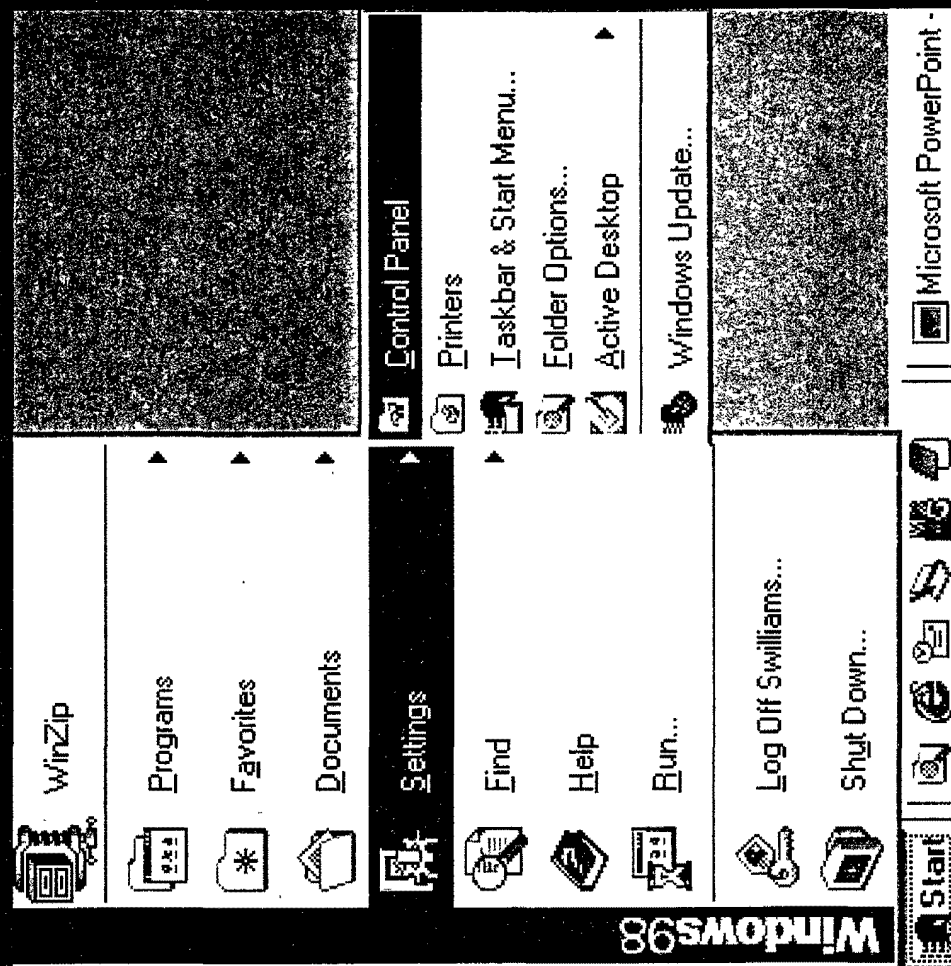
- Steve Williams, steve@ipci-inc.com, 719-579-9734

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any other way to get the information you need. If you are unable to get the information you need, please contact your local office or the IPCI Confidentiality Office at 1-800-445-4454.

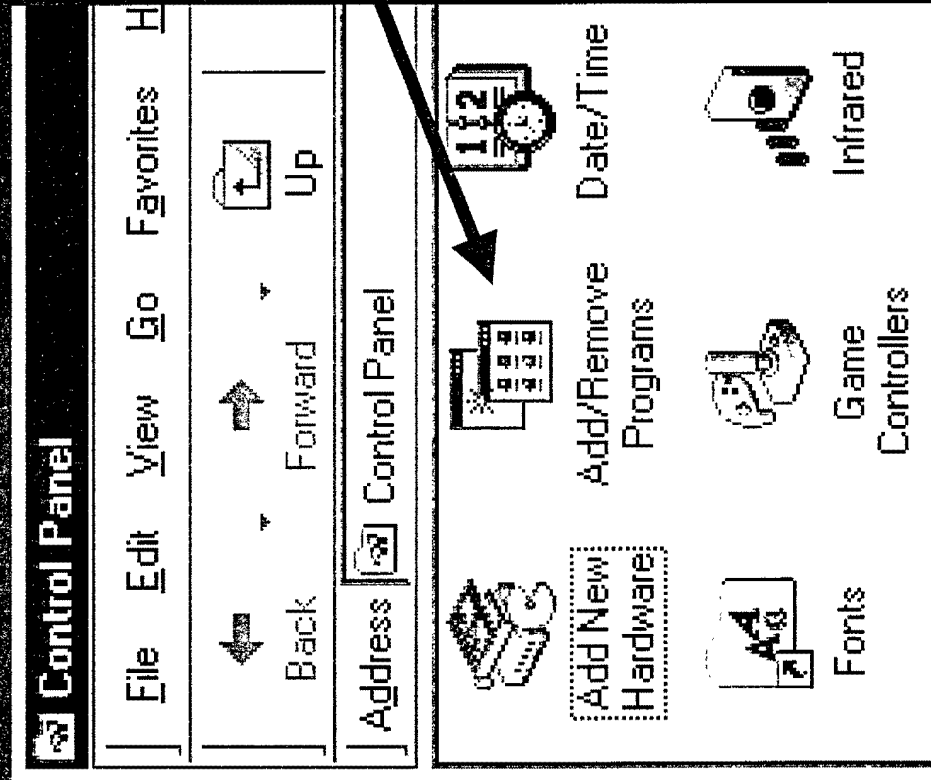
Prototype Installation



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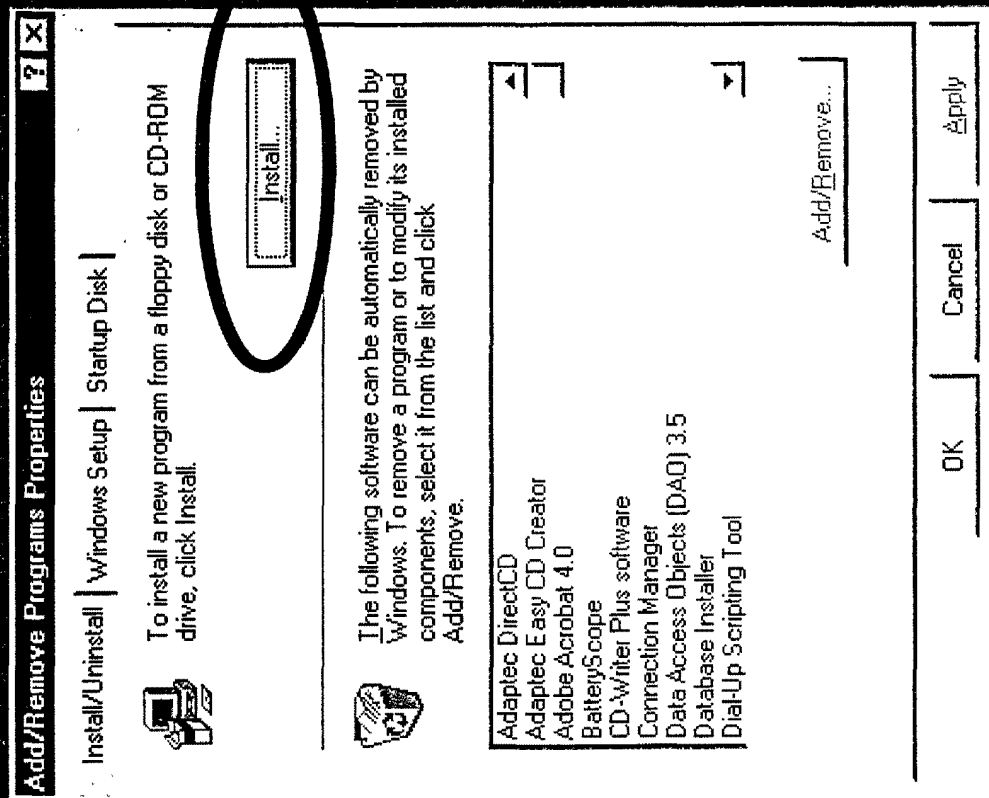
Prototype Installation



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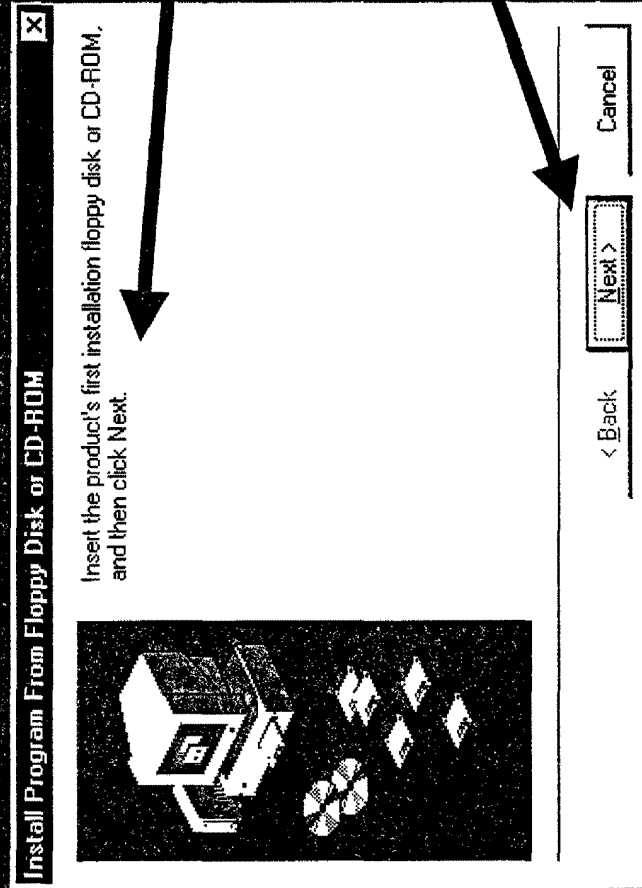
Prototype Installation



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Prototype Installation



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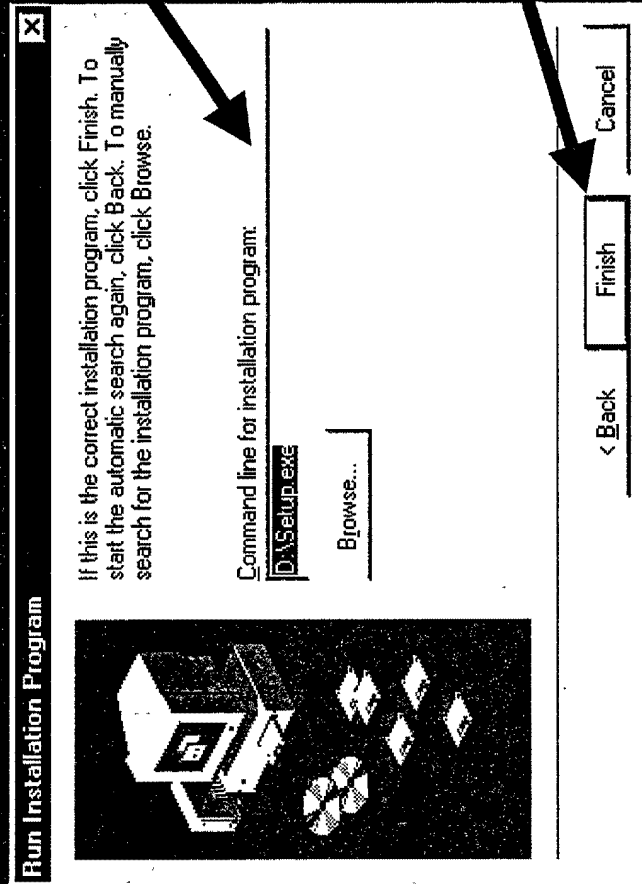
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Prototype Installation

Windows should
find the
AccuSafe install
program
automatically...

...then, click
Finish

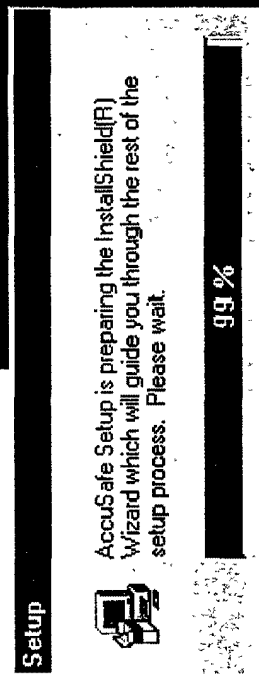
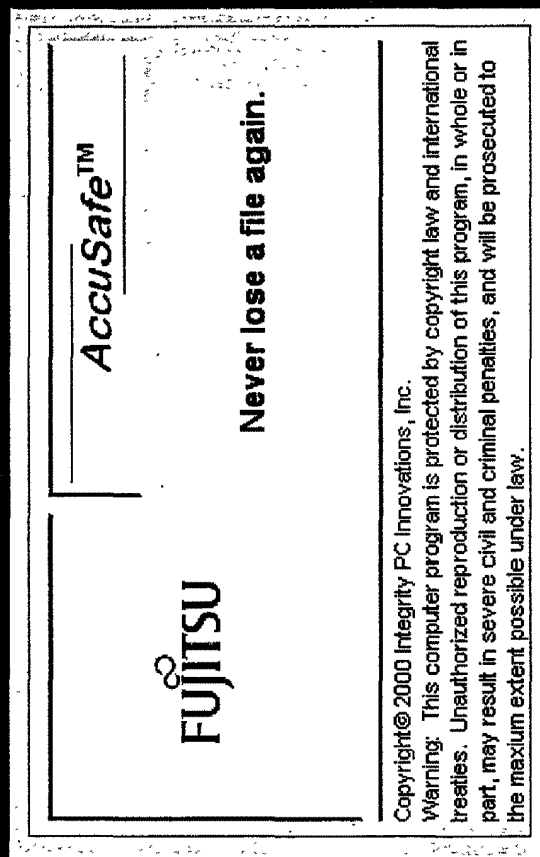


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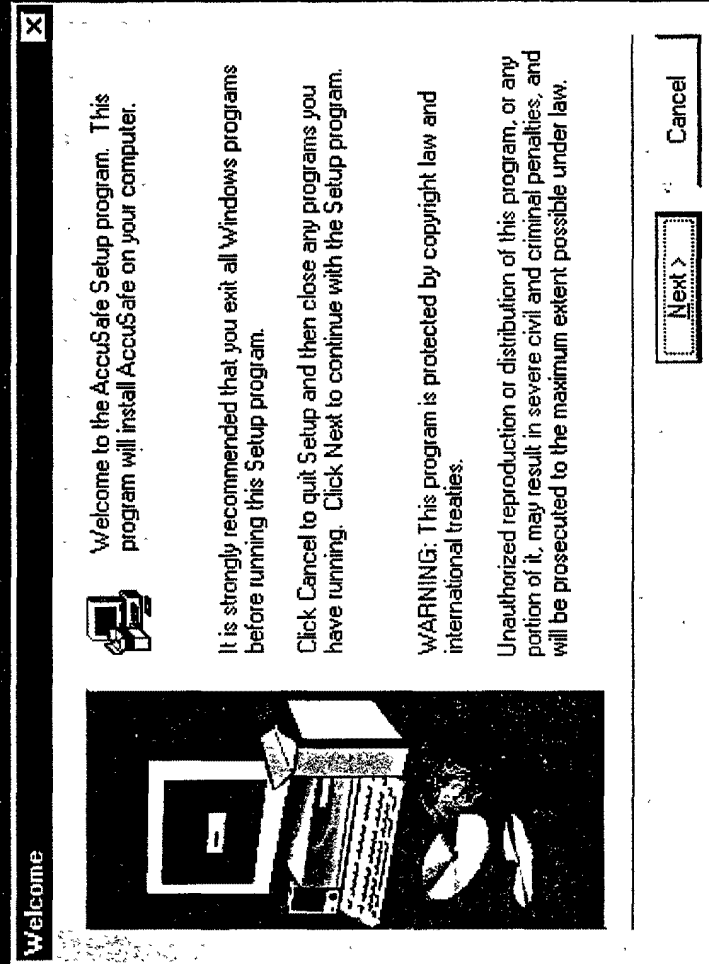
Prototype Installation



Prototype Installation

AccuSafe Setup

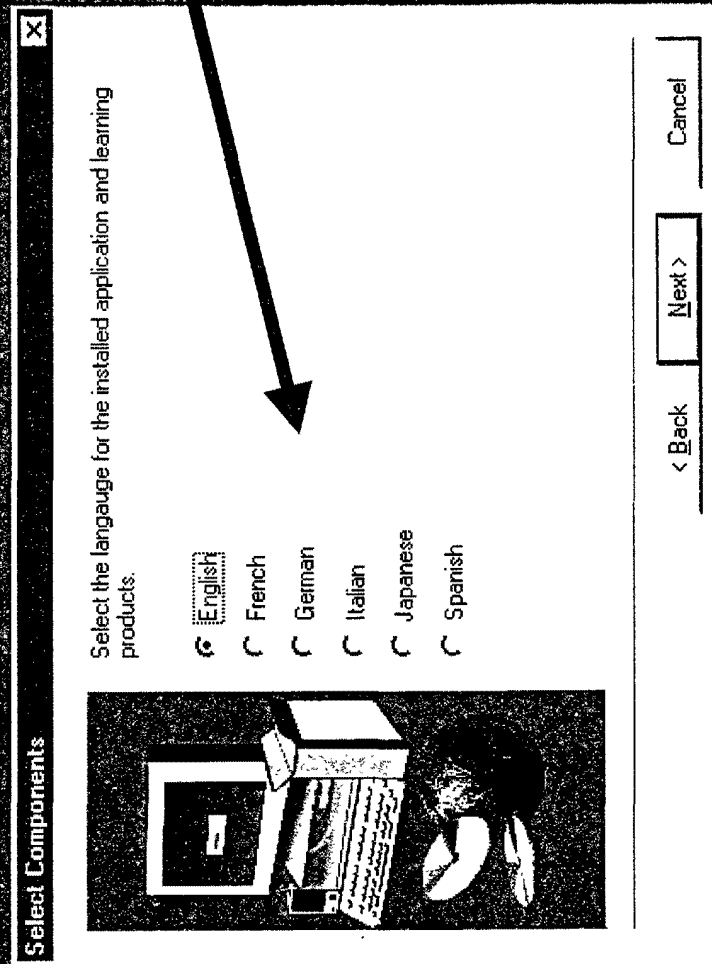
Fujitsu AccuSafe™
Prototype Version A.01.200



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Prototype Installation



Set of supported
localizations is
being finalized.

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Prototype Installation

Software License Agreement

 Please read the following License Agreement. Press the PAGE DOWN key to see the rest of the agreement.

English version

Prototype AccuSafe software license.

This is a preliminary license agreement.

This software may be installed and evaluated on the computers of current business partners, and business partner candidates of Integrity PC Innovations, Inc. (IPCI). Such business partnership, or candidate business partnership is demonstrated ONLY by the existence of a non-expired written non-disclosure agreement (NDA) in the corporate files of IPCI at 1220 Lake Plaza Drive, Colorado Springs, CO, 80906.

This software is fully and completely owned by IPCI, and no license for use other than

Do you accept all the terms of the preceding License Agreement? If you choose No, Setup will close. To install AccuSafe, you must accept this agreement.

< Back ☐ Yes ☐ No

This is a license agreement for the prototype, and in the final product, this will appear in the language chosen in the previous wizard step. As well, the entire install program may appear in the language of the user's choice.

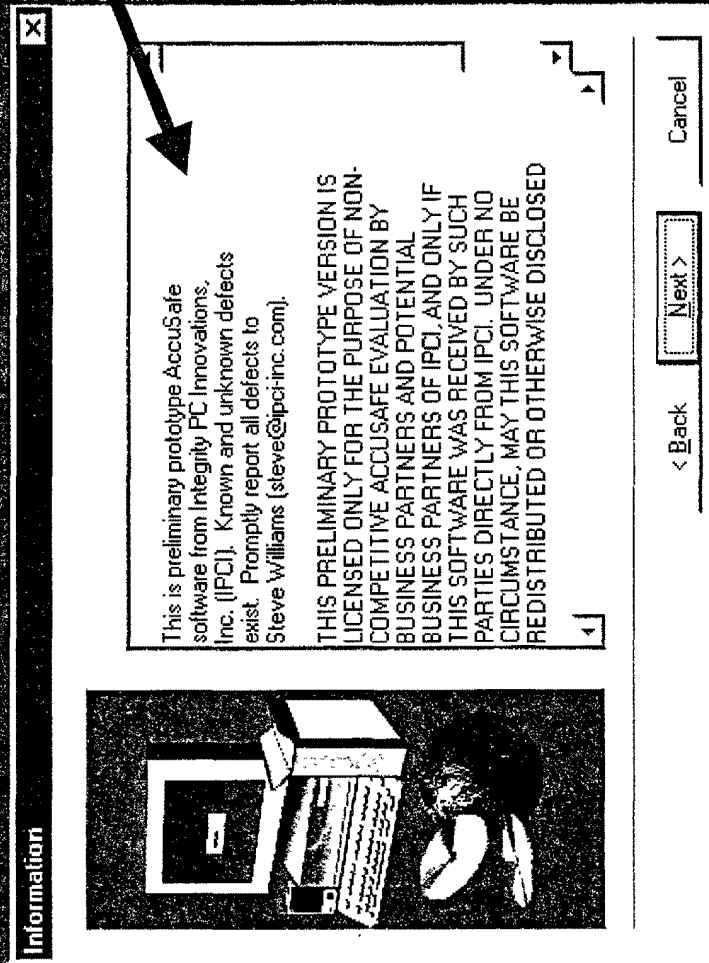
Product will
not install

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Prototype Installation



Information relevant to the current prototype is displayed. In the final product, this may be a localized display of the ReadMe file or other information

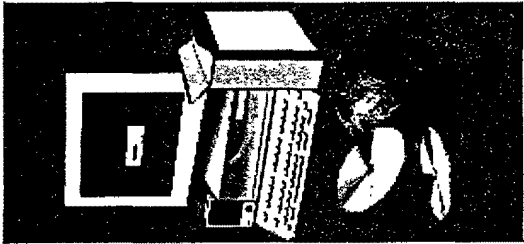
7/27/00

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Prototype Installation

User Information



Please enter your name and the name of the company for whom you work.

Name:

John Doe

Company:

ABC Corporation

< Back

Next >

Cancel

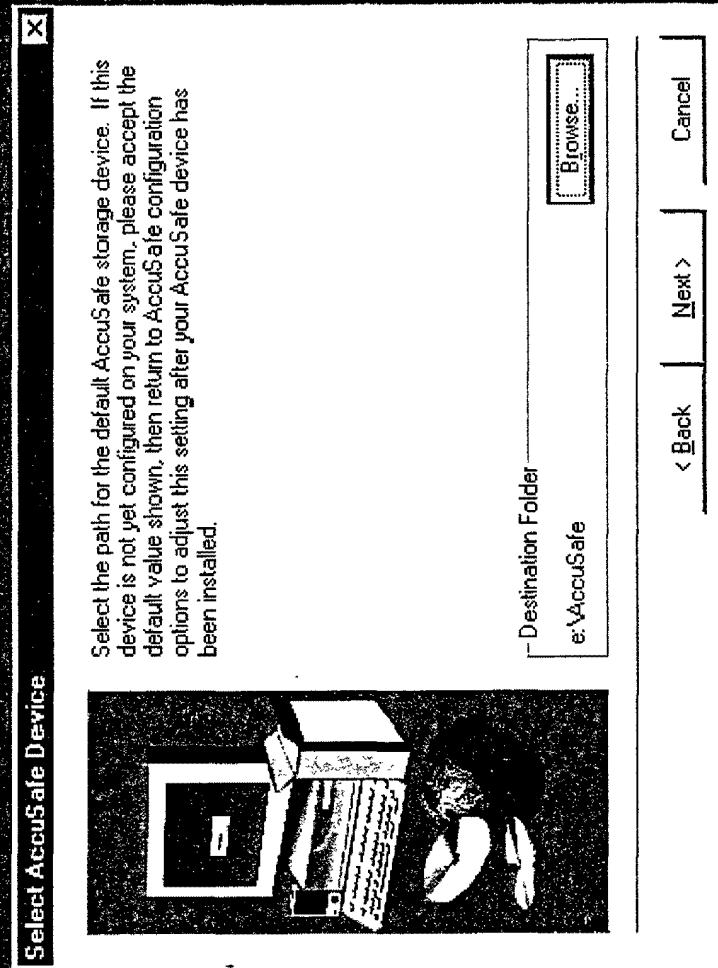
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Prototype Installation

This should point to a directory named “AccuSafe” at the root level of the media and device you wish to use as AccuSafe data storage. The prototype install program may or may not find a connected AccuSafe device automatically, but this is a planned feature.



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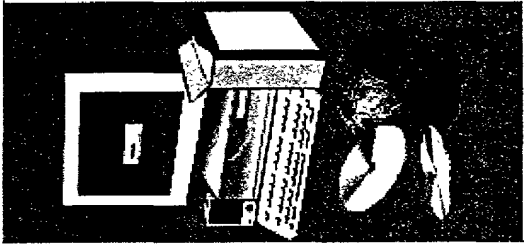
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Prototype Installation

This information lets AccuSafe keep the files from one computer segregated from the files from another computer, since especially with large AccuSafe media, multiple computers may be attached to one AccuSafe storage device.

Computer Name



Please enter the name of your computer. If you are attached to a network, this should be the same name as is used to identify your computer on your network.

notebook1

< Back

Next >

Cancel

7/27/00

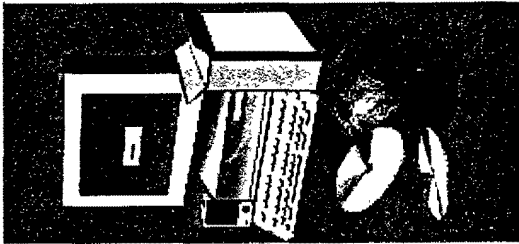
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Prototype Installation

This information lets AccuSafe keep the files from one user segregated from the files from another user, since especially with large AccuSafe media, multiple users may share a single AccuSafe storage device.

User Name



Please enter your user ID. If you are attached to a network, this should be the same user ID as is used to identify you on your network.

insmith

< Back

Next >

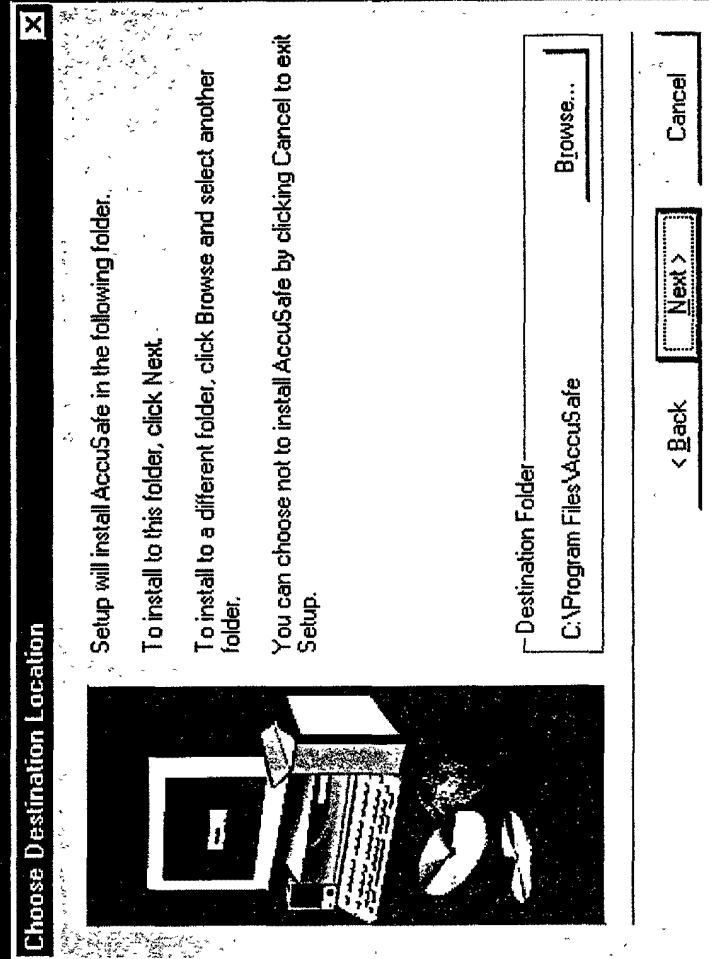
Cancel

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Prototype Installation

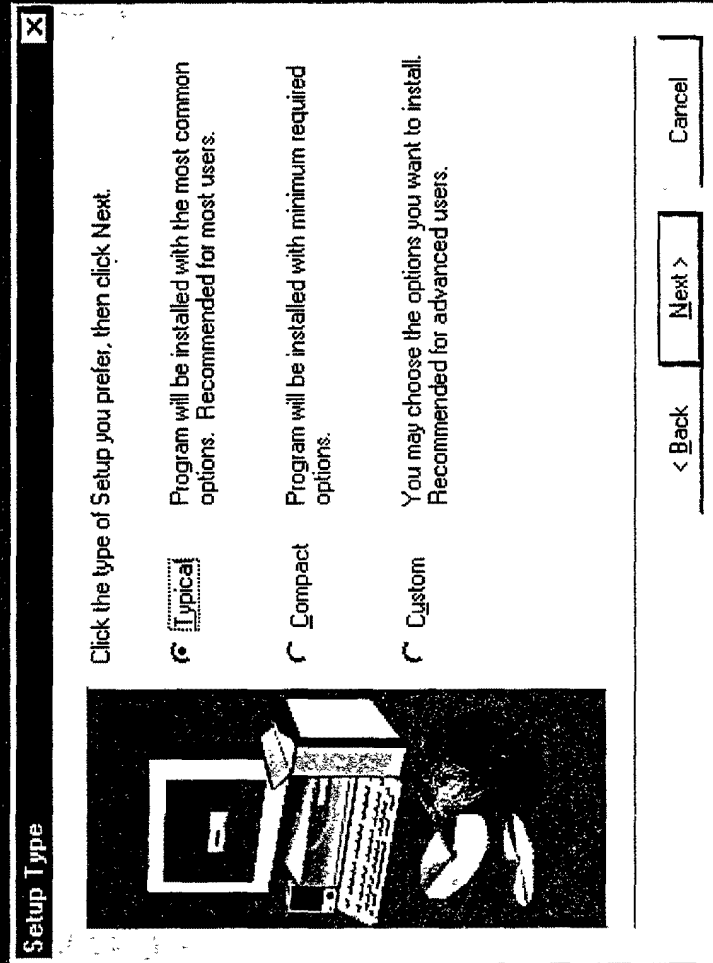


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Prototype Installation

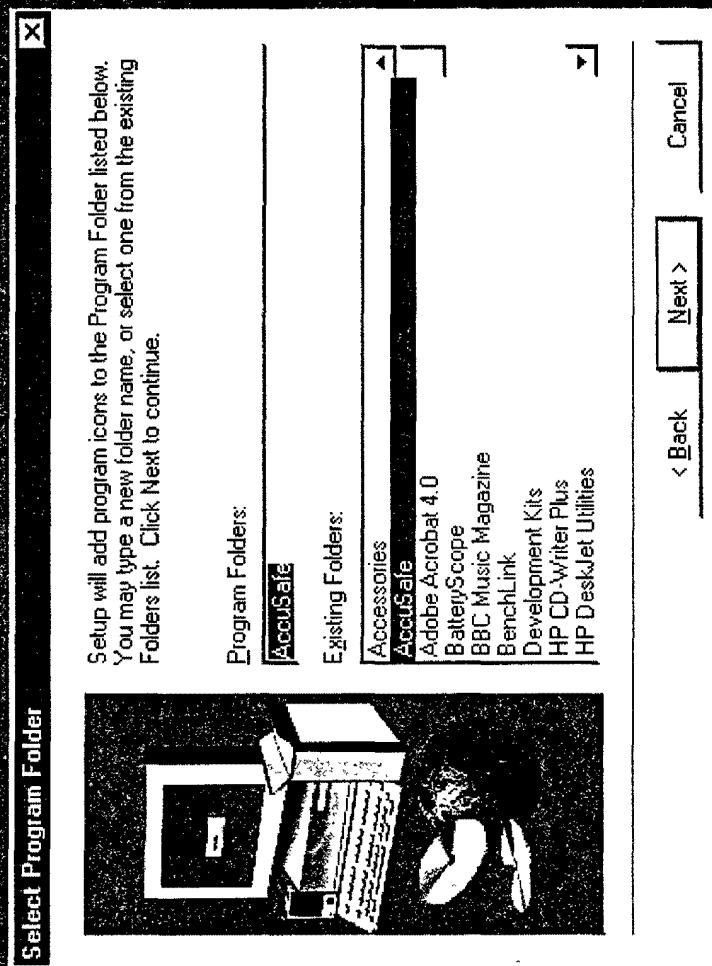


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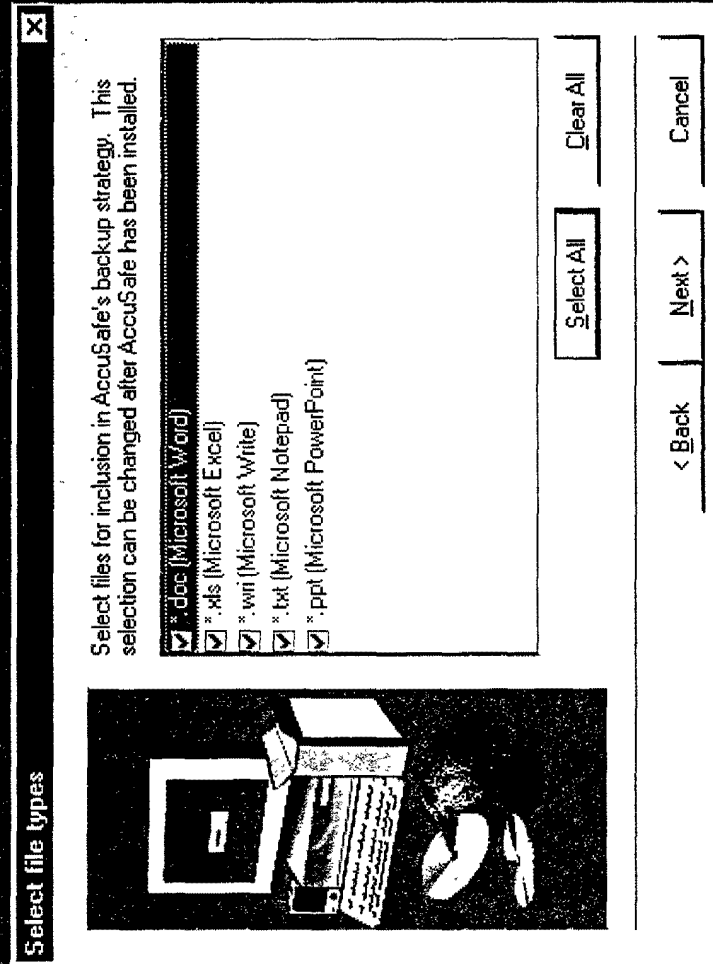
Prototype Installation



Prototype Installation

This is an artifact of the prototype software. The final software will not include such a dialog, but will allow fully hierarchical inclusion and exclusion by:

- File name
- Extension
- Base name
- Directory

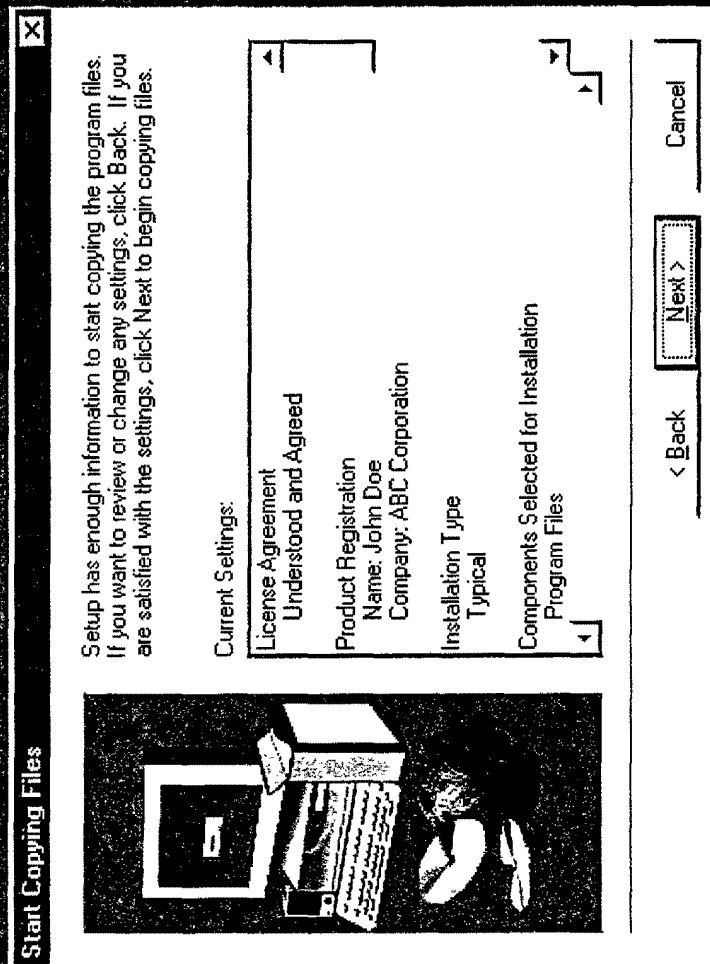


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Prototype Installation

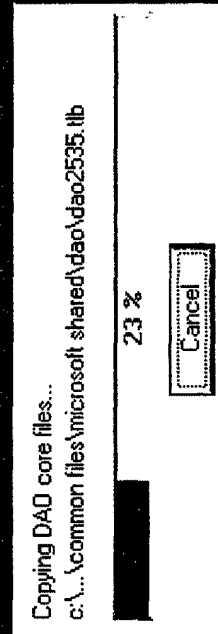
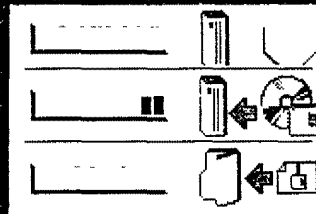


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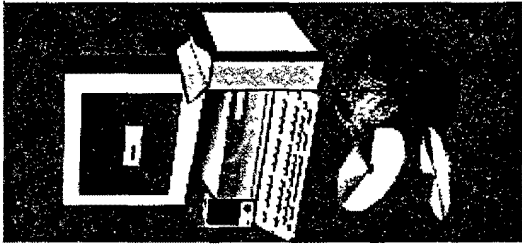
Prototype Installation

Installation progress indications...



Prototype Installation

Setup Complete



Setup has finished copying file and configuring your computer.
Before you can use AccuSafe, you must restart your computer.

☒ Yes, I want to restart my computer now
☐ No, I will restart my computer later.

Remove any removable disks from their drives, then click finish to complete AccuSafe setup.

[< Back](#) [Finish](#)

The computer must be restarted at the end of the installation. This causes AccuSafe's drivers to load and lets AccuSafe start during system bootstrap.

Prototype Installation

Version 1 missing features

- AccuSafe installation will be combined with hardware installation for maximum ease-of-use.
- Option to view the ReadMe file at the end of install
- Option to start a full system backup (in the background) after the system reboots at the end of install
- Options to allow power-users to configure AccuSafe at the end of install. Normal users would not need to perform any configuration.
- Internal install processing to examine OS and application mix, so that "recommended" include/exclude and backup-type information can be preset during install
- Etc.

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System Boot-up

 **FUJITSU**

AccuSafe™

Never lose a file again.

AccuSafe Version 1.0.200

AccuSafe is on the job!

Copyright© 2000 Fujitsu and Integrity PC Innovations, Inc.

Warning: This computer program is protected by copyright law and international treaties. Unauthorized reproduction or distribution of this program, in whole or in part, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under law.

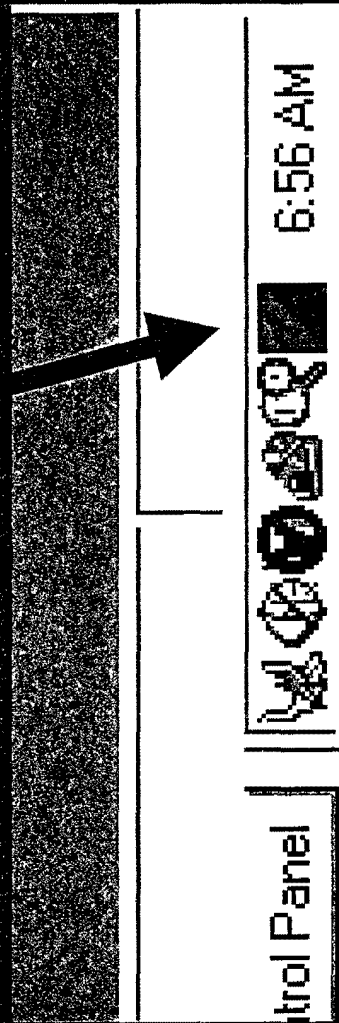
7/27/00

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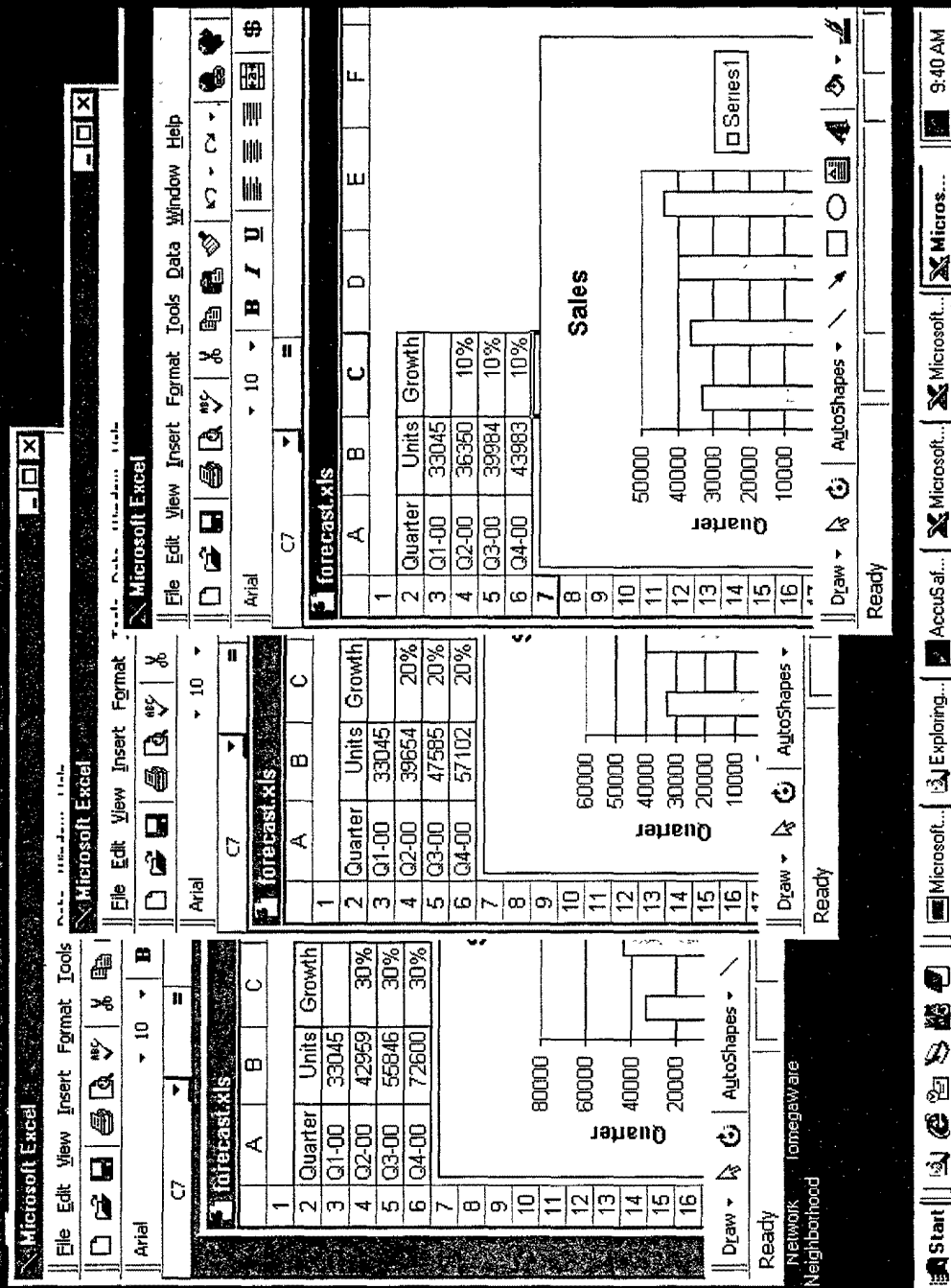
After AccuSafe Starts

System tray animated activity indicator...



...can be right-clicked for additional control options (described later)

Example use-case scenario

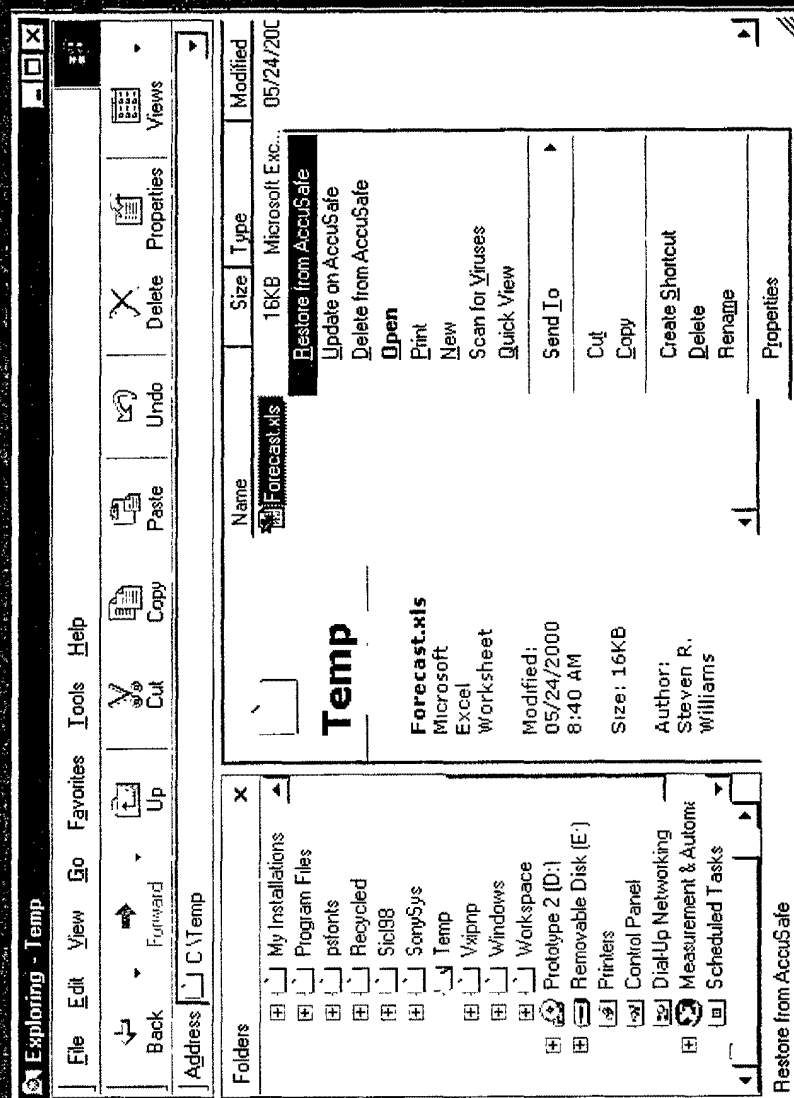


User develops 3 versions of a spreadsheet, accidentally overwriting the previous versions with the later versions...

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Example use-case scenario



The user realizes that he's overwritten his file. Via explorer (or any other file selection dialog), the user can right-click on the file he's been working with, then select AccuSafe's restore function to retrieve the lost versions.

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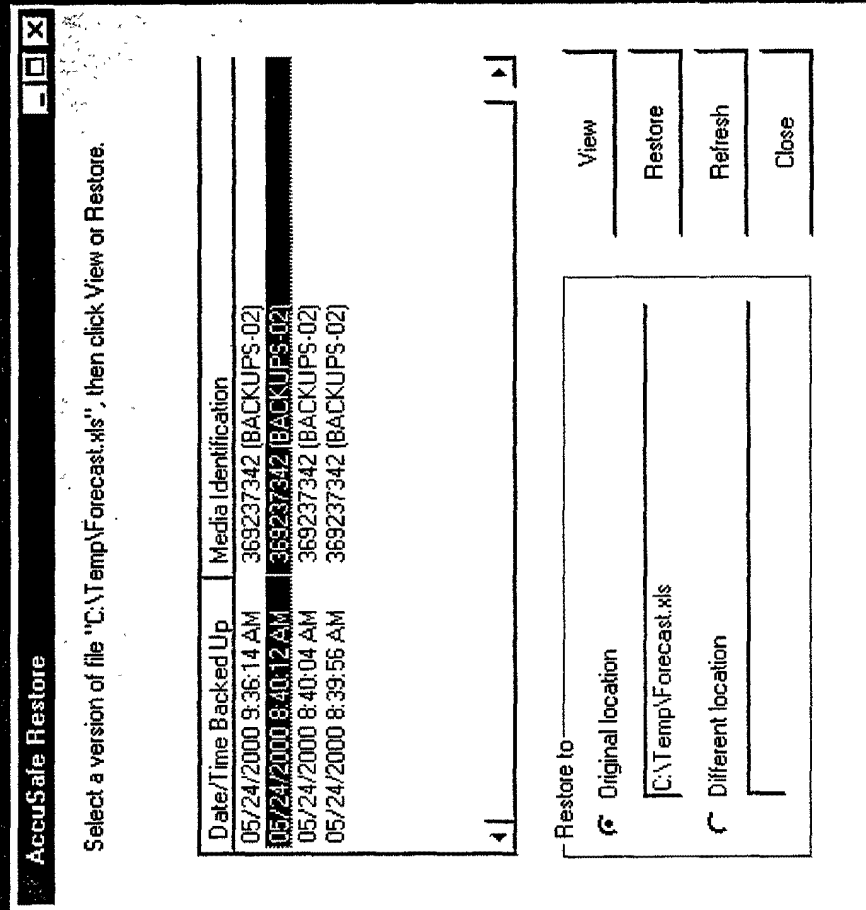
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Example use-case scenario

AccuSafe displays the list of revisions it has captured.

The user selects a version from this list, then clicks the View button to determine if this is the version he wishes to restore...

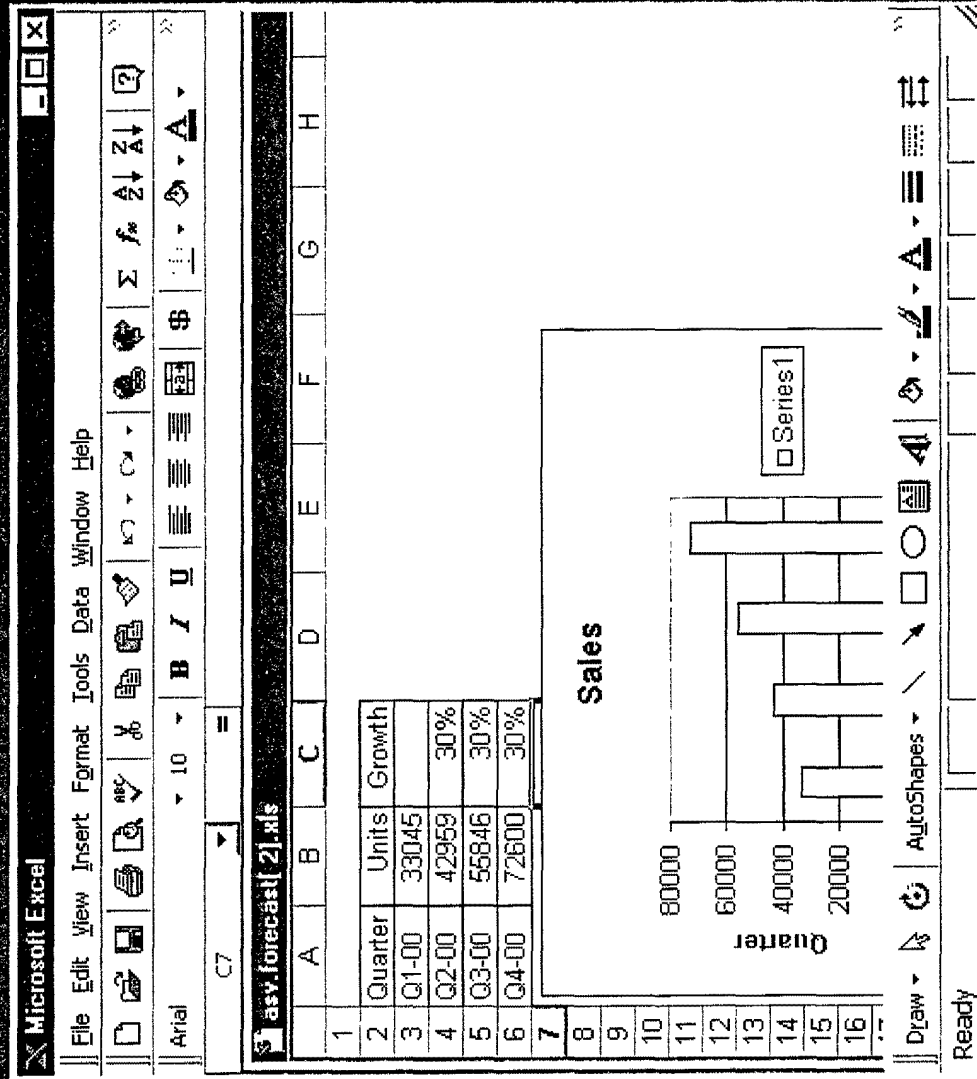


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Example use-case scenario



AccuSafe displays the revision selected, using the application that created the file.

If this isn't the version that the user wanted...

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Example use-case scenario

AccuSafe Restore

Select a version of file "C:\Temp\Forecast.xls", then click View or Restore.

Date/Time Backed Up	Media Identification
05/24/2000 9:36:14 AM	369237342 (BACKUPS-02)
05/24/2000 8:40:12 AM	369237342 (BACKUPS-02)
05/24/2000 8:40:04 AM	369237342 (BACKUPS-02)
05/24/2000 8:39:56 AM	369237342 (BACKUPS-02)

Restore to

☒ Original location

C:\Temp\Forecast.xls

☐ Different location

View

Restore

Refresh

Close

The user selects
another revision
to view...

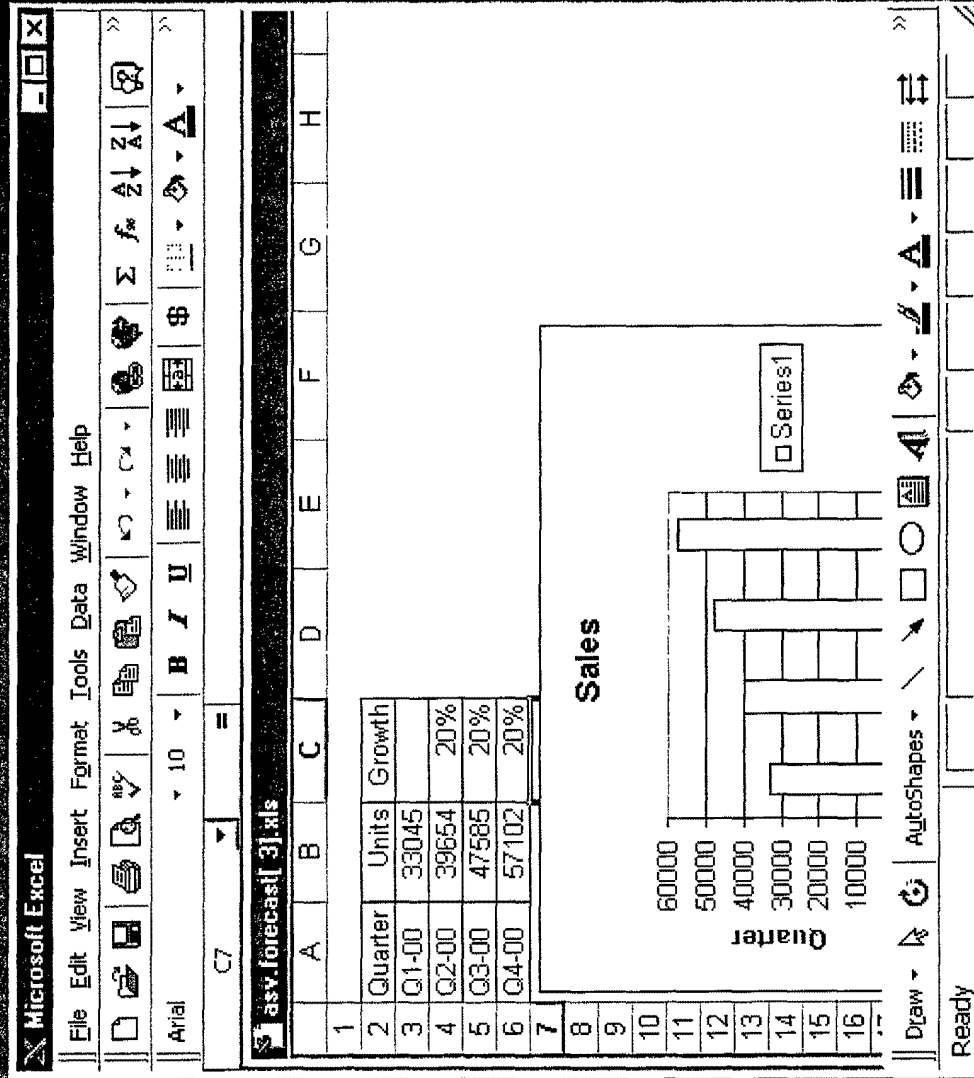
Note: Most backup
applications don't
have such a preview
capability, which
significantly enhances
ease-of-use.

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Example use-case scenario



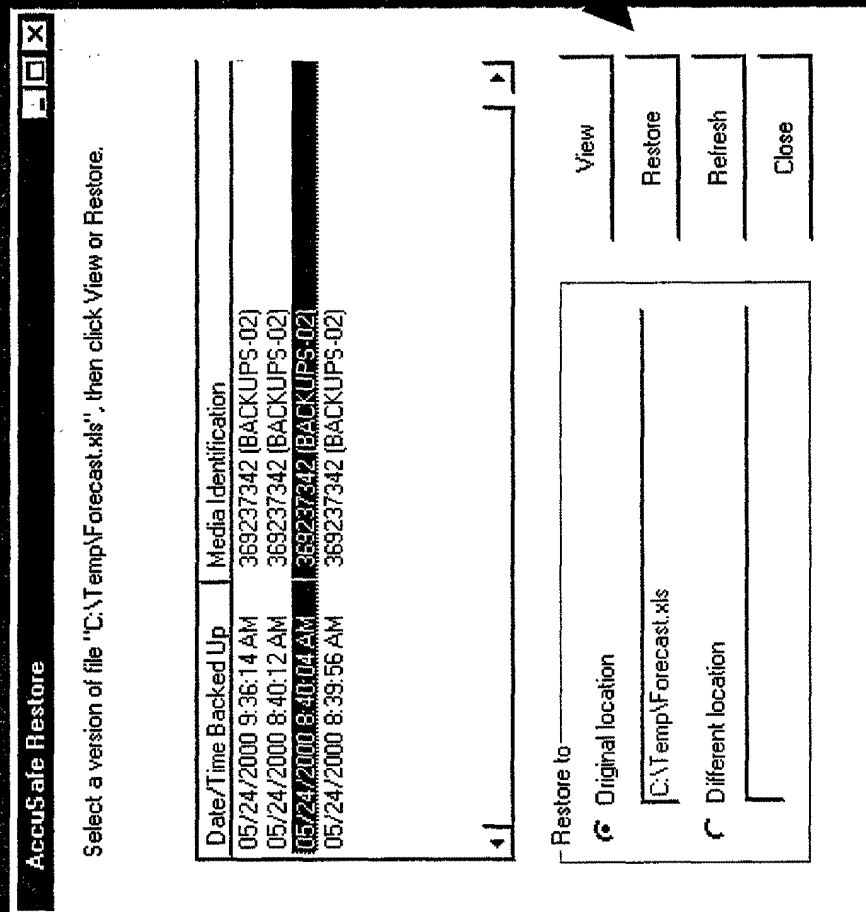
This is the version
he wanted to
restore, so....

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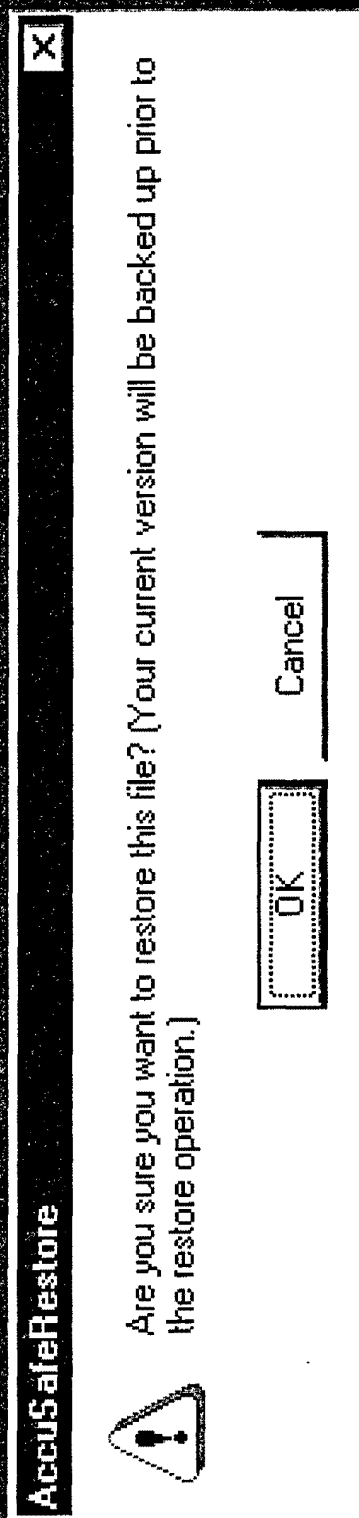
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Example use-case scenario



The user has verified this to be the proper revision to restore, so the user clicks Restore to retrieve his file.

Example use-case scenario



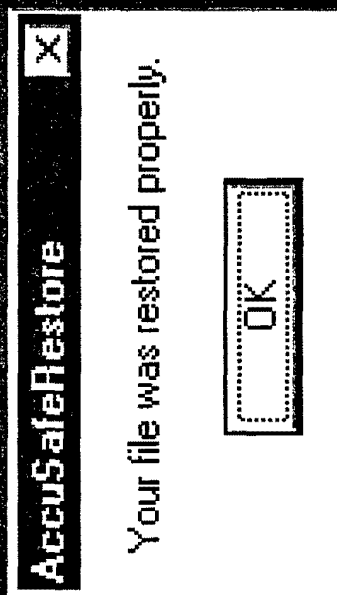
AccuSafe will save the existing file (if it needs to!) before overwriting it with the copy the user is about to restore.

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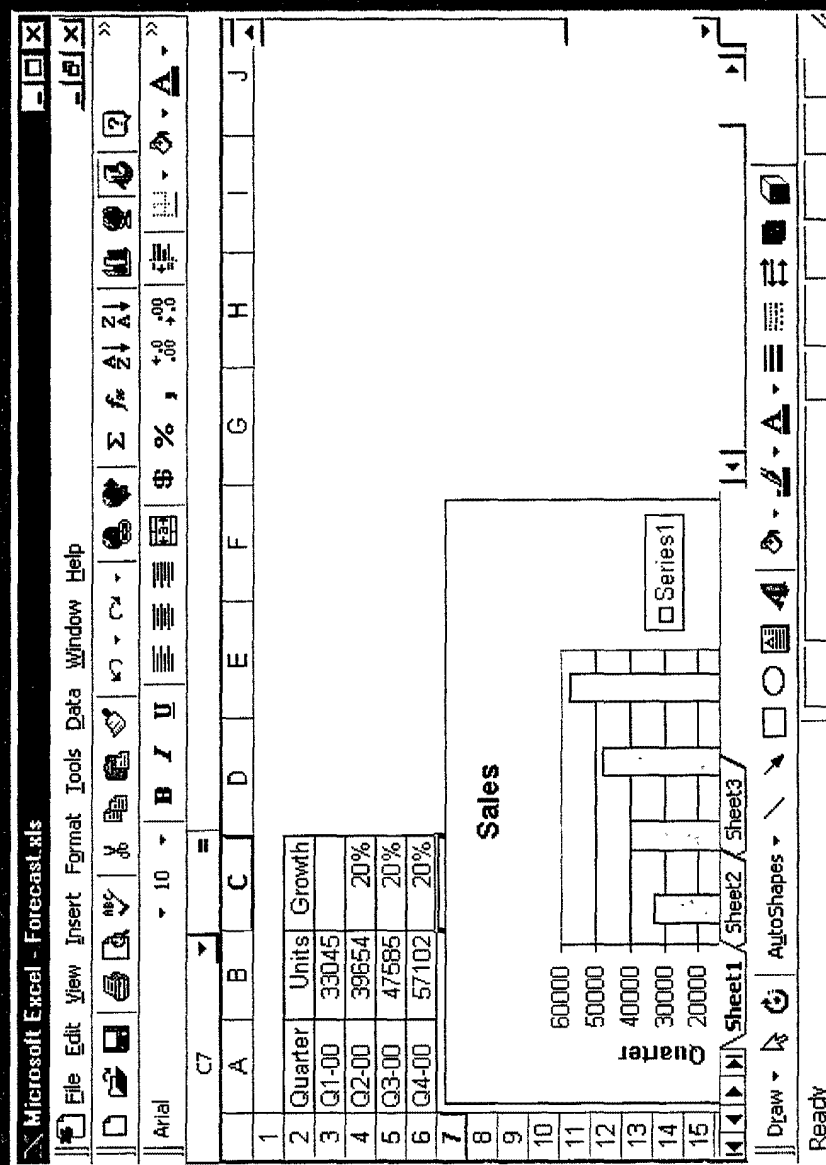
Example use-case scenario



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Example use-case scenario



The correct
revision
is restored...

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Example use-case scenario

Due to AccuSafe's IntelliQueuing technology, this entire scenario is available to the user whether or not he is actually connected to an AccuSafe storage device/media

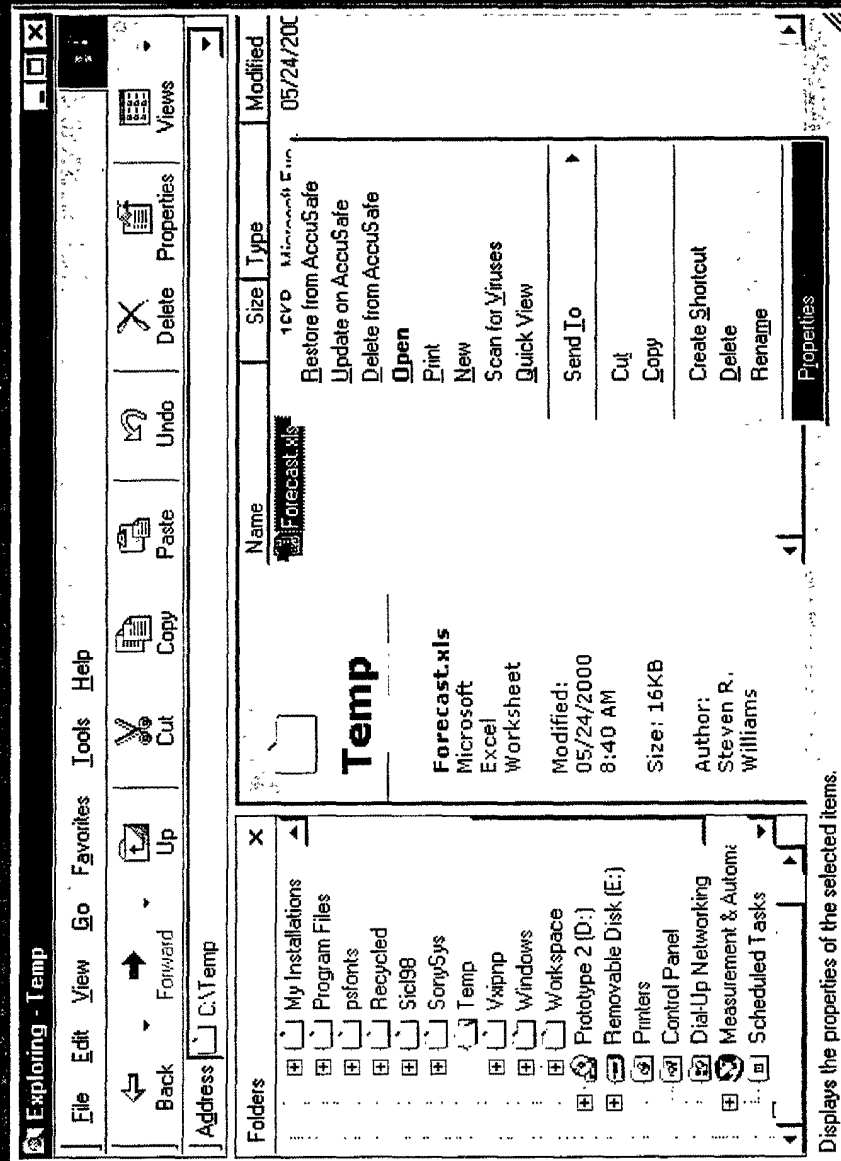
- He still wants and needs protection of his files while he's on an airplane, or otherwise away from his office.**

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Example use-case scenario



Displays the properties of the selected items.

AccuSafe operation can be controlled via a convenient user interface...

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Example use-case scenario

Forecast.xls Proper?

General | AccuSafe General | AccuSafe File-Specific |

Forecast.xls

Type:	Microsoft Excel Worksheet
Location:	C:\Temp
Size:	16.0KB (16,384 bytes), 16,384 bytes used

MS-DOS name:	FORECAST.XLS
Created:	Wednesday, May 24, 2000 10:02:06 AM
Modified:	Wednesday, May 24, 2000 10:03:10 AM
Accessed:	Wednesday, May 24, 2000

Attributes:	☐ Read-only	☐ Hidden
	☒ Archive	☐ System

OK Cancel Apply

AccuSafe augments the standard operating system dialogs and controls in many areas. AccuSafe is fused to the operating system the user is already familiar with, for maximum ease of use and functionality.

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Example use-case scenario

Extensive control options are available if the user wishes to use them...otherwise, AccuSafe makes all the decisions for the user.

- By base name, extension, directory, etc.

Revision stack depth

Include / exclude

Compression on/off and technique (not Ver. 1)

Encryption on/off, passwords and technique (not Ver. 1)

Target AccuSafe device and media ID

Backup Strategy

- Automatic, Interval or Scheduled

Etc.

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Example use-case scenario

Automatic fine tuning

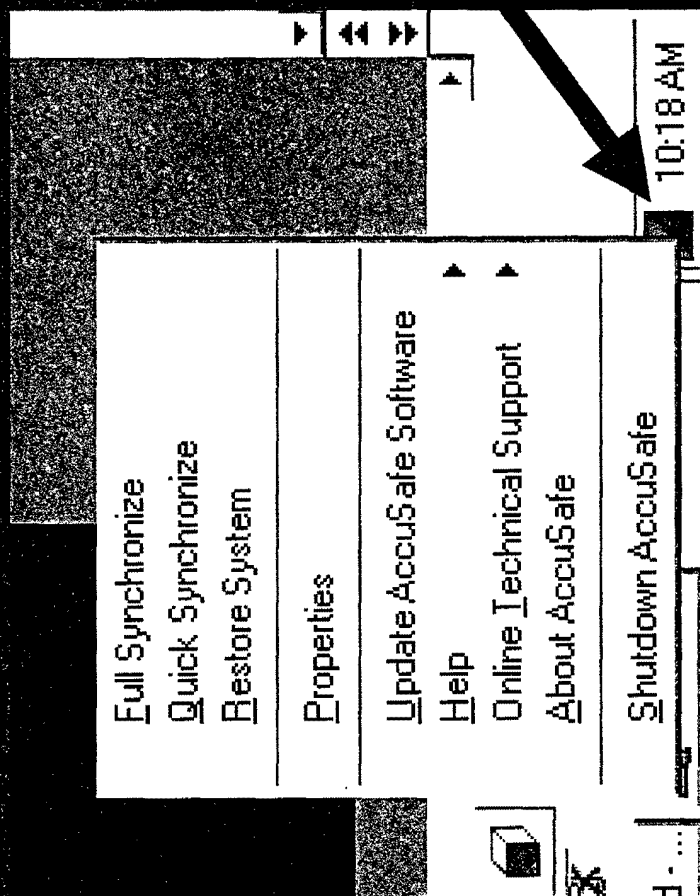
- AccuSafe monitors its own operation, as well as the operation of the computer to automatically fine-tune it's operation for maximum data integrity with minimal disk space use and minimal PC performance degradation.

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Example use-case scenario

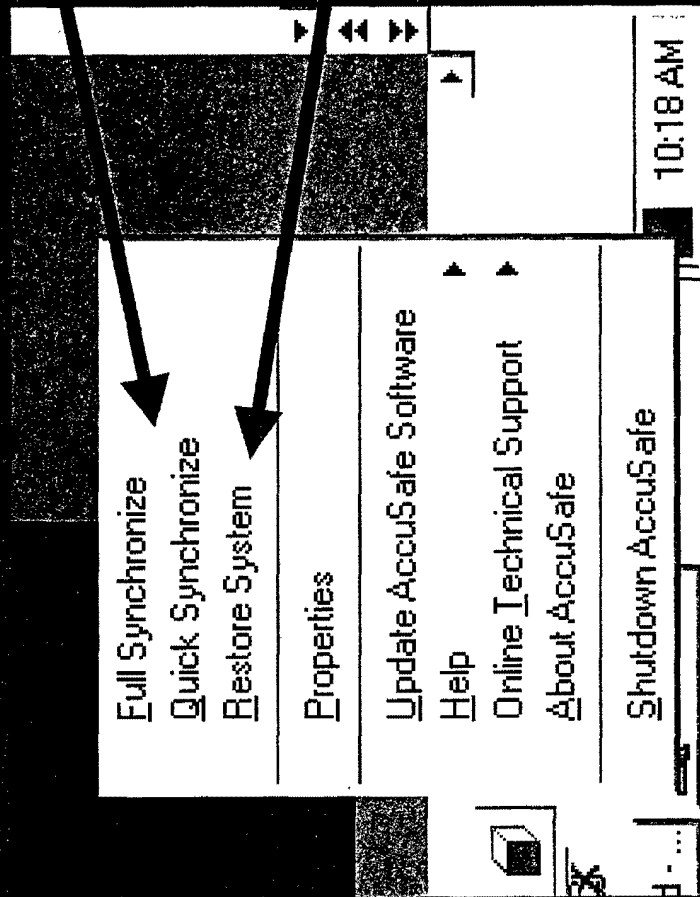


Additional capabilities
are available via a
right-click on the
AccuSafe system tray
icon...

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Example use-case scenario



Copy all files from the user's system, to the AccuSafe device.

Restore an entire system from AccuSafe to a blank hard drive (not in Version1)...

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Example use-case scenario

Users will be able to perform disaster recovery or clone disks using AccuSafe.

These features are planned as AccuSafe plug-ins after the initial introduction.

AccuSafe Restore System

Select a date and time to restore your files to. You will have an opportunity to review the changes that will be made if you elect to continue the restoration operation.

May 2000						
30	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	1	2	3
4	5	6	7	8	9	10

Today: 05/24/2000

10:00:00 PM

Prompting
☒ Enable prompting
☐ Disable prompting

Restore System Files Only
Restore All Files

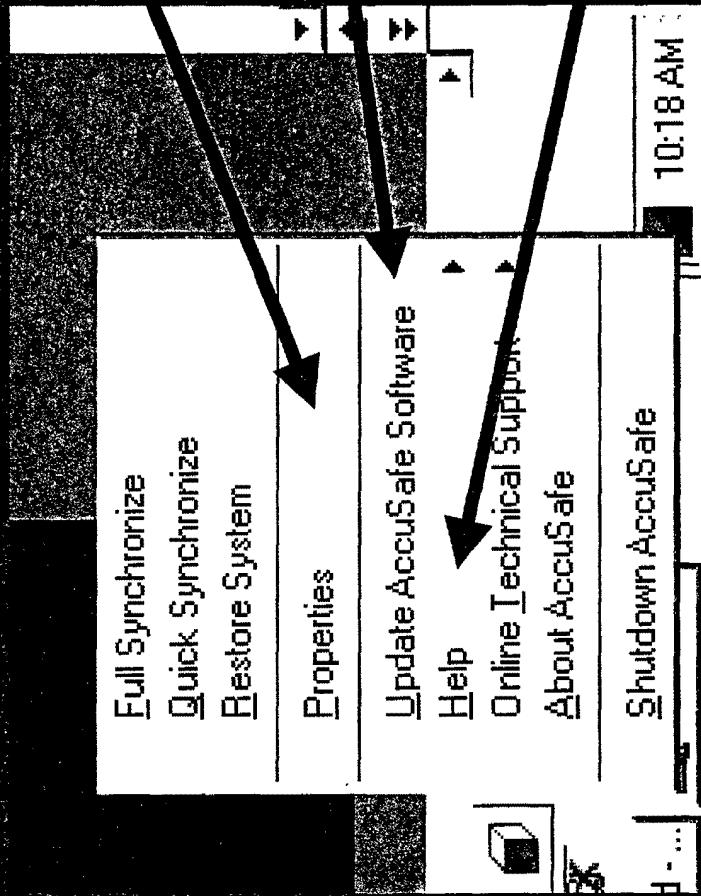
Help Close

7/27/00

45

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Example use-case scenario



General AccuSafe operational controls.

One-button software updates via the web.

Localized help and user interface.
Languages TBD.

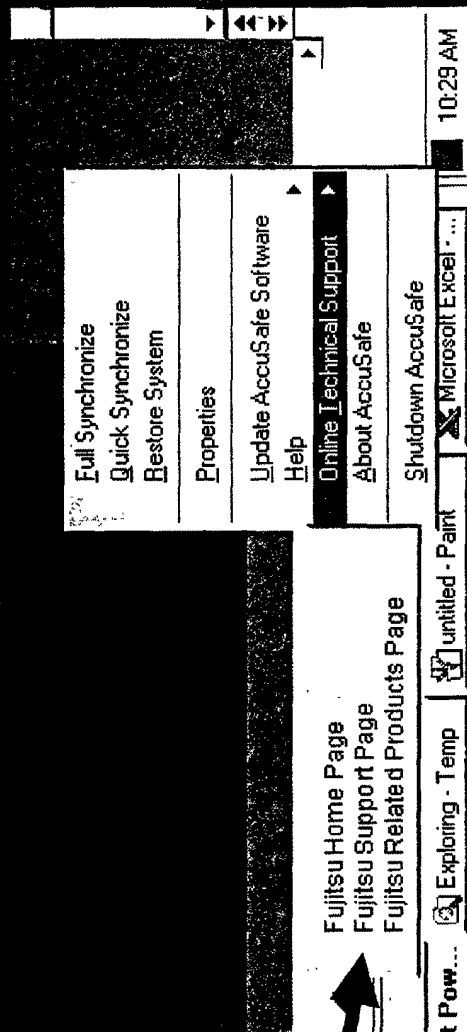
7/27/00

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Example use-case scenario

Fully web-connected
for support and cross-
selling purposes...



How AccuSafe Works

Delete Operation

time

A delete file operation is requested of the OS.

AccuSafe

Intervention:

- Hold the OS
- Copy the file to a buffer area **if** this version of the file isn't already under AccuSafe.
- Release the OS

The OS deletes the file.

7/27/00

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How AccuSafe Works

Rename Operation

time

A rename file operation is requested of the OS.

AccuSafe Intervention:

- Hold the OS
- Copy the "from" file to a buffer area if this version of the file isn't already under AccuSafe.
- Release the OS

The OS renames the file.

AccuSafe Intervention:

- Hold the OS
- Copy the "to" file to a buffer area if this version of the file isn't already under AccuSafe.
- Release the OS

7/27/00

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How AccuSafe Works

Application usage operation (open / close operation)



Application attempts to open a file

AccuSafe Intervention: *isn't help! v x d*

- Hold the OS and the application
- Copy the file to a buffer area **if** this version of the file isn't already under AccuSafe.
- Release the OS and the application

The OS & application opens and reads the file

The user and / or application make changes to the file

The OS & application closes and writes the file

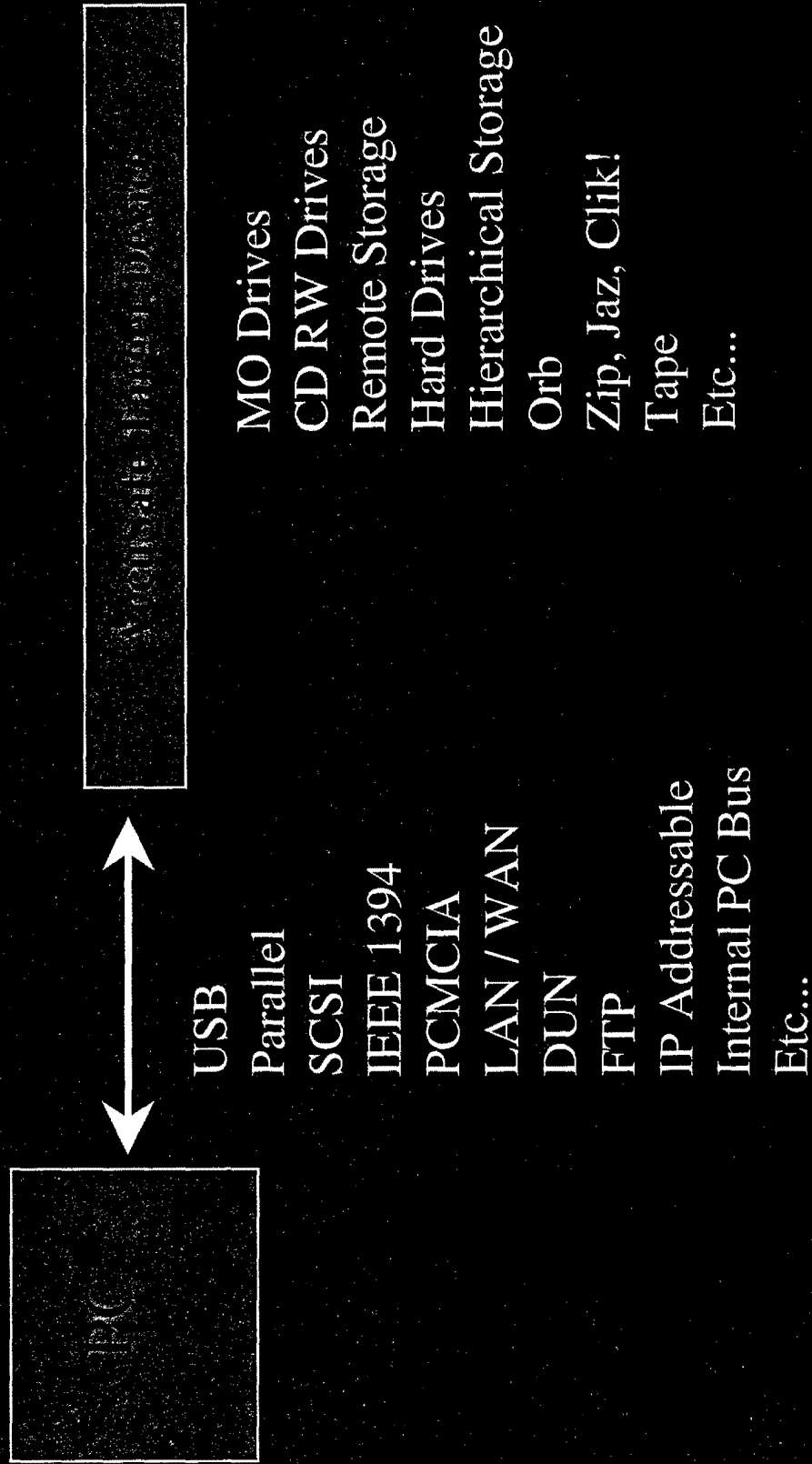
AccuSafe Intervention: *isn't help! v x d*

- Hold the OS and the application
- Copy the file to a buffer area **if** this version of the file isn't already under AccuSafe.
- Release the OS and the application

7/27/00

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Block Diagram

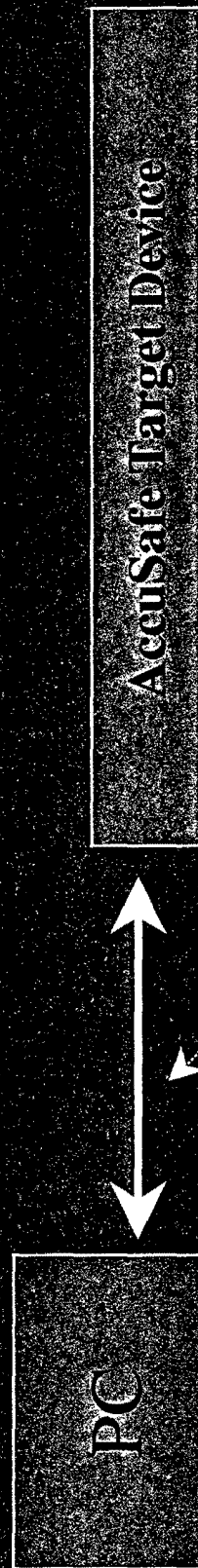


7/27/00

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Block Diagram



IntelliQueue managed connection:

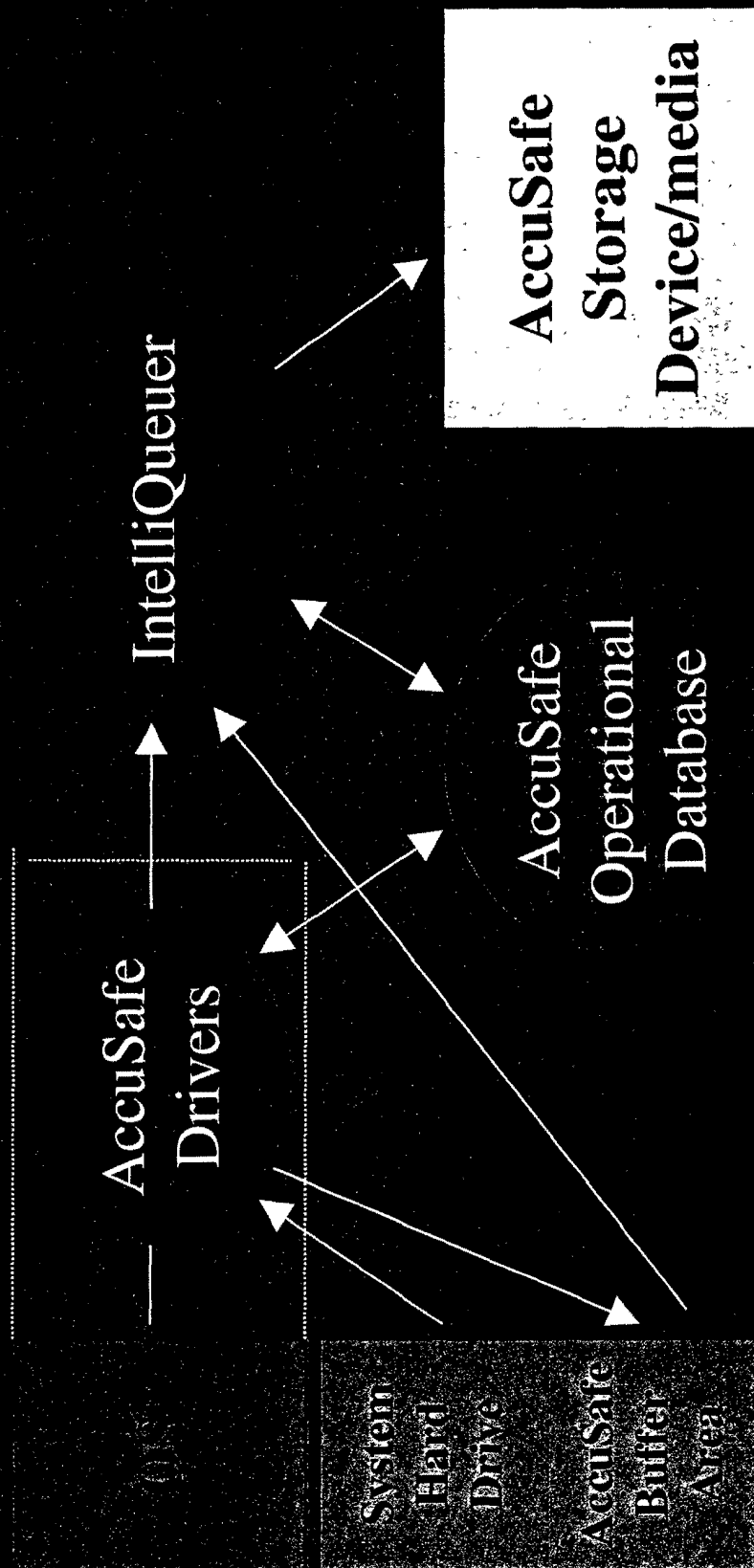
- Can be disconnected / reconnected at will
(users leaving their office connections
to AccuSafe devices for temporary travel)
- Connection bandwidth management
- Open file conflict resolution
- Spooling to / from AccuSafe Target Device.
- Etc.

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Software Block Diagram

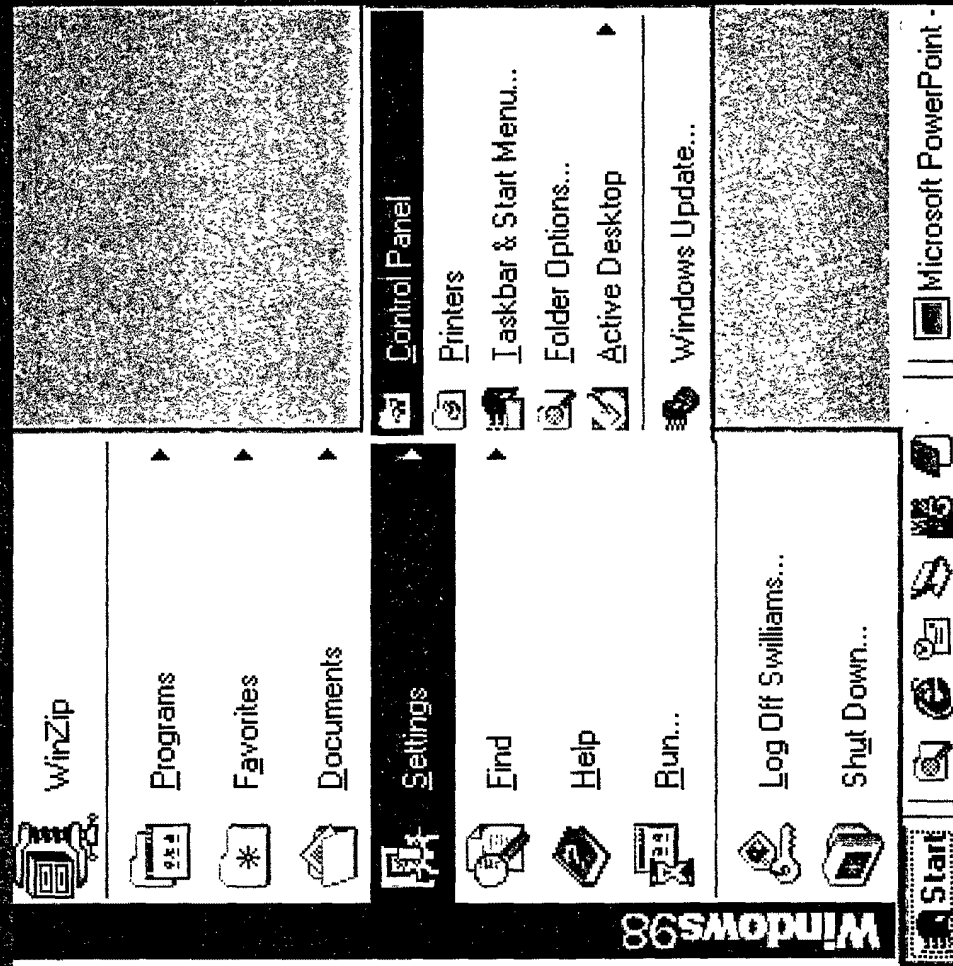


7/27/00

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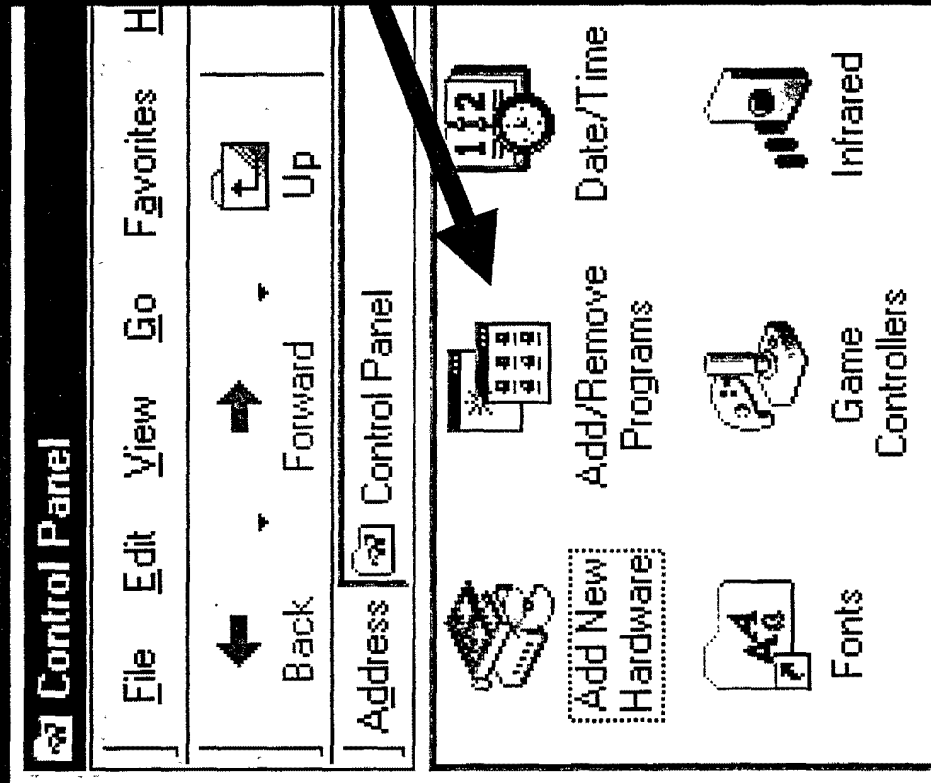
Prototype Un-installation



7/27/00

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Prototype Un-installation



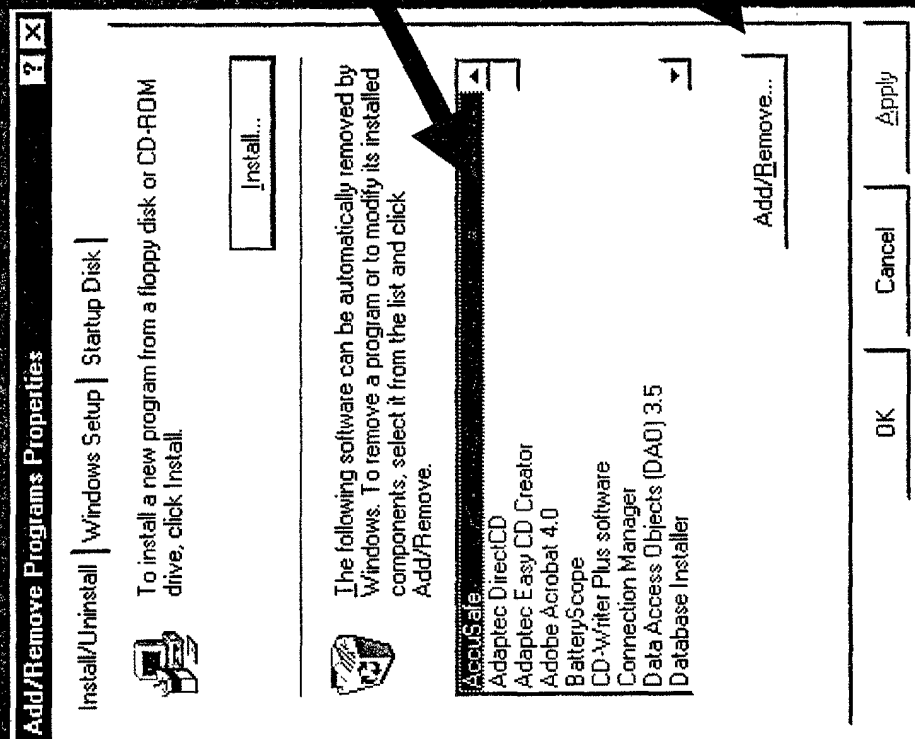
Double-click

7/27/00

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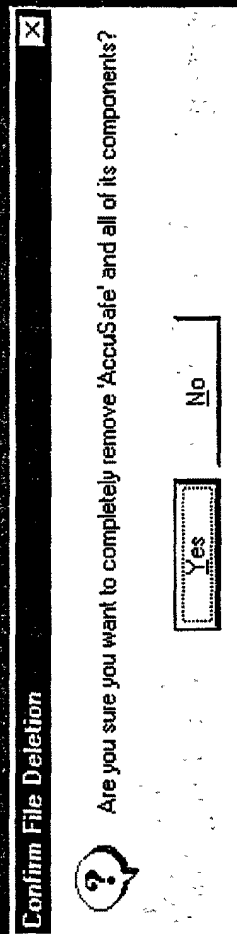
Prototype Un-installation



7/27/00

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Prototype Un-installation

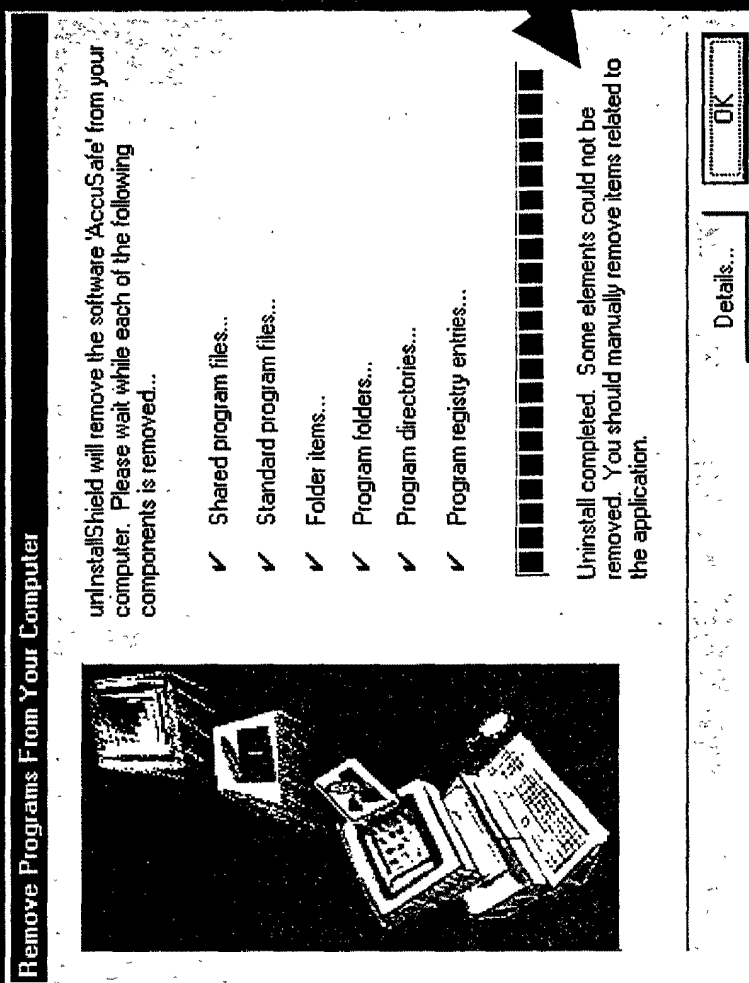


7/27/00

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Prototype Un-installation



Of course, backed up
files and other
related information
are never removed
by this process.

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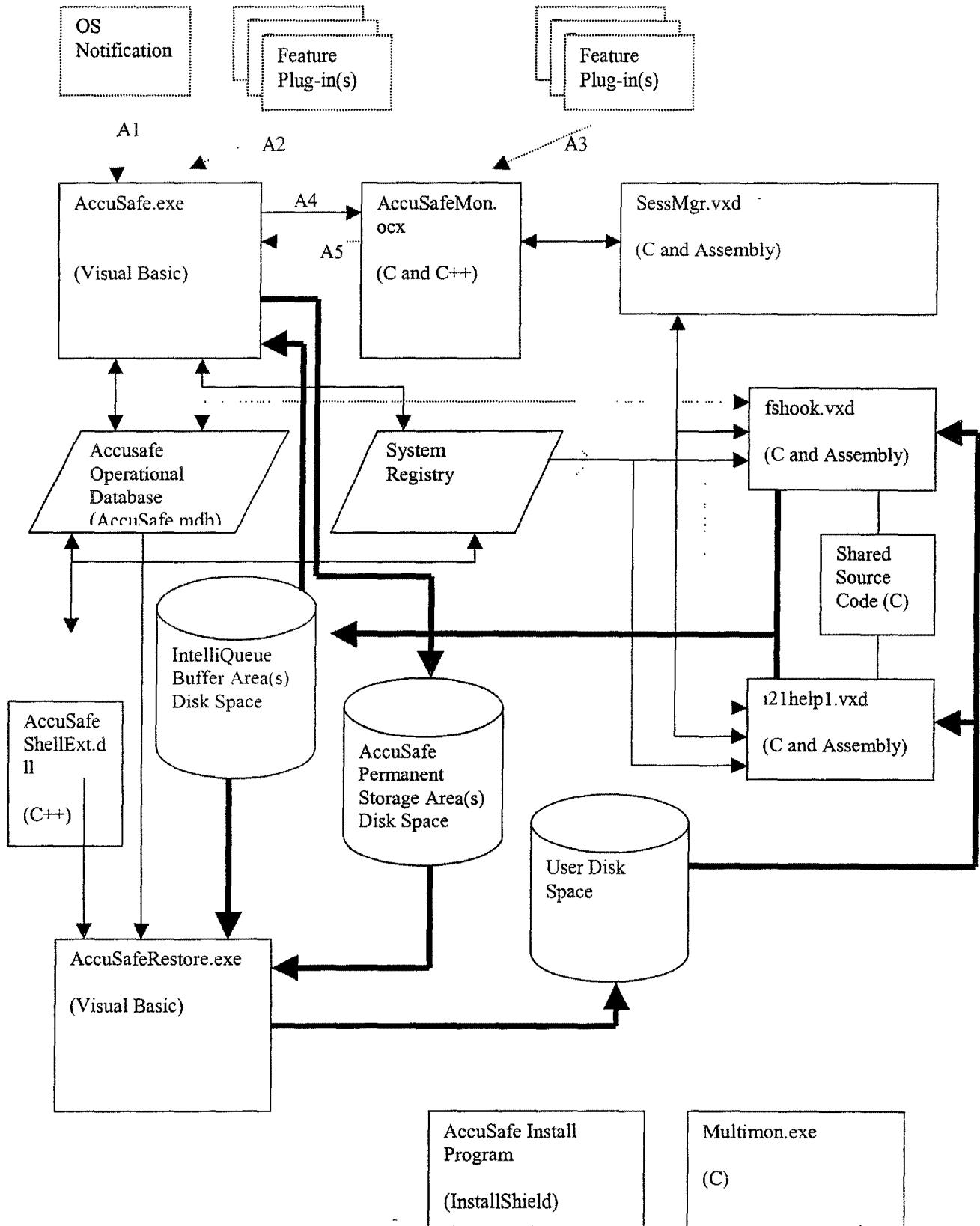
58

What is claimed is:

1. An automatic, real-time file management method comprising the steps of:
detecting when an operating system is about to perform an operation on a file;
suspending the operating system from performing the operation on the file; and
determining and executing a predetermined function on the file based upon the operation
to be performed on the file by the operating system and predefined management parameters.
2. An automatic, real-time file management method comprising the steps of:
detecting when an operating system is about to perform an operation on a file;
suspending the operating system from performing the operation on the file;
determining and executing a predetermined function on the file based upon the operation
to be performed on the file by the operating system and predefined management parameters; and
releasing the operating system to continue normal operations on the file.
3. An automatic, real-time file back-up method comprising the steps of:
detecting when an operating system is about to perform an operation on a file;
suspending the operating system from performing the operation on the file; and
determining and executing a predetermined function on the file based upon the operation
to be performed on the file by the operating system and predefined back-up parameters.
4. An automatic, real-time file back-up method comprising the steps of:
detecting when an operating system is about to perform an operation on a file;
suspending the operating system from performing the operation on the file;
determining and executing a predetermined function on the file based upon the operation
to be performed on the file by the operating system and predefined back-up parameters; and
releasing the operating system to continue normal operations on the file.

AccuSafe General Architecture.

Notes: This is the current architecture, and is not intended to be the final product architecture necessarily. Planned future capabilities are shown in dashed lines.



Preface

This document provides a detailed technical description of the current AccuSafe prototype. Further clarification and discussion is available from Steve Williams.

Note that the sections marked "To be done" are general descriptions of the main efforts that need to be applied to these tasks. Additional "TODO" indications within the related source code exist, and should be considered part of the necessary effort. Testing and debugging is also required at all levels of the software, and should also be considered part of the overall effort.

The initial version of AccuSafe should be derived to the extent possible from the architecture and the foundation represented by the current prototype source code. Areas which must diverge from the prototype are described in the following. Additional divergence may be necessary as well.

The current AccuSafe prototype, and therefore this document, relates only to a version of AccuSafe that is believed compatible with the Windows 95 and Windows 98 operating systems. Additional effort must be expended to validate this design, and re-architect parts of it, for Windows 2000, Windows NT, Windows ME and MAC OS 9.

The prototype code has been quickly pulled together in order to prove the feasibility of our technical ideas, and to create a mechanism where the software can be demonstrated / operated in a very controlled fashion. Code implementation and design is incomplete, is defect ridden, and in no way represents the necessary attention-to-detail, correctness or fit-and-finish required in the final product. Error checking and response mechanisms are largely missing or are only cursorily implemented, inappropriate hardcode exists, algorithms were included to facilitate development speed rather than final correctness, etc. Please overlook the hacks that are obvious here.

Large segments of code found in **AccuSafeMon.ocx**, as well as the bulk of **sessmgr.vxd**, **fshook.vxd** and **i21help1.vxd** are from the O'Reilly & Associates book entitled *Inside the Windows 95 File System*. We have obtained O'Reilly permission to use their code without royalty or other infringement in our product. Further discussion and documentation of the O'Reilly code can be found in the above-mentioned text. Most AccuSafe modifications to the original O'Reilly code are noted via "srw" or "AccuSafe" indications in comment fields.

Bold type is used to refer to other functional blocks or numbered block interconnections.

This document, all ideas it embodies and all prototype code is the exclusive property of Integrity PC Innovations, Inc. It cannot be used for any purpose other than that which is specified in written contract materials between IPCI and the developer. This material is confidential to IPCI.

Part 1 – Description of functional blocks

1.1 OS Notification

Summary

This block refers to a future capability to have part of the IntelliQueue process triggered by a file change notification from the operating system whenever a driver (fshook.vxd or i21help1.vxd) places a file in the **AccuSafe Buffer Area**.

To be done

Presently, **AccuSafe.exe** detects that new files have been placed in the **AccuSafe Buffer Area** as a result of an internal timer event (with an associated time interval registry entry) that initiates a process to examine the **AccuSafe Buffer Area** for new files. Most of this process doesn't need to change as a result of the implementation of the file change notification.

The file change notification mechanism itself will need to be added to the initialization of **AccuSafe.exe**, and since the notification is cancelled each time a notification occurs, the notification will need to be re-enabled after each occurrence. Note too that since we can miss notifications while prior notifications are being processed (this is ok, since this isn't in the real-time portion of the **AccuSafe** kernel), it will be necessary to retain the timer mechanism currently in place, but the timer should be fired at a much decreased frequency.

Making this change would allow **AccuSafe** to be more quiescent during periods when no file changes were occurring, and would therefore decrease it's performance impact on the user's system.

Estimated LOE

Main Source Files Location

The Visual Basic project in \devel6\AccuSafe.

1.2 Feature Plug-in(s) with respect to AccuSafe.exe

Summary

This is a future capability that relates to the desire to be able to add additional features to **AccuSafe** via a plug-in scheme. While we intend to be able to add additional features to the revision 1 code, we do not require a plug-in-friendly architecture for revision 1.

To be Done

For release 1, there is no effort to be expended in this area. For a future release, a revised plug-in enabled overall **AccuSafe** product architecture will be required.

Estimated LOE

0 – This is an effort for a future release.

Main Source Files Location

None

1.3 Feature Plug-in(s) with respect to AccuSafeMon.ocx

Summary

This is a future capability that relates to the desire to be able to add additional features to AccuSafe via a plug-in scheme. While we intend to be able to add additional features to the revision 1 code, we do not require a plug-in-friendly architecture for revision 1.

To be Done

For release 1, there is no effort to be expended in this area. For a future release, a revised plug-in enabled overall AccuSafe product architecture will be required.

Estimated LOE

0 – This is an effort for a future release.

Main Source Files Location

None

1.4 AccuSafe.exe

Summary

This block implements the IntelliQueue features of the AccuSafe product, and manages the system tray icon and its available right mouse click features. This block is responsible for instantiating AccuSafeMon.ocx in order to commence the file-change detection process, and the process that copies changed files from the **User Disk Space** to the **AccuSafe Buffer Area(s)**.

To be Done

Estimated LOE

Main Source Files Location

The Visual Basic project in \devel6\AccuSafe

1.5 AccuSafeMon.ocx

Summary

This block formulates the connection between the largely platform-independent AccuSafe.exe (IntelliQueue implementation) block, and the platform-specific mechanisms that implement AccuSafe's changed file detection and buffer algorithms (**sessmgr.vxd**, **fshook.vxd** and **i21help1.vxd** primarily). Implemented as an ActiveX control, **AccuSafeMon.ocx** embodies the "AccuSafe Kernel" and allows the kernel to be "dropped into" other IPCI-generated applications, and the applications of other kernel licensees. In the future, the AccuSafe Kernel itself may become an IPCI product which could be sold as a toolkit component separate from the present AccuSafe application.

AccuSafeMon.ocx is responsible for starting **sessmgr.vxd**, which is responsible for starting, managing and stopping **fshook.vxd** and **i21help1.vxd**. Note that **sessmgr.vxd** is a dynamically loaded device driver on Windows 95 and 98, and this dynamic load occurs in **AccuSafeMon.ocx**. **Fshook.vxd** and **i21help1.vxd** are statically loaded device drivers, loaded at system boot-up time, but they are enabled and disabled, and managed by the **sessmgr.vxd** block, and as a result of various registry settings that inform **sessmgr.vxd** as to the desired **fshook.vxd** and **i21help1.vxd** operation.

AccuSafeMon.ocx presently implements 4 methods available to programs that instantiate **AccuSafeMon.ocx**. These methods relate to interconnection A4 on the block diagram.

AccuSafeMonInitialize

This method performs all the initializations required by the control, and performs all appropriate initializations of the MultiMon-derived O'Reilly code included in the control. This method must be called before any of the other methods are called. Currently, this method is called from by AccuSafe.exe in the Class_Initialize subroutine of the AccuSafeMonReceiver class module. This method is called when AccuSafe is initially started.

AccuSafeMonStartTrace

This method results in **sessmgr.vxd** being command to start all of the drivers that have been registered with it. In the case of this prototype code, the **fshook.vxd** and **i21help1.vxd** drivers are the only drivers that are registered with **sessmgr.vxd**. **Sessmgr.vxd** understands which drivers are registered with it, as well as information about how to start, stop and manage them, via the registry. This method starts the process of AccuSafe detecting and responding to file changes. This method is currently called by AccuSafe.exe in the Form_Load subroutine of the frmTaskBar form.

AccuSafeMonStopTrace

This method results in **sessmgr.vxd** being command to stop all of the drivers that have been registered with it. In the case of this prototype code, the **fshook.vxd** and **i21help1.vxd** drivers are the only drivers that are registered with **sessmgr.vxd**. **Sessmgr.vxd** understands which drivers are registered with it, as well as information about how to start, stop and manage them, via the registry. This method stops the process of AccuSafe detecting and responding to file changes. This method is currently called by AccuSafe.exe in the Form_UnLoad subroutine of the frmTaskBar form.

AccuSafeMonShutdown

This method results in **sessmgr.vxd** being command to cleanup and shutdown, as well as general cleanup and shutdown of the MultiMon-derived O'Reilly code. This method is called only when AccuSafe itself is being shutdown. This method is currently called by AccuSafe.exe in the Form_UnLoad subroutine of the frmTaskBar form.

AccuSafeMon.ocx is also a conduit for generating COM events based on the detection of file change events by the **fshook.vxd** and **sessmgr.vxd** drivers. The process by which this is accomplished is not implemented completely or correctly at present, and should be disabled in the revision 1 product since such events are not presently used by **AccuSafe.exe**. The future use of such events is now in question as well. From a prototype historical perspective, these events were generated by **AccuSafeMon.ocx** based on the activities of the **fshook.vxd** and **sessmgr.vxd** drivers in the hope that **AccuSafe.exe** could be triggered by these events to take care of all the file copies from the User Disk Space to the AccuSafe Buffer Area(s). This implementation however, could not allow the drivers to hold off the operating system while **AccuSafe.exe** performed the file transfer (**AccuSafe.exe** can't run while the OS is held off!), and as a result, the file transfers had to be performed by the drivers themselves. These comments relate to interconnection A5 on the block diagram.

To be Done

Estimated LOE

Main Source Files Location

The Visual C++ project in \devel6\AccuSafeMon.

Note that this project incorporates much of the previously-mentioned O'Reilly & Associates source code for MultiMon. This code is principally "C" code, but has been wrapped by C++ functions where necessary. Much of the included MultiMon code is likely to be unnecessary, but has been included here "just in case we ever need it" and for the purposes of most quickly getting the prototype up-and-running.

1.6 sessmgr.vxd

Summary

To be Done

Estimated LOE

Main Source Files Location

1.7 AccuSafe.mdb

Summary

To be Done

Estimated LOE

Main Source Files Location

1.8 System Registry

Summary

To be Done

Estimated LOE

Main Source Files Location

1.9 fshook.vxd

Summary

This virtual device driver is responsible for letting AccuSafe detect certain file change operations immediately after they are actually performed by the operating system. See the dashed-line encircled areas in figures 2 and 3.

To be Done

Estimated LOE

Main Source Files Location

Description

You will note there to be only 4 files in this project:

Accusafe.c

AccuSafe specific functions that are used in the fshook and i21help1 device drivers. Note that a single instance of this c file (which resides in "..\i21help1) is #included within the fshook.c, i21help1.c and i21help2.c files. (Yuck! This should be redone so that these functions are all in a library that is properly connected into the fshook project).

Basically, these functions are responsible for conducting the AccuSafe-required file activities whenever a trapped os function is encountered. In fshook.c, you'll find calls to the major functions in AccuSafe.c for this purpose. AccuSafe.c also implements some prototype-level extension, directory, size and application filtering, but this should really all be done not by looking at registry entries, but by connecting to the ops db.

Fshook.c

In the FileHook() function, under the IFSFN_OPEN case, note that we simply record the file names and handles of open files. We do not perform any file copies to the buffer area at this time, since that has already been handled by the i21help1.vxd driver (which can see an OPEN just before it actually occurs). The list open file handles/names is maintained in fshook.vxd, so that when an IFSFN_CLOSE call occurs, we can match it's file handle, to a name, and call the CopyToIQ() function to copy the file to the buffer area immediately after a close actually occurs.

In the FileHook() function, under the IFSFN_RENAME case, we copy the file to the buffer area via the CopyToIQ() function. This is the destination file for the rename function. The source file was copied to the buffer area within the i21help1.vxd.

In the FileHook() function, under the IFSFN_DASDIO case, note that a flag is maintained within the file name/handle list mentioned earlier, indicating whether or not a write has occurred on the particular file. This is so that on a CLOSE, we can be intelligent about not copying a file to the buffer area if it wasn't written to.

Also in the FileHook() function, under the IFSFN_DASDIO case, note that IFSFN_CLOSE functions are detected, and if the file was written, and the open file list (OFL) contains an entry for the handle available with IFSFN_CLOSE, the file will be copied to the buffer area.

The AcceptCall() function in fshook.c is where the driver checks to see if the call is one that we want to trap within AccuSafe. This relates to the settings in fshook's ApiStates registry entry described elsewhere in this document. Note as well, that some AccuSafe-specific filtering is done here too, but that in general, the filtering should occur as a result of examining the ops db.

Makefile.mak

The "C" style makefile. Note that the makefile refers to another larger makefile in the \$(FSINC)\vxd.mak directory. As described in section "F" of this document, this refers to the vxd.mak file found in \devel6\AS-VxDs\fsdev\include. This makefile then refers to many other headers and libraries within the \98ddk structure, and the \devel6\AS-VxD structure.

Version.h

Holds various defines that are used to set the version information for this vxd.

1.10 Shared Source Code

Summary

To be Done

Estimated LOE

Main Source Files Location

1.11 AccuSafeShellExt.dll

Summary

To be Done

Estimated LOE

Main Source Files Location

1.12 AccuSafe Buffer Area(s) Disk Space

Summary

To be Done

Estimated LOE

Main Source Files Location

1.13 AccuSafe Permanent Storage Area(s) Disk Space

Summary

To be Done

Estimated LOE

Main Source Files Location

1.14 i21help1.vxd

Summary

To be Done

Estimated LOE

Main Source Files Location

Description

This project has contains the accusafe.c, makefile.mak and version.h files described under ..\Fshook above.

i21help1.c

In the FillABlk() function, under case 0x41, we detect a delete before it actually happens, and use the CopyToIQ() function to copy the file that is about to be deleted, to the buffer area. Also in the FilABlk() function, under case 0x71 and subcase 0x41, the same delete processing is performed. I don't recall what the circumstances are, for having delete processed in these two different places.

In the FillABlk() function, under case 0x56, we detect a rename before it actually happens, and use the CopyToIQ() function to copy the file that is about to be renamed, to the buffer area. The fshook.vxd driver will eventually copy the file after it is renamed, to the buffer area. Also in the FilABlk() function, under case 0x71 and subcase 0x56, the same rename processing is performed. I don't recall what the circumstances are, for having rename processed in these two different places.

In the FillABlk() function, under case 0x6c, we detect a open before it actually happens, and use the CopyToIQ() function to copy the file that is about to be opened, to the buffer area. Also in the FilABlk() function, under case 0x71 and subcase 0x6c, the same open processing is performed. I don't recall what the circumstances are, for having open processed in these two different places.

1.15 User Disk Space

Summary

To be Done

Estimated LOE

Main Source Files Location

1.16 AccuSafeRestore.exe

Summary

To be Done

Estimated LOE

Main Source Files Location

2

Summary

To be Done

Estimated LOE

Main Source Files Location

1.18 Multimon.exe

Discussion

To be done

Estimated LOE

Main source files location

Part 2 – Description of interconnections

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Part 3 – Development Environment

This section describes the general directory structure of the CD ROM that accompanies this document.

A. \devel6\AccuSafe

This is the location of the AccuSafe Visual Basic program. The primary function of this program, is to implement the IntelliQueuer.

B. \devel6\AccuSafeMon

This is the OCX that controls the operation of the device drivers.

TODO description.

C. \devel6\AccuSafeRestore

This is the restore program.

TODO description.

D. \devel6\AccuSafeUnderConstruction

This is the “under construction” program that is accessed when the user selects the “update” or “delete” functions from the drop down menu that appears when right-clicking a file name in Explorer or in other standard windows file dialogs.

E. \devel6\AS-VxDs

This is the area where all of the AccuSafe-specific device driver code is located.

..\bin

Various files required for building the O'Reilly vxds. I don't believe I've changed any of this.

..\Fsdev

Various files required for building the O'Reilly vxds. I don't believe I've changed any of this.

..\Fshook

This is the “fshook.vxd” AccuSafe device driver project. This is a “C” project, with a makefile that is run from within the VC++ environment during build. The makefile should be converted into a normally structured VC++ project, but one that generates C code.

..\I21help1

This is the “i21help1.vxd” AccuSafe device driver project. This is a “C” project, with a makefile that is run from within the VC++ environment during build. The makefile should be converted into a normally structured VC++ project, but one that generates C code.

..\I21help2

This is the "i21help2.vxd" AccuSafe device driver project. This is a "C" project, with a makefile that is run from within the VC++ environment during build. The makefile should be converted into a normally structured VC++ project, but one that generates C code.

This driver is not used at present.

..\Multimon

This is the slightly tweaked version of O'Reilly's original MultiMon application. This has been adjusted only to communicate with vxd-related registry entries of the form "AccuSafe_" instead of the original "MultiMon_XXXX". Building this exe should leave the result in the \devel6\AccuSafe directory.

..\Sessmgr

TODO

F. \98ddk

This is the standard Windows 98 device driver kit. Note that separate device driver kits exist for NT, 2000, etc. Refer to windows documentation for information regarding the contents of this area. AccuSafe makes use of header, include and library files from here, and the build process associated with the AccuSafe VXD's also uses various executables from here.

Note that user environment settings are necessary to make this work. The associated settings on my laptop are as shown below:

AutoExec.Bat Entries

```
REM AccuSafe-related, Windows 98 DDK environment variables
REM Short path names are required where shown below. These short path names
REM may differ from computer to computer.

SET PATH=%PATH%;C:\98DDK\BIN;C:\Progra~1\mks\bin
SET PATH=%PATH%;c:\Progra~1\Micros~4\vc98\Bin
SET PATH=%PATH%;C:\PROGRA~1\MICROS~4\COMMON\MSDEV98\BIN

SET FSINC=c:\devel6\AS-VxDs\fsdev\include
SET FSLIB=c:\devel6\AS-VxDs\fsdev\lib
SET FSBIN=c:\devel6\AS-VxDs\bin
SET DDKINC=c:\98ddk\inc\Win98
SET DDKLIB=c:\98ddk\lib\Win98;c:\98ddk\lib\i386\free
SET DDKBIN=c:\98ddk\bin;c:\98ddk\bin\win98
SET
VC32INC=c:\Progra~1\Micros~4\vc98\Include;c:\Progra~1\Micros~4\vc98\MFC\Include;c:\Progra~1\Micros~4\vc98\Include\Sys
SET VC32BIN=c:\Progra~1\Micros~4\vc98\Bin;c:\Progra~1\Micros~4\common\MSDev98\Bin
SET VC32LIB=c:\98ddk\lib\i386\free;c:\Progra~1\Micros~4\vc98\Lib
SET MONH=c:\devel6\AS-VxDs\multimon\common
SET MONLIB=c:\devel6\AS-VxDs\multimon\monlib
SET SDK16BIN=c:\98ddk\bin\win98\bin16
```

G. \Distrib\AccuSafe Prototype A.01.200

H. \My Installations\AccuSafe

This is the InstallShield 5.5 (I believe that's the proper version) AccuSafe installation program. The only thing known for sure here, is that there are too many system-level components being installed. I had trouble getting the installed file set correct at the last minute before an out-of-town AccuSafe meeting, so simply included "the world" in the installation set. There is much being installed that is not necessary for AccuSafe.

Note too that we're having trouble presently with installations on some Windows 98 machines...some machines are fine, some are problematic in that AccuSafeMon.ocx fails to register during install, and cannot be manually registered either. This would tend to indicate that something is in fact missing from the install, but the fact that the software can be installed on some clean Windows 98 machines, and not on others, is confusing.

The install program gets all of its files from the \distrib\AccuSafe\Files directory structure, and emits its results into the \distrib\AccuSafe\Media directory structure. After a successful install build, the contents of the AccuSafe CD can be found in \distrib\AccuSafe\Media\Disk Images\Disk1.

Part 4 – System Registry Utilization

The following registry entries are presently utilized. Many/all of these should be moved to the ops db. Note comments in italics. Note that the install program sets many of these items at present.

Check the install program for the latest information on which registry items are installed.

[HKEY_CURRENT_USER\Software\VB and VBA Program Settings\AccuSafe]

In the final product, any registry settings should appear under an AccuSafe key, not under "VB and VBA Program Settings" as is the case here. Note too, we must be careful to deal with the registry in the proper fashion for NT installations (admin vs. user, etc.)

[HKEY_CURRENT_USER\Software\VB and VBA Program Settings\AccuSafe\Settings]

"RejectDirectory0"="C:\\Program Files\\AccuSafe\\"

"RejectDirectory1"="C:\\Program Files\\AccuSafe\\AccuSafeBuffer"

"RejectDirectory2"="C:\\Recycled\\"

"RejectDirectory3"="C:\\WINDOWS\\"

These entries are temporary ones, so that the VXD's have some way to reject files from certain directories, from what is actually dealt with automatically. The VXD's should ideally connect to the ops db for this information, since we want to allow much finer control over the things that should be included and excluded from the automatic capture mechanisms.

"DriverLogging"=""

"ComputerID"="srwnb"

The computer ID couldn't be read using the normal API function, or at least I couldn't make it work, so the computer ID is hardcoded here. This shouldn't be the case in the final software.

"DefaultMaxVersionsString"="10"

A string version for the maximum number of revisions of a file. Right now, this is global, and applies to all files. In the final software, this information must be at a much more granular level, and must reside in the ops db.

"SplashScreenMode"="normal"

A simple mechanism to let the splash screen stay up as it would for a normal user, or to immediately vanish if we're doing lots of compile/test cycles. In the splash screen form of the AccuSafe VB application, you'll find the value for this that allows the splash screen to be in "quick" mode.

"UserID"="swilliams"

Similar to the computer name issue above, this is the hardcoded user name. It should come from the OS, not a registry or ops db entry. I couldn't get the normal API function to operate properly.

"BufferPath"="C:\\Program Files\\AccuSafe\\AccuSafeBuffer\\srwnb\\swilliams"

The full path to the AccuSafe buffer. This is old...the computer name and user name are not part of the path used for the buffer area any longer.

"LogFile"="C:\\Program Files\\AccuSafe\\AccuSafe.log"

The location of the AccuSafe log file. The population of the log file is not particularly nice looking, nor comprehensive at this time.

"DefaultCompressionMode"="none"

We really don't have any compression yet, so this is just a placeholder for the default compression mode that will be applied if the ops db doesn't specify otherwise.

"DevicePath"="d:\\accusafe"

The path to the accusafe device. Note that the ops db should contain this information, and should allow for different target devices for different files, extensions, directories, etc.

"BufferBasePath"="C:\\Program Files\\AccuSafe\\AccuSafeBuffer\\"

This is the path to the accusafe buffer area.

"UserType"=""

This isn't presently used, but the intent was to provide for several "sophistication levels" of users, and thus control the presentation of options and jargon appropriately.

"CommonFileProcessing"="off"

AccuSafe contains a very rudimentary mechanism for eliminating the redundant storage of files that are common amongst several users. This turns that capability on and off. But, the current mechanism is not sufficient for a robust implementation, and we'll likely wait for a subsequent release in order to implement the elimination of common files.

"DefaultMaxVersions"=dword:0000000a

This is a numeric version of the number of file revisions to be retained. I don't recall why we have a numeric version and a string version.

"AccuSafeMonLogDir"="C:\\Program Files\\AccuSafe"

The location of the log file for the OCX.

"UserName"="Steve Williams"

User registration name.

"LogDir"="C:\\Program Files\\AccuSafe"

The directory where the log file is located.

"BufferCheckFrequency"="2000"

The number of msec between checks of the AccuSafe buffer area.

"DefaultVirusScanningMode"="none"

Placeholder for retaining the default setting of the AccuSafe internal virus scanning mechanism. Note that no such mechanism currently exists, and we're not planning for such capability in version 1. Additionally, all such settings should be retained in the ops db.

"SplashLogoFile"="C:\\Program Files\\AccuSafe\\iomega-splash.bmp"

This is the splash screen to be used. This value allows for easier rebranding for demos and for the final product.

"InstallDir"="C:\\Program Files\\AccuSafe"

This installation directory for AccuSafe.

"ExtensionList"="*.doc;*.xls;*.wri;*.txt;*.ppt; "

In lieu of having a connection to the ops db, the VXD's look here to determine whether a file should, or should not, be part of the automatic backup mechanism. See also the criteria for rejected directories, and the criteria for maximum file size.

"DeviceMediaConnectivityMessageInterval"="10000"

This doesn't work properly at present, but is supposed to be the number of msec between notifications to the user that the AccuSafe device, or it's media, cannot be written to (not found, no space, write only, etc.)

"MaximumFileSize"=dword:005b8d80

This is a temporary filter for the VXD's, so that huge files won't be copied during AccuSafe operation. This is here primarily to solve a potential prototype problem where huge files are accessed, and our prototype can't handle them properly, or can't do so with any decent performance.

"AboutBoxSupportLink"="http://www.iomega.com"

The URL that appears in the about box. Having this adjustable without recompilation assists in quicker rebranding for demos and for the final product.

"TempDirForRestore"="C:\\Program Files\\AccuSafe\\Temp\\Restore"

The location of the temporary directory used by the restore operation.

"DefaultEncryptionMode"="none"

Placeholder for the default encryption mode to be used. As with the other similar placeholders, this should be retained in the ops db. Note that no encryption is planned for the first edition of this product.

"CompanyName"="SM&A Corporation"

Registered users company name.

[HKEY_CURRENT_USER\\Software\\VB and VBA Program Settings\\AccuSafe\\WebSupport\\0]

"Name"="Iomega Home Page"

"URL"="http://www.iomega.com"

Populates the AccuSafe icon right mouse click support menu items.

[HKEY_CURRENT_USER\\Software\\VB and VBA Program Settings\\AccuSafe\\WebSupport\\1]

"Name"="Iomega Support"

"URL"="http://www.iomega.com/support/index.html"

Populates the AccuSafe icon right mouse click support menu items.

[HKEY_CURRENT_USER\\Software\\VB and VBA Program Settings\\AccuSafe\\WebSupport\\2]

"URL"="http://www.iomegadirect.com"

"Name"="IomegaDirect"

Populates the AccuSafe icon right mouse click support menu items.

[HKEY_CLASSES_ROOT*\\shell]

@="restore,update,delete"

Adds AccuSafe-related items to the drop down menu when right clicking on a file name within Explorer, or in other standard Windows dialogs.

[HKEY_CLASSES_ROOT*\\shell\\restore]

@="&Restore from AccuSafe"

Text to appear in the drop down menu when right clicking on a file name within Explorer, or in other standard Windows dialogs.

[HKEY_CLASSES_ROOT*\\shell\\restore\\command]

@="C:\\Program Files\\AccuSafe\\AccuSafeRestore.exe %1"

Command to be executed when clicking restore from the down menu after right clicking on a file name within Explorer, or in other standard Windows dialogs. Note that we shouldn't do restore this way, but should in fact use a Context Menu (like WinZip does – below). The way this is currently implemented, there will be one call to AccuSafeRestore for each file name (or directory name – which isn't currently supported) included in a multi-select situation.

[HKEY_CLASSES_ROOT*\\shell\\update]

@="&Update on AccuSafe"

Text to appear in the drop down menu when right clicking on a file name within Explorer, or in other standard Windows dialogs.

[HKEY_CLASSES_ROOT*\shell\update\command]

@="C:\Program Files\AccuSafe\AccuSafeUnderConstruction.exe %1"

This function isn't implemented in the prototype, so we go off to the AccuSafeUnderConstruction application whenever this right mouse menu item is selected.

[HKEY_CLASSES_ROOT*\shell\delete]

@="&Delete from AccuSafe"

Text to appear in the drop down menu when right clicking on a file name within Explorer, or in other standard Windows dialogs.

[HKEY_CLASSES_ROOT*\shell\delete\command]

@="C:\Program Files\AccuSafe\AccuSafeUnderConstruction.exe %1"

This function isn't implemented in the prototype, so we go off to the AccuSafeUnderConstruction application whenever this right mouse menu item is selected.

[HKEY_CLASSES_ROOT*\shellex\PropertySheetHandlers\{333882E0-F78C-11d3-9099-444553540000}]

This is the class ID for Tom Albrecht's property sheet shell extension. This is the right way to add property sheets for AccuSafe General behavior, and AccuSafe file-specific behavior to the standard windows property sheets.

[HKEY_CLASSES_ROOT*\shellex\ContextMenuHandlers\WinZip]

@="{E0D79304-84BE-11CE-9641-444553540000}"

This is an example of how AccuSafe should add items to the right mouse click drop down menu, and how it should respond to them being selected. A technique like this should replace the ... \shell\restore... and ... \shell\update... and ... \shell\delete... techniques used above.

[HKEY_CLASSES_ROOT\AccuSafeFile]

@="AccuSafe.File"

This is a connector to another registry entry that tells the OS how to handle files with the extension "AccuSafeFile". We'll probably not use this, since if we implement a name space extension to control the user's view of the files if he examines the AccuSafe device directly, we won't need to use this mechanism for hiding these files, or making them appear with different icons, etc. Note, this extension is used on the backup copy of the actual file.

[HKEY_CLASSES_ROOT\AccuSafeInfo]

@="AccuSafe.Info"

This is a connector to another registry entry that tells the OS how to handle files with the extension "AccuSafeInfo". We'll probably not use this, since if we implement a name space extension to control the user's view of the files if he examines the AccuSafe device directly, we won't need to use this mechanism for hiding these files, or making them appear with different icons, etc. Note, this extension is used on the information file that is stored in parallel with the actually backed up file. At present, the info file contains some original file information (where it was originally stored, the original attributes, the size, etc., but I don't believe this file is used for anything right now).

[HKEY_CLASSES_ROOT\AccuSafe.File]

@="AccuSafe Backed Up File"

"NeverShowExt"=""

Causes the "AccuSafeFile" extension to never appear in Windows explorer, or other common Windows dialogs. The HKEY_CLASSES_ROOT\AccuSafe.File registry branch is the one that is connected to by the HKEY_CLASSES_ROOT\AccuSafeFile registry entries described earlier.

[HKEY_CLASSES_ROOT\AccuSafe.File\DefaultIcon]

@="C:\Program Files\AccuSafe\AccuSafe.Ico"

Causes files with the "AccuSafeFile" extension to appear with the specified icon. This isn't really necessary, and we should eliminate this complexity, and possible confusion, in the future.

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[illegible]

[illegible]

"Enabled"=hex:00

[illegible]

See notes under the fshook vxd.

I don't know why the AccuSafe `i21help2\1` branch is necessary along with the previously described AccuSafe `i21help2\0` branch. This should be examined.

See notes under the fshook vxd.

See notes under the fshook vxd

See notes under the fshook vxd. Note at present, that this driver is NOT enabled, and is therefore not necessary for AccuSafe operation. We should be able to eliminate this driver altogether for AccuSafe, and thus not create the AccuSafe_i21help2\1 (or AccuSafe_i21help2\0) registry branch at all.

See notes under the fshook vxd.

- g. We need to investigate the possibility of adding the bootmgr.vxd driver to the set of drivers used by AccuSafe. Bootmgr.vxd effectively allows detection of file operations while the system is booting up (e.g. during the SysCritInit period). Although I don't believe that we can actually copy such changing files to the IntelliQueue Buffer area during this time (the file system isn't fully available to AccuSafe during this period. I don't believe), it is at least possible to note that files changed, and copy them after the system has booted up. Noting that files changed, is enabled via the event block request/populate notify mechanism described in item "h" above, and it should be noted particularly that this mechanism is functional during the SysCritInit period.
- h. The i21help1 driver is installed at system boot time, by the normal system VXD installation process related to
HKEY_LOCAL_MACHINE\System\CurrentControlSet\Control\SessionManager\KnownVxDs
registry entries. Further detail about this process is available through a variety of Microsoft resources.
- i. The i21help1 driver operation is specified by the
[HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\VxD\AccuSafe_i21help1] registry
entries. These entries are created via the \devel6\AccuSafe\Multimon.exe program, which is a very
close derivative of the original O'Reilly & Associates MultiMon.Exe program (we have changed it
only to refer to "AccuSafe_XXX" in the above key, rather than the original "MultiMon_XXX").
- j. The i21help1 driver is "armed" by the sessmgr.vxd. This occurs as a result of the invocation of the
StartTrace method of the AccuSafeMon.ocx ActiveX control. Refer to the CtrlMsg_Arm_Monitor
function in i21help1.
- k. The i21help1 driver is "disarmed" by the sessmgr.vxd as a result of the StopTrace method of the
AccuSafeMon.ocx ActiveX control. Refer to the CtrlMsg_Sys_VM_Terminate function in i21help1.
- l. The sessmgr.vxd is dynamically loaded, not at system boot time, but via the AccuSafeMon.ocx
Initialize method.
- m. Regarding the AccuSafeFilter function: the intent here is to provide some filtering for the work of
i21help1 so that not ALL files that are opened are actually copied immediately to the **IntelliQueue
Buffer Area**. AccuSafe must minimize computer/application performance impacts and disk space
utilization, so it is necessary that AccuSafe be intelligent about the work it performs. Specifically,
AccuSafe must be intelligent about not operating on files that the user (or AccuSafe) has elected to
exclude from the automatic backup mechanism.

Based on the services available to a device driver, it is not believed possible/practical to attempt a connection directly to the **AccuSafe Operational Database** in order to properly filter file requests against the various AccuSafe-settable criteria. Therefore, the current prototype code employs a "hint" scheme, whereby file extensions to be included, and directories to be excluded, can appear within the AccuSafe registry area, and therefore can easily be accessed via the i21help1 driver.

"Hints" would be added to the AccuSafe registry area whenever a user adjusts the behavior of AccuSafe via the AccuSafe General or AccuSafe File Specific tabs supplied by the AccuSafe Shell Extension DLL (**AccuSafeShellExt.dll**). This hint scheme has many limitations, and must be **augmented**. A hint scheme is likely a correct approach however, in some form, but note that the hints must always be managed so that the filtering they provide, always represents a superset (or an exact set) of the files that the user actually wants to backup. If this cannot be accomplished with the hint scheme, then we run the risk of missing changes that might be interesting to the user. This means that the hint scheme has a close connection to the AccuSafe Shell Extension where files are included/excluded (etc.) based on basename, extension, etc. The AccuSafe Shell Extension populates

IntelliQueue Buffer Area. The main AccuSafe application will then need to perform this copy, with normal backup from the **IntelliQueue Buffer Area** to the **AccuSafe Permanent Storage Area** also occurring, but normally so, via the main AccuSafe application.

Additional thinking and design is required in this area.

Scheduled Backup

AccuSafe will also implement the most traditional of all backup methods, the Scheduled Backup. AccuSafe will include a user interface that allows the user to set up to 3 times per day when the selected file will be backed up.

As with the Interval Backup, the main AccuSafe program must generate periodic events to check the **AccuSafe Operational Database** for files that are due to be backed up (via the user-specified schedule for the associated file), but have not yet been backed up from the **User Disk Space** to the **IntelliQueue Buffer Area**. The main AccuSafe application will then need to perform this copy, with normal backup from the **IntelliQueue Buffer Area** to the **AccuSafe Permanent Storage Area** also occurring, but normally so, via the main AccuSafe application.

Additional thinking and design is required in this area.

AccuSafe can automatically switch between the various backup modes, depending on encountering various triggering criteria in terms of backup frequency, bandwidth limits from the PC to the **AccuSafe Permanent Storage Area**, file size, computer/application performance impacts, etc. Such automatic shifts are temporary in nature, and AccuSafe must return to the original backup mode as soon as the triggering criteria is no longer present, and after a suitable hysteresis. These algorithms are not implemented in the prototype, but have been considered.

- n. Regarding the **CopyToIQ** function: this function is responsible for copying the identified file from the **User Disk Space** to the **IntelliQueue Buffer Area**. It must do so with minimal computer/application performance degradation, and must be able to copy open files. It is believed that the current mechanism allows for open file copies, but this requires further investigation.

The **CopyToIQ** function generates a unique filename in the **IntelliQueue Buffer Area** by replacing all "/" symbols in the "source" file name, with "@" symbols in the "destination" file name. (Source files comes from the **User Disk Space**, and destination files are placed in the **IntelliQueue Buffer Area**.) This results in a flat directory structure within the **IntelliQueue Buffer Area**, which reduces algorithmic complexity in the i21help1 and fshook drivers and in the AccuSafe application itself, and improves processing time for most AccuSafe operations. Unique filename determination is the responsibility of the **GenerateBufferFilename** function.

GenerateBufferFilename also appends a "[x]" revision indication immediately to the left of the "." preceding the (final) filename extension. Here "x" refers to the revision number (numbers increase with time) within the **IntelliQueue Buffer Area**, should multiple revisions of this file exist there. It should be noted that this revision number relates only to the revision number within the **IntelliQueue Buffer Area**, and specifically is not related to the revision number in the **AccuSafe Permanent Storage Area**. This revision number allows the revisions within the **IntelliQueue Buffer Area** to remain chronologically ordered.

Once a destination file name has been determined via **GenerateBufferFilename**, the i21help1 driver makes a fast attempt at determining whether the latest known version of the associated file is already stored in the **IntelliQueue Buffer Area**, and if so, determines that it need not store the version it is about to store. This is a performance and disk space management technique, but one which is also

intended to make efficient use of the revision stack by not including multiple copies of the same revision within the stack

Note that the **GenerateBufferFilename** function results in filenames that are completely lower case, and this should be changed so that the normal filename casing is maintained. I believe that this is a defect in the prototype conversion conversions to all lower case are done for comparison purposes, but it could also be that the operating system provides only fully lower-cased file names. I don't recall. The **GenerateBufferFilename** function properly deals with long file names, and the file names provided by the OS to the "help" driver, are long file names. This results in file names in the **IntelliQueue Buffer Area**, and on the **AccuSafe Permanent Storage Area**, being long file names as well. This comment is significant as it relates to the current prototype implementation of the **AccuSafe Restore** functions.

Revision comparison algorithms are handled in the **CompareRevisions** function. At present, this function simply examines the latest revision in the **IntelliQueue Buffer Area**, performing a byte-by-byte comparison with the file about to be placed in the **IntelliQueue Buffer Area**. If the comparison results in at least one byte difference between the two files, the **CopyToIQ** function will proceed to the **FileCopy** function. If the two revisions are identical, the file about to be copied is not necessary, and therefore the **FileCopy** function will not be invoked.

Note that the **CompareRevisions** function should be updated so that it calculates a checksum of the file to be copied to the **IntelliQueue Buffer Area**, and to compare this value with the checksum value of the last revision copied there. This will improve the speed of the operation, and will allow the algorithm to work properly, even when there are no files in the **IntelliQueue Buffer Area** (a normal state when an AccuSafe Permanent Storage device is connected to the PC).

In future product revisions, **FileCopy** should only copy the portions of the file that were changed from the prior revision. This is possible via intercepts within the OS of the **FILE_READ**, **WRITE**, **function**.

- o. Regarding the **FileCopy** function, this function is responsible for actually copying the file that is being opened to the **IntelliQueue Buffer Area**. The function presently ignores zero-length files, but this limitation should be removed. In addition, the function presently ignores files greater than a size threshold value specified in the registry. This limitation should also be removed.

It is imperative that this function operate as quickly as possible, since the operating system is completely suspended while the **FileCopy** function is performing its duties. Creative thinking should be applied here to minimize all **FileCopy** invocations that are not absolutely required. This is the reason for the existence of the **CompareRevisions** function described earlier. Reduction of the number of required **FileCopy** invocations is also the driving force behind some of our incomplete thinking on the potential for redundant file elimination. (e.g., I don't really don't need to keep multiple copies of the same file in different directory areas within the AccuSafe Permanent Storage Area.)

The **FileCopy** function currently understands the **IntelliQueue Buffer Area** to be on a single device, as specified by a registry entry. But, this can be evolved so that multiple devices are available for the **IntelliQueue Buffer Area** to assist for example, in cases where the first **IntelliQueue Buffer Area** location is full.

The **FileCopy** function currently only checks for available disk space within the **IntelliQueue Buffer Area** prior to conducting its file copies, but it must also be augmented so that the user can specify a "guard band" amount of disk space that must always remain free on the computer. This would result

in the IntelliQueue Buffer Area not consuming the entirety of the available computer disk space, which may render the computer unusable.

Step 4 Discussion

Note, many comments here are similar to comments under the "Step 2" section above

- a. Step 4 code can be found in Steve AS-VxD's fshook project. This project creates the fshook.vxd virtual device driver. The bulk of the code here, other than sections with comments containing "AccuSafe" or "fshook", are original O'Reilly & Associates code for their i21help1.vxd driver for MultiMon. See the book, Inside the Windows 95 File System, published by O'Reilly & Associates for further information. IPCI has obtained O'Reilly & Associates permission for use of their code in our product.
- b. See "Step 2" sections "b" and "c" for comments also relevant to the fshook driver. As these "Step 2" comments are studied, replace "i21help1" by "fshook" in interpreting them.
- c. Regarding the FileHook function: this function is installed as a standard "file system hook" within Windows 95 and 98. All activities performed in such a file system hook, occur immediately AFTER the operating system has performed the associated file action (as contrasted to the operation of the i21help1 driver which is called immediately BEFORE the operating system performs the associated file action).

FileHook first calls the AcceptCall function for preliminary handling and filtering of file system functions for AccuSafe purposes. If AcceptCall returns false, then FileHook will exit without further operation, and the system continues to the next installed file system hook (typically, a non-AccuSafe installed hook for another program), if any. AcceptCall's preliminary handling and filtering is described below.

IFSFN_OPEN (Open File):

If the file is being opened in "read/write" or "write only" mode, then AcceptCall will return true or false, depending on a) whether or not the installable file system IFSN_OPEN function is to be intercepted by fshook, and b) if AccuSafe filtering is satisfied (see step 2 item "m").

For AccuSafe purposes, IFSN_OPEN is always intercepted, and this is specified by the content of the AccuSafe-installed setting of the appropriate entry within the [HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\VxD\AccuSafe\ fshook\ b\ b\ States\ reg stry value. (See later notes as to how these entries are set during AccuSafe's development.)

The system file handle (OFI) referred to in other IFSN operation notes, is populated as a result of IFSN_OPEN, later in FileHook's operation.

IFSFN_CLOSE (Close File):

If the file being closed is not present on fshook's Open File List (OFL), then AcceptCall will return false. Otherwise, the file name associated with the numeric file handle available during an IFSN_CLOSE call, will be determined by looking up the file handle value in the OFL. Then, AcceptCall will return true or false, depending on a) whether or not the installable file system IFSN_CLOSE function is to be intercepted by fshook.

For AccuSafe purposes, IFSEN_CLOSE is always intercepted, and this is specified by the content of the AccuSafe-installed setting of the appropriate entry within the [HKLM\LOCAL_MACHINE\System\CurrentControlSet\Services\Wd\AccuSafe_fshook\IOApStates] registry value. (See later notes as to how these entries are set during AccuSafe development.)

IFSEN_WRITE (Write to File):

Same operation as with IFSEN_OPEN above.

IFSEN_RENAME (Rename File):

AcceptCall will return true or false, depending on a) whether or not the installable file system IFSEN_RENAME function is to be intercepted by fshook, and b) if AccuSafe file hook is satisfied (see step 7 later in this document).

For AccuSafe purposes, IFSEN_RENAME is always intercepted, and this is specified by the content of the AccuSafe-installed setting of the appropriate entry within the [HKLM\LOCAL_MACHINE\System\CurrentControlSet\Services\Wd\AccuSafe_fshook\IOApStates] registry value. (See later notes as to how these entries are set during AccuSafe development.)

The Open File List (OFL) is not a factor in the rename operation.

After AcceptCall performs it's preliminary handling and filtering, FileHook continues with the following operations.

IFSEN_OPEN (Open File):

IFSEN_CLOSE (Close File):

IFSEN_WRITE (Write to File):

IFSEN_RENAME (Rename File):

TODO: Populate the above sections.

The Open File List (OFL) referenced above is a very simple dynamically allocated/deallocated linked list containing basic data elements at each node:

- a. Numeric system file handle
- b. Alphanumeric file path and name
- c. A flag as to whether or not the file has been written since the last IFSEN_OPEN operation
- d. Pointer to previous entry (entries are not sorted, this is just a pointer to the prior element in the list). This pointer is NULL if there is no next entry.
- e. Pointer to next entry (entries are not sorted, this is just a pointer to the next element in the list). This pointer is NULL if there is no next entry.

The OFL should be reconstructed to be more quickly searchable (linked list searches are SLOW), and possibly augmented to carry additional information. Currently available OFL-related functions are listed below.

OFL.AddElementToTail (add a new node to the OFL)

OFL.DeleteElement (delete a selected node from the OFL)

OFL.FindElementByHandle (find an OFL node by passing in the numeric file handle)

OFL.FindElementByFileName (find an OFL node by passing in a file path and file name)

OFL.DeleteAllElements (delete all OFL nodes)

OFL.DumpToLog (Dump the OFL contents to the log file. WARNING: this function cannot be used within many of the IFSN calls...doing so will crash/lock-up the operating system.)

Note that the FileLock function currently contains code relating to "name blocks" and "multiple name blocks" and calls to the Directed Sys Control function. These are all necessary for proper Multimon operation, but are not presently required for AccuSafe operation. No need to changes these, unless they create defects or present significant development/test-reliability issues.

The

[HKEY_LOCAL_MACHINE\system\CurrentControlSet\Services\VxD\AccuSafe\IsHook\0ApiStates] values are constant for AccuSafe and are installed into the registry by the AccuSafe installation program. During AccuSafe development, these values can be controlled via the "AccuSafe-adjusted" version of O'Reilly's MultiMon, executing in devc6 multimon. This version of MultiMon.exe is produced by the VS++ project in devc6 AS-VxDs\MultiMon\MultiMon\MultiMon.dsp. Note that if various IsHook and other API filters are changed in a MultiMon session, the corresponding registry entries must also be changed in the AccuSafe install project if these changes are to be migrated to the user's system.

NOTE: ADD SIMILAR COMMENTS TO THE STEP 2 DISCUSSION.

General Discussion

- a. The entire body of code here requires much more testing, particularly under a variety of operating system conditions resulting from use of different programs, use on different operating system revisions, use with virus-scanners (and other applications that hook into the file system in the same manner that AccuSafe does, etc.).
- b. Work is necessary to improve the error checking mechanisms here, to add them in some cases, and to improve the error mechanism response in case of troubles. In some cases, errors in the current code simply result in AccuSafe ignoring a file change, and there are a class of errors where this response is reasonable, but the entire area must be studied much more carefully.
- c. Lots of this code has been assembled very quickly, with primary focus on proving major technical paths, and on providing large, scalable software. Therefore, there are inappropriate hacks and hardcoding in places that must be reworked.
- d. Future product revisions can further instrument I2help1.vxd and IsHook.vxd to prevent unauthorized disk accesses to the **AccuSafe Permanent Storage Area** and/or the **IntelliQueue Buffer Area**. This is possible due to the fact that these drivers have access to the name and path of the executable that is attempting to perform a file operation, and could therefore check this name (along with the indicated executable's checksum) to determine if the executable is allowed to access the **AccuSafe Permanent**

Storage Area or IntelQueue Buffer Area. Among other things, this will provide some measure of virus protection. Only AccuSafe data repository. The list of "allowed executables" would reside in the AccuSafe Operational Database, and would be initially populated during install, could be updated by periodic download, and can be updated by the user in response to an AccuSafe-generated message that "XXXX executable attempted to write to file.YYYY. Is XXXX a trusted executable?"

- e. Item "d" above can be expanded, we believe, to provide increased virus protection for all areas of the User Disk Space. This will be considered in future revisions of AccuSafe.
- f. We need to determine if we reliably can force our drivers into the proper order, such that no virus can install itself before or after our drivers in the associated file system hook chain, or interrupt 21 chain, and as a result, negatively impact the anti-virus operation described under "d" and "e" above, or any other AccuSafe-related operation. Special attention should be given to testing AccuSafe operation with virus-scanners and other software that hooks the file system, or places functions on the interrupt 21 chain.

FeatureNum	Bucket	Group	PrioriPh	Docum	Docum
198		Configuration	1	QCPC	
199		Configuration	1	QCPC	
145	Administrative	Install	1	ERS	9.04
132	Administrative	Install	1	ERS	7.01
252	Administrative	Install	1	AIQI	
251	Administrative	Install	1	AIQI	
131	Administrative	Install	2	ERS	7.0B
130	Administrative	Install	1	ERS	7.0A
113	Administrative	Web	1	ERS	6.20
150	Administrative	Help	1	ERS	9.09
332	Administrative	Install	1	ERS	6.12
102	Administrative	Install	2	ERS	6.14
151	Administrative	Install	2	ERS	9.10
129	Administrative	Install	1	ERS	7.0
142	Administrative	Help	1	ERS	9.0
255	Administrative	Configuration	1	ERS	5.0
134	Administrative	Install	2	ERS	7.0G
126	Administrative	Future	3	ERS	6.24K
339	Administrative	Web	1	ERS	6.20
149	Administrative	Help		ERS	9.08
200	Administrative	Configuration	1	QCPC	
141	Administrative	Help	1	ERS	9.0
89	Administrative	Configuration	1	ERS	6.11
88	Administrative	Configuration	1	ERS	6.11
87	Administrative	Configuration	2	ERS	6.11
140	Administrative	Uninstall	1	ERS	8.0
139	Administrative	Install	3	ERS	7.0
336	Administrative	Install	1	ERS	6.19
138	Administrative	Install	1	ERS	7.0
335	Administrative	Install	Dup3		
137	Administrative	Install	2	ERS	7.0
92	Administrative	Configuration	Dup8	ERS	6.11
143	Administrative	Install	1	ERS	9.02

Feature List

Description	
Control by directory	
Control by File	
License file created for installation process.	
Password should be required for web and email downloads (installation)	
User must agree to license during install	
Trouble free installation	
Localization option in install program.	
Autorun file and capability for the CD (installation)	
AS must be capable of launching IE or NN to connect to AS and/or vendor related web sites	Launches should normally be performed
Learning product should be created that are not specific to any vendor or customer by inclusion of company names or logos	
It is anticipated that the AS installation will be called after the completion of the device installation	
The splash screen should be easily customizable for different vendors and copyrights.	
Design product for localization.	
The install program will be developed using industry standard InstallShield.	
Help will be available via help buttons, right click "what's this?", F1 and right click menu items form the AccuSafe system tray icon. All	
Product should require no configuration after installation to provide a minimum acceptable level of operation.	
Option to build AS product floppy disks so it can be installed on systems having no CDROM drive.	
Future - Add 'In AccuSafe backup files' to the functionality available via the Windows start menu's find menu capabilities.	
If a user does not have an internet browser installed, when a user clicks on an AccuSafe web link, a pop up message should appear	
Technical support training package will be included and usable via some viewer or demo product. - for users in tech support situation	
Control by type (wild cards)	
A comprehensive help system based on the WinHelp or HTML help format will be available. HTML is acceptable only if there are no r	
It must be possible and intuitive for the use to include parent directories, then exclude directories or individual files under that director	
Users must be able to multi-select items for include and exclude status.	
AS users must be able to control which files are included and excluded at the full file name, base file name, file extension, directory,	
Comprehensive un-install should be included and available through standard access.	
Installation across platforms should be as consistent as possible.	
AS will install as a startup application by default	
Installation must be user friendly and jargon-sparse.	
AS will be a startup application (by default when installed).	
Installation program must be built with localization in mind.	
Extension selection/ exclusion should be available.	
Read me file will be included for late breaking info.	

9/21/2000

What is the difference in include and control?	Note	Est Code	Diffic
What is the difference in include and control? Control implies include/exclude/versions/compression/etc			
What is the difference in include and control? Control implies include/exclude/versions/compression/etc			
Need some explanation - registration number/code to verify payment/licensed copy of software			0.5
			4
			1
			1
			1
Requires cooperation and proactiveness on Device Manufacturer			1
			1
Japanese probably first language			3
This has a difficulty of 4 right now, but will decrease with familiarity with product (in training)			4
			1
			1.5
			2
			4
			3
Requires post test phase results so that best information can be provided to tech support			4
EB: Compiled HTML Help or would straight HTML be ok			2
			1.5
			1
			2
			3
			5
			1
			1
This has a difficulty of 4 right now, but will decrease with familiarity with product (in training)			4
			2
			0.5

FeatureNum	Bucket	Group	PrioriPh	Docum	Docum
136	Administrative	Install	1	ERS	7.0 mul
135	Administrative	Install	1	ERS	7.0 (m
144	Administrative	Help	2	ERS	9.03
127	Administrative	Future	3	ERS	6.24L
133	Administrative	Install	2	ERS	7.0N
180	Administrative	Configuration	1	AFD	
115	Administrative	Web	2	ERS	6.20
173	Administrative	Configuration	1	AFD	
176	Administrative	Configuration	3	AFD	
114	Administrative	Web	2	ERS	6.20
191	Administrative		1	QCPC	
359	Advisor	Detect	2	ERS	6.22a
360	Advisor	Detect	2	ERS	6.22b
358	Advisor	Performance	1	ERS	6.22
123	Advisor	Future	3	ERS	6.24H
361	Advisor	Detect	1	ERS	6.22c
364	Advisor	Action	2	ERS	6.23e
362	Advisor	Detect	1	ERS	6.22d
363	Advisor	Action	2	ERS	6.22e
356	Advisor	Detect	1	ERS	6.22
365	Advisor	Action	1	ERS	6.23e
357	Advisor	Action	1	ERS	6.22
5	BackupDevice	Hardware	1	SOW	1.0
279	BackupMedia	Files	1	ERS	6.02
62	BackupMedia	Files	2	ERS	6.05
63	BackupMedia	OS	2	ERS	6.05
280	BackupMedia	Files	1	ERS	6.02
212	BackupMedia	Hardware	2	AIQI	
117	BackupMedia	Hardware	3	ERS	6.24B
37	BackupMedia	Hardware	3	ERS	2.0
36	BackupMedia	Hardware	1	ERS	2.0
384	BackupMedia	Files	1	ERS	6.3
184	BackupMedia	Hardware	1	AFD	

Feature List

Description	
During installation user should have option to customize installation directories, names, installation type (typical, compact, custom), s	
Smart installation program that knows not supported environments, OS, currently connected AS devices, should install all files neces	
Getting started guide will be created	
Future - Add "in AS backup files..." to the functionality available via the Windows Explorer's "tools" find" menu capabilities.	
User specific installation option. Install program should ask if AccuSafe is available to all users or one (installing) user.	
File selection configurable by time since last backup	
Web linkage should provide method of automatically allowing the user to update software with little or no user intervention.	
Auto configuration or use advanced features	
Configurable by drive type	
URLs should be administered in a way that is easily updateable (not hardcoded into program - maybe in registry or other file).	
Easy to use and learn	
AS Advisor detects when x% of media is occupied by files not touched in Y days - responds by asking user if they would like to delete	
AS Advisor detects that x% of media is occupied by files that no longer exist on original locations on PC - asks if its okay to delete th	
AS advisor does not significantly impact PC Performance	
Future - Enhanced AccuSafe Advisor capabilities.	
AS Detects that system file(s) not in AS, therefore system restore function could not run properly. Asks user or automatically runs ba	
The AS Advisor log should be viewable, printable, and resizable by the user.	
AS detects file n in backup strategy is not in AS at latest version. AS conducts backup automatically.	
All actions taken by the AS Advisor should be chronologically logged.	
AS advisor responds to larger, non-time critical situations	
AS Advisor minimizes interruptions - only interrupted with things that require attention...	
AS Advisor runs on a scheduled basis	
Store to internal storage device	
Versions of files are maintained up to the number indicated in AccuSafe configuration.	
The AS media device directory structure will mimic the user's directory structure.	
The AS media device directory structure will allow for multiple computers to be connected to the same AS device.	
When the maximum number of versions of a file is reached, the oldest is dropped and each previous version is incremented by one.	
Multiple connected target drives.	
Future - official support of additional AccuSafe device media hardware.	
Design for use with PAS	
Designed for use with COTS hardware.	
Files backed up as a result of AS operations are backed up with an AccuSafe directed file extension.	
Target any mass storage media - HD, CD R/RW drives, MO drives, NAS drives.	

Feature List

Note	Est Code	Diffic
	1	
	3.5	
	1	
	4	
	4	
EB: Only on rapidly changing files and directories? Yes, files not directories performed by Monitor/Advisor		
EB: This is different than what was stated in meeting - IPCI does not want auto update, user or Advisor initiates	3	
Not sure what this is... Defaults for the program options.		
HS: ?? IPCI not sure either		
	1	
Implied - is it stated?		
HS: why would user make a back up of a backup file before they delete the backup file.	3.75	
	3.75	
	4.5	
	1	
	3.75	
	1	
	3.75	
	1	
	3.75	
	3.5	
	3	
	5	
	1	
	1	
	1	
	1.5	
	5	
For this item and 37,45,46,47,48,49,50,56 - As written these are very difficult - as they are hardware specific - if, howev	5	
	1	

Feature List

[illegible]

FeatureNum	Bucket	Group	Priori	Ph	Docum	Docum
23	BackupMedia	Hardware	Dup3		AVD	
6	BackupMedia	Hardware	1		SOW	1.0
333	BackupMedia	Hardware	1		ERS	6.12
48	BackupMedia	Hardware	1		ERS	3.3
53	BackupMedia	Files	1		ERS	6.03
54	BackupMedia	Files	1		ERS	6.04
55	BackupMedia	Files	1		ERS	6.04
56	BackupMedia	Hardware	2		ERS	6.04
57	BackupMedia	OS	3		ERS	6.04
58	BackupMedia	Files	3		ERS	6.04
50	BackupMedia	Hardware	3		ERS	3.3
111	BackupMedia	Files	1		ERS	6.05
110	BackupMedia	Files	2		ERS	6.18
60	BackupMedia	Files	1		ERS	6.04
49	BackupMedia	Hardware	2		ERS	3.3
59	BackupMedia	Files	1			
241	BackupMedia	Files	1		AIQI	
96	BackupMedia	Hardware	1		ERS	6.12
47	BackupMedia	Hardware	1		ERS	3.3
367	BackupMedia	Files	1		ERS	6.04
46	BackupMedia	Hardware	1		ERS	3.3
260	BackupMedia	Files	1		ERS	5.0
368	BackupMedia	Files	2		ERS	6.04
45	BackupMedia	Hardware	1		ERS	3.3
304	Core App	Action	1		ERS	6.02e
256	Core App	Performance	2		ERS	5.0
189	Core App	Action	3		QCPC	
257	Core App	Performance	2		ERS	5.0
274	Core App	Detect	1		ERS	6.02
218	Core App	Detect	1		AIQI	
270	Core App	Detect	1		ERS	6.02
226	Core App	Encryption	3		ERS	6.09
276	Core App	Detect	1		ERS	6.02

Description	
Design to work with PAS	
Store to an external storage device	
A UNC path (including directory specifications) as well as a drive letter prefixed path (including directory specifications) will be allowed	
Design for use on dial up networking connected hard drives	
Files are to be backed up in their native format.	
An information file containing the specifics of each backed up AccuSafe file is kept in a simple format.	
The AS information file is kept on the AccuSafe target drive	
The AS target drive is to be able to be portable between different computers.	
The AS Target drive is to be portable between different platforms	
Portability of the AS target drive will not require migration of a "master database" from one computer to another.	
Design for use in PCI-developed external hard drives on USB, Firewire, Serial or Parallel	
Long file/path names that would exceed 255 characters when placed under the AS Backup media directory structure will be truncate	
AS backup filenames and their paths should mirror the original file structure with the addition of AS specific extensions added to the	
The AS information file will contain:	
Design for use on Fujitsu MO drives on USB or Firewire	
The AccuSafe information file exists in parallel to the backup file for each stored file version.	
Open files directly from backup repository	
AS should be able to communicate with any device that appears as a hard drive to the AS application (uses drive API and has a drive	
Design for use on LAN/WAN connected hard drives.	
The AS Information file is a flat ASCII file	
Design for use on directories on internal hard drives used for standard and AccuSafe related file storage.	
Versioned copies of files are saved on a defined AS drive.	
The directory structure on the AS backup media is \AccuSafe\{pcname}\{pcdrive}\{pcdirname} where pcname and pcdrive identify the	
Design for use with AccuSafe dedicated internal hard drives	
When files are moved on AS, either directly on AS or as a result of PC activity, all revisions and information files are moved as well.	
Less than 2% increase in average CPU usage allowed	
HW and SW solution	
No detectable change in keyboard or mouse operations by a power user allowed.	
File information is available and responded to in AccuSafe when a file is deleted	
Automatic file change detection and storage for all files, in all directories, and on all connected disk drives.	
File information is available and responded to in AccuSafe when a file is moved.	
File encryption - [remainder of comment from AIQI] Can be specified at the drive, directory, file name, file base name and/or file extension	
On a file open, file properties are recorded by AccuSafe.	

Note	Est Code	Diffic
Connected device with drive letter assignment, mapped network drive, network UNC path	5	1
	5	1
	5	1
	5	1
EB: Where in NT - AS prog directory? Has to do with permission issues btw admin and user	5	10
EB: ?	2	5
	1	1
	1	1
	1	1
	5	5
Without disaster recovery from failed/crashed hard disk - still achieve system roll back recovery	5	1
	1	5
	2	1
EB: ?	5	5
	4.5	
	4.5	
	4	
	4	
	1	
	4	

FeatureNum	Bucket	Group	Priority	Ph	Docum	Docum
227	Core App	Compression	2		ERS	6.10
269	Core App	Detect	1		ERS	6.02
273	Core App	Detect	1		ERS	6.02
272	Core App	Detect	1		ERS	6.02
271	Core App	Detect	1		ERS	6.02
305	Core App	Action	1		ERS	6.02e
369	Core App	Rules	1		ERS	5.0
316	Core App	Encryption	3		ERS	6.09
296	Core App	Action	1		ERS	6.02d
329	Core App	Compression	2		ERS	6.10
298	Core App	Action	1		ERS	6.02d
299	Core App	Action	1		ERS	6.02d
300	Core App	Action	1		ERS	6.02e
301	Core App	Action	1		ERS	6.02e
302	Core App	Action	1		ERS	6.02e
303	Core App	Action	1		ERS	6.02e
52	Core App	Performance	1		ERS	4.0
294	Core App	Action	1		ERS	6.02c
366	Core App	Rules	1			
295	Core App	Action	1		ERS	6.02d
44	Core App	Hardware	1		ERS	3.2
43	Core App	Hardware	1		ERS	3.2
42	Core App	Hardware	1		ERS	3.2
41	Core App	Hardware	1		ERS	3.2
40	Core App	Hardware	1		ERS	3.2
39	Core App	Hardware	2		ERS	3.2
38	Core App	Hardware	1		ERS	3.2
29	Core App	Action	1		ERS	2.0
380	Core App	Action	1		ERS	6.02c
24	Core App	Architecture	1		ERS	2.0
51	Core App	Performance	Dup		ERS	4.0
284	Core App	Action	1		ERS	6.02b
318	Core App	Encryption	3		ERS	6.09

Description	
File compression -[remainder of comment from AIQIJ]	Can be specified at the drive, directory, file name, file base name and/or file extension
File information is available and responded to in AccuSafe when a file is opened.	
File information is available and responded to in AccuSafe when a file is renamed	
File information is available and responded to in AccuSafe when a file is copied	
File information is available and responded to in AccuSafe when a file is created	
File moves on the AS device, but outside the AS directory structure, are detected and handled by AS normally	
The user is not allowed to format the AS drive while there is still information on it that does not exist in the system drive.	
Multiple encryption algorithms varying in strength and performance are desired.	
When a user copies a file on the AS device, warning messages are given, but the user is allowed to proceed	
Users viewing or restoring compressed files will be exposed to a decompression progress indicator prior to the file being viewed or restored	
When a file is copied in AccuSafe, either directly or as a result of a PC activity, all corresponding AS files are copied as well.	
When a file copy takes place on the AS device, but outside the AS directory structure, AS responds normally.	
When files are moved on the PC, AS detects the file write associated with the creation of the new copy and conducts backup operation	
Does a 'move' operation result in file writes on the PC, or does it just modify directory content tables? If file writes don't occur, then file information is not updated	
When a user moves a file on the AS device, warning messages are issued but the user is allowed to proceed.	
When a user moves a file on the AS device, should the corresponding files be moved on the PC?	
Product use must result in negligible network performance degradation on if the AccuSafe Media device is located on a network connection	
File renames on the AS device but outside the AS directory structure are detected and handled by AS normally.	
The Core application receives the messages from the kernel, applies rules from the OpDb, creates the required action request, then sends the request to the AS device	
When a file is copied on the PC, AS detects the file write event and backs up the file as normal.	
Design for use with MS approved pointing device.	
Design for use with VGA display	
Design for use with 3.5" floppy drive	
Design for minimum of 4x CDROM	
Design for minimum of 16 MB available RAM	
Design for minimum of 100 MHZ AMD Processor	
Design for minimum of 100 MHZ Intel Pentium Processor	
Disaster recovery without user action or intervention	
When a file is renamed, all backup files, revisions, and information files on the AS device are renamed as well.	
Client based software	
Product use must result in negligible PC performance degradation on client PC's - System performance impact is negligible - AccuSafe	
When a file is deleted, AS asks if the user if the corresponding backup files should simultaneously be deleted.	
Legality issues may direct which encryption algorithms are available.	

Note	Est Code	Diffic
EB: Eric remembers Dynazip being discussed.		1
For all of the detection aspects of the application, anything but Windows 95 is basically a mystery.		4
		4
		4
		4
		1
Add Fdisk, Initialize, Repartition, and DOSBoot to list - Also, how would you trap for this?		5
		5
		5
Depending on what product is being used for decompression, there may not be any events or anything else to capture s		4
Can this cause recursion errors - to do this we'd have to monitor the AS drive and respond to events on it, but that could		5
		1
		1
		5
No, the info file retains the location of the original file		
		4.5
		3
		1
		1
		1
		1
		1
We don't have one of these!		2
		1
EB: ? Define better - user is provided step by step instructions to recovery		5
		1
The difficulty isn't with making the product client based rather than client server - but some features may not work well,		3
		4.5
		1
		1

[illegible]

FeatureNum	Bucket	Group	Priority	PhDocum	Docum
319	Core App	Encryption	3	ERS	6.09
320	Core App	Encryption	3	ERS	6.09
321	Core App	Encryption	3	ERS	6.09
322	Core App	Compression	2	ERS	6.10
325	Core App	Compression	2	ERS	6.10
326	Core App	Compression	2	ERS	6.10
327	Core App	Compression	2	ERS	6.10
328	Core App	Compression	2	ERS	6.10
330	Core App	Rules	1	ERS	6.11
313	Core App	Encryption	3	ERS	6.09
278	Core App	Action	1	ERS	6.02
297	Core App	Action	1	ERS	6.02d
283	Core App	Action	1	ERS	6.02a
293	Core App	Action	1	ERS	6.02c
285	Core App	Action	2	ERS	6.02b
286	Core App	Action	1	ERS	6.02b
287	Core App	Action	1	ERS	6.02b
288	Core App	Action	1	ERS	6.02b
289	Core App	Action	1	ERS	6.02c
290	Core App	Action	1	ERS	6.02c
291	Core App	Action	1	ERS	6.02c
292	Core App	Action	Dup	ERS	6.02c
282	Core App	Action	1	ERS	6.02a
172	GUI	FeatureAccess	1	AFD	
168	GUI	FeatureAccess	1	AFD	
167	GUI	FeatureAccess	1	AFD	
166	GUI	FeatureAccess	1	AFD	
125	GUI	FileAccess	3	ERS	6.24J
90	GUI	FeatureAccess	1	ERS	6.11
314	GUI	FeatureAccess	3	ERS	6.09
95	GUI	FeatureAccess	2	ERS	6.11
266	GUI	FeatureAccess	1	ERS	6.01
267	GUI	FeatureAccess	1	ERS	6.01

Description	
Encryption feature should be designed so that it is modular and can be easily updated with new encryption algorithms.	
When a user attempts to view or restore an encrypted file they will be requested to supply the appropriate security parameters before Administrator capability will provide opportunity to decrypt files even if original parameters are not known. This feature only available AccuSafe will provide a means for files to be compressed as they are copied to the AS device	
Several types of compression algorithms should be available offering different compression ratios and performance options.	
Selection of available compression algorithms may be affected by legal issues.	
AS compression functions will examine source file contents in order to determine which of the available algorithms should be used to AS compression features should be engineered so that it is easy to upgrade them in a modular manner...	
A control hierarchy will be employed to eliminate contradictions such as selecting a particular file or type to include within a folder, the A user will be able to have files encrypted as they are backed up to the AS device.	
Captures and copies occur in the background without user's interaction	
When a user copies a file on the AS device, should the corresponding files be copied on the PC?	
File changes on the AS device, but outside the AS directory structure, are detected and handled by AS normally.	
Whenever files are renamed on AS, (whether directly or as a result of a rename on PC) all revisions and information files are rename	
When files are deleted on the PC that are not backed up on AccuSafe a copy of the file is made to AccuSafe prior to the delete actual	
When files are deleted from the AccuSafe directory structure, appropriate warnings are presented, but the use is allowed to continue	
When a file is deleted by the user from the AS backup devices, should the corresponding files on the PC be deleted?	
When files are deleted on AccuSafe, all revisions and information files are also deleted	
When a file is renamed on the PC, AS performs the same rename on the AS storage device.	
If a file being renamed is not presently stored on AS, the rename operation causes a backup to occur immediately.	
If a user renames files on the AS backup device, the user is warned but allowed to rename the files anyway.	
If the user renames a file on the AS device, are the corresponding files on the PC renamed?	
Users are not allowed to change file contents within the AS directory structure on the AS device.	
Right mouse drag and drop	
right mouse - Delete	
right mouse - copy to...	
Right mouse - restore from	
Future - tie certain AccuSafe features and/or look-and-feel to firmware codes supplied by AccuSafe device media and/or hardware.	
The user must have right click access to the include/exclude status of a file. (Adjust AccuSafe behavior)	
Encryption capabilities will be adjustable via the file specific as behavior tab on the file/directory properties dialog.	
The AS properties dialog box must be available for all files, on all attached devices, when the AS SW is present on the PC.	
Adjustments to AccuSafe Behavior is available via right click	
File or Folder restoration is available upon right click.	

Feature List

Note	Est Code	Diffic
HS: Should it be specified that any upgraded encryption modules be backwards compatible?		3.5
HS: Portable unlock key?		1
Defeats the purpose of encryption to provide an administrative way around it - also would require 2 separate encryption		100
		4
		5
		1
		5
HS: Does it need to be stated that they should be backwards compatible.		3.5
		4
		4
		1
No		
		3
		5
		3
		2
No and ...HS: Are records in OpDb deleted as well? - Yes		
		1
		1
No		1
		1
No		
1 - how do you prevent this - especially if the device is a shared device? Also, despite this statement in the ERS, there		5
EB: Right Click in what area? Where is the user?		
EB: Right Click in what area? Where is the user?		
EB: Right Click in what area? Where is the user?		
EB: Right Click in what area? Where is the user?		
		3
		1
		1
		1
		1

Feature List

[illegible]

FeatureNum	Bucket	Group	Priorit	PhDocum	Docum
268	GUI	FeatureAccess	1	ERS	6.01
264	GUI	FeatureAccess	1	ERS	6.01
91	GUI	FeatureAccess	1	ERS	6.11
263	GUI	FileAccess	1	ERS	6.01
75	GUI	FeatureAccess	1	ERS	6.07
315	GUI	FeatureAccess	3	ERS	6.09
317	GUI	FeatureAccess	2	ERS	6.09
323	GUI	FeatureAccess	2	ERS	6.10
324	GUI	FeatureAccess	2	ERS	6.10
67	GUI	FeatureAccess	1	ERS	6.07
94	GUI	FeatureAccess	1	ERS	6.11
106	GUI	FileAccess	2	ERS	6.15
103	GUI	FileAccess	2	ERS	6.15
104	GUI	FileAccess	1	ERS	6.15
105	GUI	FileAccess	2	ERS	6.15
236	GUI	FileAccess	2	AIQI	
234	GUI	FeatureAccess	1	ERS	
265	GUI	FeatureAccess	1	ERS	6.01
107	GUI	FileAccess	2	ERS	6.16
108	GUI	FeatureAccess	1	ERS	6.17
109	GUI	FileAccess	1	ERS	6.17
120	Intelligenceuer	Future	3	ERS	6.24E
119	Intelligenceuer	Future	2	ERS	6.24D
116	Intelligenceuer	Future	2	ERS	6.24A
124	Intelligenceuer	Future	3	ERS	6.24I
121	Intelligenceuer	Future	3	ERS	6.24F
128	Intelligenceuer	Future	3	ERS	6.24M
84	Intelligenceuer	OffLine	1	ERS	6.08
309	Intelligenceuer	Architecture	1	ERS	6.08
334	Intelligenceuer	Boot	1	ERS	6.19
310	Intelligenceuer	Architecture	1	ERS	6.08
312	Intelligenceuer	?	1	ERS	6.08
308	Intelligenceuer	RealTime	2	ERS	6.08

Description	
System restore functions are available by double-clicking the minimized AccuSafe icon.	
There is an AccuSafe icon that appears minimized on the system tray.	
A tabbed page in the properties dialog should include AccuSafe properties. (accessible from the right-click action on a file)	
The user interface is the Windows Explorer	
The AS restoration should use the Windows Explorer.	
Default encryption settings will be available to the user via the general AS behavior tab	
User interface should be provided so that the user can specify algorithm specific parameters such as password, key, etc	
Compression capabilities will be adjustable via the file specific AS behavior tab on the file/directory properties dialog	
Default compression related features will be available to the user via the general AccuSafe behavior tab.	
AS file restoration is to be accomplished via a UI similar to other AS UI's	
General AS behavior should be available (user name, company name, etc) should be available when the user right	
Design look & feel of AS directories using a method that users cannot override as easily as using the desktop.ini and folder.htt files,	
AS backup directories and the files in them should have a visual appearance and operation that differentiates them from standard file	
AS related files stored in the AS media device directory must be hidden and not visible to the user. (reduce clutter, potential user inter	
Design look and feel and shown directory contents by some other means than marking files as 'hidden' as the user can override this	
Distinctive look to the backed up files - Via AccuSafe file icons	
Feature set integrated within the Windows Explorer	
AccuSafe is right mouse click context driven	
When viewing AS media device directory structures, backup files should have a distinctive AS related icon regardless of their native t	
An AS icon in the system tray should be visible, indicate that AS is operational, provide progress when applicable, and allow right clic	
Standard tool tip on mouse over of System Tray icon should be visible.	
Future - use of multiple encryption types for optimization of speed and security, and to position encryption capabilities to be legally di	
Future - disk spanning for use with lower storage capacity AS device media This function would make use of IntelliQueueing mechani	
Future - enhanced compression functions that briefly analyze the file type being compressed and the select algorithms for speed or s	
Future - Block level and or byte level file change recording. This will reduce the disk space requirements currently associated with the	
Future - Integrated virus scanning capabilities and enhanced virus protection mechanisms.	
Future - enhance the redundant file elimination mechanism so that redundant files can be detected and linked (rather than copied) int	
IntelliQueueing - Can retain changes even when the applicable storage device is not connected, or the storage device's media is not p	
The IQ queue database should be implemented using standard, simple technology such as MSJet to an Access db.	
During the boot process, AS will update Windows system files that cannot be easily copied once Windows is up and running (i.e. - Nt	
The IQ queue database should be maintained on the client PC in the AS installation directory, and should be backed up under AS.	
Are file restoration operations to be controlled by the IQ?	
The buffer/unbuffer can be used when the user has set AccuSafe to meter file transfers to the as storage device in order to reduce n	

FeatureNum	Bucket	Group	Priori	Ph	Docum	Docum
307	Intelligenceuer	OffLine	1		ERS	6.08
306	Intelligenceuer	RealTime	1		ERS	6.08
262	Intelligenceuer	OffLine	1		ERS	5.0
261	Intelligenceuer	OffLine	1		ERS	5.0
259	Intelligenceuer	RealTime	1		ERS	5.0
224	Intelligenceuer	RealTime	1		AIQI	
223	Intelligenceuer	Action	2		AIQI	
201	Intelligenceuer	OffLine	1		QCPC	
311	Intelligenceuer	Architecture	1		ERS	6.08
194	Intelligenceuer	Other	Dup2		QCPC	
181	Intelligenceuer	RealTime	3		AFD	
153	Kernel	Detect	Dup		AFD	
1	Kernel	Detect	1		SOW	1.0
165	Kernel	Architecture	Dup		AFD	
258	Kernel	Detect	1		ERS	5.0
277	Kernel	Detect	1		ERS	6.02
378	Kernel	Architecture	2		ERS	4.0
377	Kernel	Architecture	3		ERS	3.1
376	Kernel	Architecture	2		ERS	3.1
375	Kernel	Architecture	1		ERS	3.1
374	Kernel	Architecture	1		ERS	3.1
208	Kernel	Architecture	1		QCPC	
281	Kernel	Detect	1		ERS	6.02a
118	Kernel	Future	3		ERS	6.24C
146	Logistics	Packaging	2		ERS	9.05
33	Logistics	Distribution	2		ERS	2.0
147	Logistics	Packaging	2		ERS	9.05
32	Logistics	Distribution	2		ERS	2.0
31	Logistics	Distribution	2		ERS	2.0
30	Logistics	Distribution	1		ERS	2.0
148	Logistics	Packaging	2		ERS	9.07
34	Logistics	Distribution	2		ERS	2.0
35	Logistics	Distribution	2		ERS	2.0

Description	
If the AS device is not available, file transfers are performed to a buffer area. The unbuffer request is generated/maintained until the IQ is responsible for managing all AS generated PC to AS device file transfer requests in a time ordered fashion. Once AS determines reconnection to AS Drive after a disconnection, data will be copied over without user intervention.	
Break in connection between PC and AS drive destination does not interfere with AS db tracking of changes that occur	
Creates db log of relevant file saves	
Automatic synchronization with PC	
Manual synchronization with PC	
Off line change capture	
Each IQ queue entry should include, source path, target path, encryption mode and attributes, operation to be performed, earliest date	
Complete mirroring	
Virus Scan, (AIQI)Protection from virus contamination -Via file difference checking between stored and restored revisions.	
Fully automated with no user intervention required, real time background operation	
Real Time	
Fused with the OS	
AS tracks file operations at the interrupt level	
AccuSafe reacts when a user makes a change and saves the file. AccuSafe tells IntelliQueueer that the file requires copy to AS.	
The architecture should be designed so that it is re-usable in Windows applications beyond the AccuSafe Application, and to efficient	
AccuSafe will be fully functional, tested and supported on Windows 2000.	
AccuSafe will be fully functional, tested and supported on Windows NT4.0.	
AccuSafe will be fully functional, tested and supported on Windows 98.	
AccuSafe will be fully functional, tested and supported on Windows 95.	
ActiveX, VxD controls	
When files are changed on the PC, AS automatically detects the changes and conducts the normal backup operations specified for t	
Future - official support of Mac, Linux, and Unix OS's	
CD front liner created for jewel case - may contain getting started guide.	
Product to be distributed as mailed evaluation CD's	
CD Back Liner will be included with jewel-cased CD.	
Product to be distributed bundled with targeted hardware	
Product to be distributed via download evaluations	
Product to be distributed via internet	
CD will be attractively silk-screened.	
Product to be distributed to white box PC's (?)	
Product to be bundled with OEM PC manufacturers	

Feature List

Note	Est Code	Diffic
HS: Is it possible to perform actions on the PC side that queue activities in IQ that can't be completed ?		3
		2
		3
		3
		1
HS: Not sure what this means		
HS: Not sure what this means		
		1
HS: Of everything?		4.5
Listed as future enhancement in ERS but found twice in other docs - AFD and AIQI		
EB: Exactly what parts of the program are to be real time? Detection of file saves, change, delete, rename, copy		
Core App?		
		3
		1
		5
Supported on Windows 2000 only if the final retail version is available to AS QA at least 2 months prior to market releas		5
		4
		3
		2
HS: The ERS says detects changes - would it be better to say that it detects a save event?		1
EB: Can new CD Holder be used?		
EB: Is there a "unlock > convert to full" key?		
EB: Can new CD Holder be used?		
EB: Is there a "unlock > convert to full" key?		

FeatureNum	Bucket	Group	Priorit	Phi	Docum	Docum
15	Logistics	Distribution	1		AVD	
20	Logistics	Distribution; Pack	1		AVD	
341	Monitor	Detect	1		ERS	6.21
222	Monitor	Action	2		AIQI	
221	Monitor	Action	2		AIQI	
348	Monitor	Detect	1		ERS	6.21c
347	Monitor	Detect	1		ERS	6.21b
275	Monitor	Detect	1		ERS	6.02
346	Monitor	Detect	2		ERS	6.21a
64	Monitor	RealTime	3		ERS	6.06
343	Monitor	Performance	1		ERS	6.21
340	Monitor	RealTime	1		ERS	6.21
122	Monitor	Future	3		ERS	6.24G
219	Monitor	Action	1		AIQI	
337	Monitor	Boot	1		ERS	6.19
345	Monitor	Detect	1		ERS	6.21
338	Monitor	Boot	1		ERS	6.19
344	Monitor	Detect	1		ERS	6.21
342	Monitor	Detect	1		ERS	6.21
353	Monitor	Action	2		ERS	6.21e
245	Monitor	Detect	2		AIQI	
161	Monitor	RealTime	2		AFD	
160	Monitor	RealTime	2		AFD	
156	Monitor	RealTime	2		AFD	
163	Monitor	RealTime	3		AFD	
182	Monitor	RealTime	1		AFD	
354	Monitor	Action	2		ERS	6.21e
205	Monitor	??	Dup		QCPC	
352	Monitor	Detect	3		ERS	6.21d
101	Monitor	Boot	1		ERS	6.14
351	Monitor	Detect	2		ERS	6.21c3
231	Monitor	Action	2		AIQI	
350	Monitor	Detect	1		ERS	6.21c2

Feature List

Description	
Designed for mass distribution (millions)	
Design for OTS distribution	
AS Monitor performs its checks each time a file is transferred from the PC to the AS device.	
Smart backup algorithms automatically shift between retention of all changes, and storage of files at specified time intervals when file	
Time interval-specified backup even if a file change did not occur within the time interval	
AS Monitor detects when PC to AS storage device communication cannot be established or have been interrupted. ASMon warns th	
ASMonitor will detect frequent modifications of a file that is in the AS backup mechanism, but whose frequent transfer from PC to AS	
AS screens and captures, on a periodic basis, files that are in constant use and updated frequently so that they can be restored/back	
ASMonitor will detect frequent modifications of a file that is excluded from the AS backup mechanism. It will respond by automatically	
AS shall employ a redundant file elimination technique to reduce backup space requirements and bandwidth requirements. Details in	
AS monitor does not interfere with PC performance	
Monitor's AS' operation on a continual basis	
Future - Enhanced AccuSafe monitor capabilities	
Time interval specified backup if a file change occurred within the time interval	
The AccuSafe monitor will begin house-keeping checks following Windows boot-up and any startup virus check programs.	
ASMon watches for situations on a file by file basis that may require either automatic or manual intervention to resolve. AS Monitor will t	
After bootup, the AS IQ database is checked for queued files and the AS device is tested for communications link.	
ASMonitor assures that AS application data structures and databases remain internally consistent.	
ASMonitor assures that connectivity to the AS device is properly maintained	
All actions taken by AS Monitor should be chronologically logged.	
Backup system monitor functions for automatic performance and functional tuning, as well as hardware/software health detection	
Ongoing SW diagnostics	
Ongoing HW diagnostics	
Audit capability	
Auto background formatting	
AccuSafe Monitor	
The AS Mon log should be printable, viewable and resizable.	
Multiple destination control	
AS Monitor detects that bandwidth between the PC and AS storage device is causing file transfer times to be elongated beyond norm	
A splash screen on start up should provide graphics, file info, and messages that give the user the progress of the AS boot process.	
AS Monitor detects that the media in AS device is not the one that contains revision history for a particular file. AS Mon responds by	
Schedules or meters file changes to storage device in order to minimize impact on PC-to-storage device bandwidth.	
AS Monitor detects that AS storage device is full during a file transfer	

Feature List

Note	Est Code	Diffic
		4
		4
		4
		4
		4
HS: Discussed changing this feature in meeting		4
		5
		3.5
Time interval backup of certain files change or no-change		
		4
		2
		4
		2
		1
HS: What are the diagnostics?		
HS: What are the diagnostics?		
?		
HS / EB : ???		
		1
HS: Not sure what this means		
How does the monitor know what is acceptable? How does it not go into a permanent state of 'waiting 'till I'm faster'? W		5
		2
		5
HS: Would it be better to prevent this rather than detect it		1

Feature List

[illegible]

FeatureNum	Bucket	Group	Priorit	PhDocum	Docum
349	Monitor	Detect	1	ERS	6.21C1
65	Monitor	RealTime	3	ERS	6.06
355	Monitor	Action	1	ERS	6.21e
370	OpDb		1	ERS	6.04
61	OpDb		1	ERS	6.04
331	OpDb		1	ERS	6.11
372	OpDb		1	ERS	6.04
228	OpDb		1	ERS	1.0
229	OpDb		1	AIQI	
379	OpDb	Rules	2	ERS	6.02
371	OpDb		1	ERS	6.04
93	OpDb		1	ERS	6.11
66	OpDb		1	ERS	6.06
388	Restore	File Recovery	3	ERS	6.03e
373	Restore	Disaster Recover	1	ERS	6.03c
387	Restore	File Recovery	1	ERS	6.03d
386	Restore	File Recovery	2	ERS	6.03b
385	Restore	Disaster Recover	1	ERS	6.03a
79	Restore	File Recovery	1	ERS	6.07
389	Restore	Disaster Recover	3	ERS	6.13
237	Restore	Disaster Recover	3	AIQI	
100	Restore	Disaster Recover	2	ERS	6.13
99	Restore	Disaster Recover	3	ERS	6.14
98	Restore	Disaster Recover	1	ERS	6.13
97	Restore	Disaster Recover	3	ERS	6.13
83	Restore	File Recovery	1	ERS	6.07
82	Restore	File Recovery	1	ERS	6.07
73	Restore	File Recovery	1	ERS	6.07
80	Restore	File Recovery	2	ERS	6.07
68	Restore	File Recovery	1	ERS	6.07
78	Restore	File Recovery	2	ERS	6.07
77	Restore	File Recovery	1	ERS	6.07
76	Restore	File Recovery	1	ERS	6.07

Description	
AS Monitor detects that AS media is full. Responds by warning user an allows them to change the media now or later. IQ is used until File redundancy checking shall employ file size, checksum, file location, and date-time.	
AS Monitor should not be interrupting the user much, especially when immediate action is not required for them to continue.	
The OpDb should be a database file, not an ASCII file	
AS operation information, including default values is store in the AccuSafe operational database.	
All persistent information as to the items selected for inclusion and or exclusion should be stored in the AccuSafe Operational database Extension / basename/ directory based default values are in OpDb	
File revision control - Can be specified at the drive, directory, file name, file base name and/or file extension level.	
Adjustable number of stored file revisions. - Can be specified at the drive, directory, file name, file base name and/or file extension level	
The default number of backup revisions kept is 4.	
The OpDb is stored in the installation directory and backed up in AS	
Persistent inclusion/exclusion information shall be maintained in the AccuSafe operational database.	
A table of all of the AS stored files with a particular base name shall be created and maintained	
The recovery process should be able to deal with file formats from non-Windows computing platforms without the necessity for platform Provide a simple recovery opportunity / process in the unlikely event that the AS SW isn't available, becomes corrupted, or fails in so	
The AS Restore process should be able to deal with a very large and growing variety of file formats without the necessity to individual	
The AS restore process should not inhibit a high performance backup process (in other words, users are more sensitive to the speed	
The recovery process should be technically simple.	
The user can select an item from the list to be restored to its original location	
Restore capability should allow a user to rebuild a new hard drive from the AS media device that was fully synchronized with a PC.	
Full system recovery and disk cloning	
After restart (emergency boot) the user should be able to either proceed immediately to system restoration functions or operate as if the emergency boot floppy should be able to redirect the boot device to the AS media device, then restart the computer from the Accu	
AS should be able to generate an emergency boot floppy (3 5" media only).	
AS should implement the ability to completely restore a users system in the event of a crashed system hard disk, destroyed files, or o	
The user must be able to view the file in the restore list by selecting a file, clicking a 'view' button which will call the appropriate viewer	
The AS restore process will determine if the file to be restored will overwrite a file of the same name and provide options to the users	
Multiple file selection capabilities must be provided during file restoration.	
The user can select an item from the list to be restored to an alternate location.	
AS users must have the ability so select files to be recovered during a restoration by full file name.	
The restore UI should display the file timestamp, original file location, possibly a comment provided by the user to describe a particular	
The restore function should have an intuitive user interface.	
The user should have right click access to file restore features.	

Feature List

Note	Est Code	Diffic
		2
		4
		3
		1
		1
HS: Could use some more info on opdb		1
		1
		1
		1
		1
		1
		1
HS: how do you make it easy if AS doesn't exist any more - should it be downgraded to possible?		4
		1
		3.5
For file recovery - this only has a difficulty of 3		5
		1
		5
		5
		5
		5
		5
EB: ?Open?		1
		1
		3.5
		1
		1
		1
		1
		1

FeatureNum	Bucket	Group	Priority	PhDocum	Docum
74	Restore	File Recovery	2	ERS	6.07
72	Restore	File Recovery	2	ERS	6.07
71	Restore	File Recovery	1	ERS	6.07
70	Restore	File Recovery	2	ERS	6.07
69	Restore	File Recovery	2	ERS	6.07
81	Restore	File Recovery	2	ERS	6.07

Feature List

Description	
User must be able to indicate files not to be restored at the file, directory, and drive level.	
AS users must have the ability to select files to be recovered during a restoration by drive.	
AS users must have the ability to select files to be recovered during a restoration by directory.	
AS users must have the ability to select files to be recovered during a restoration by file extension.	
AS users must have the ability to select files to be recovered during a restoration by base file name.	
AS will check the checksum of the file to be restored (just before it is restored) with the checksum of the file when it was originally ba	

Master Risk Assessment Document

#	Name	Source	Likely Cause	Consequence
1	Not enough time	Project Management	Insufficient development plan	Miss delivery date
2	Not enough resources	Project Management	Insufficient development plan, Pro	Miss delivery date, Cost overrun
3	No hardware partner vendor	Marketing	Product doesn't seem value added	Low and/or difficult market penetration
4	Beaten to market by competitor	Marketing	Timeline not aggressive enough, r	Low and/or difficult market penetration
5	Software conflicts	Development	Flawed architecture	User dissatisfaction, product use discontinued
6	Runtime error rate too high	Development	Error handling insufficient, bench testing insufficient	User dissatisfaction, product use discontinued
7	Basic architecture won't work	Development	Good idea gone bad	Development significantly delayed, maybe impossible
8	Performance impact too high	Development	Too much happening on system real-time	User dissatisfaction, product use discontinued
9	A key feature won't work (not released)	Development		V1 release incomplete
10	Too many features in Version 1	Project Management	Project scope too large	Miss delivery date or incomplete release
11	Unable to support vendor after sale	Infrastructure	No plan or supporting infrastructure, too many field problems	User dissatisfaction, bad word of mouth advertising
12	Unable to support users after sale	Infrastructure	No plan or supporting infrastructure, too many field problems	User dissatisfaction, bad word of mouth advertising
13	Learning products not ready by ship date	Development	Schedule slip, not enough time, no in-house expertise	Users don't know why or how they should use product, so they don't
14	Install program insufficient	Development	Field conditions of install not determined properly	User dissatisfaction, product not installed
15	Not enough resources for localization	Project Management		
16	Excessive recurring engineering costs	Project Management		
17	Feature creep	Project Management		
18	Unanticipated configurations (by user)	User		
19	Unanticipated user patterns	User		
20	Insufficient testing	QA		
21	Slow testing	QA		
22	Expensive testing	QA		
23			Insufficient test plan Test contractor not managed	

Master Risk Assessment Document

#	Name	Source	Likely Cause	Consequence
1	Not enough time	Project Management	Insufficient development plan	Miss delivery date
2	Not enough resources	Project Management	Insufficient development plan, Pro	Miss delivery date, Cost overrun
3	No hardware partner vendor	Marketing	Product doesn't seem value added	Low and/or difficult market penetration
4	Beaten to market by competitor	Marketing	Timeline not aggressive enough, r	Low and/or difficult market penetration
5	Software conflicts	Development	Flawed architecture	User dissatisfaction, product use discontinued
6	Runtime error rate too high	Development	Error handling insufficient, bench	User dissatisfaction, product use discontinued
7	Basic architecture won't work	Development	Good idea gone bad	Development significantly delayed, maybe impossible
8	Performance impact too high	Development	Too much happening on system	User dissatisfaction, product use discontinued
9	A key feature won't work (not released)	Development	Project scope too large	V1 release incomplete
10	Too many features in Version 1	Project Management	No plan or supporting	Miss delivery date or incomplete release
11	Unable to support vendor after sale	Infrastructure	infrastructure, too many field	User dissatisfaction, bad word of mouth
			problems	advertising
12	Unable to support users after sale	Infrastructure	No plan or supporting	User dissatisfaction, bad word of mouth
			infrastructure, too many field	advertising
13	Learning products not ready by ship date	Development	Schedule slip, not enough time,	Users don't know why or how they should
			no in-house expertise	user product, so they don't
14	Install program insufficient	Development	Field conditions of install not	User dissatisfaction, product not installed
			determined properly	
15	Not enough resources for localization	Project Management		
16	Excessive recurring engineering costs	Project Management		
17	Feature creep	Project Management		
18	Unanticipated configurations (by user)	User		
19	Unanticipated user patterns	User		
20	Insufficient testing	QA	Insufficient test plan	
21	Slow testing	QA	Test contractor not managed	
22	Expensive testing	QA		
23				

[illegible]

AccuSafe™ Version 1.0 External Reference Specification

(ERS Revision A.00.01 01172000)

17 January, 2000

1.0 Introduction

This document is the External Reference Specification for the AccuSafe™ product of Integrity PC Innovations, Inc. (IPCI). All content of this document is the sole intellectual property of IPCI. This document may not be used for any purpose or by any person without the written consent of IPCI.

By convention, this document will use the product names **AccuSafe™** and **AccuSafe** interchangeably. It is understood that AccuSafe™ is a trademark of Integrity PC Innovations, Inc.

Throughout this document, various items are marked as TBD, signifying an area or decision that is yet **to be determined**. This document is therefore a living document, whose contents are expected to evolve and become more refined throughout the definition, planning and R&D stages of development. It is understood however, that changes to this document beyond the initial non-draft release, must be approved by IPCI and applicable development resources, and may have ramifications including, but not limited to financial and schedule matters.

This document includes discussion of features, capabilities and concepts that are currently part of the overall AccuSafe product vision. It is not intended that everything described here will be implemented in the initial release of the product. The particular feature set of the initial version will be determined by the product team, with consideration to factors such as market pull, hardware partner-related requirements, technical risk, test risk, cost and schedule. The feature set for the initial AccuSafe release is enumerated elsewhere in this document.

2.0 AccuSafe Product Vision

Include more "what it is" information here...

AccuSafe™ is a client-based software application that creates data safety, integrity, backup, revision control and disaster recovery for the customer without user action or intervention. AccuSafe™ is intended for mass distribution to millions of customers. The primary target customer is the PC end-user (home-user, small business, and medium business). We envision a day when AccuSafe™ ships standard with every new PC sold as a means of ensuring the integrity of the intellectual property stored and created therein.

AccuSafe™ is being actively marketed by IPCI to several large hardware manufacturing companies in order to create large market exposure in a short period of time. Sales of AccuSafe™ are anticipated to occur as direct Internet downloads, download evaluations, bundled with targeted hardware, as mailed evaluation CD's, through distribution channels to "white box" PC's resellers and bundled with OEM PC manufacturers.

Commercial Off the Shelf (COTS) hardware will be used with AccuSafe™ to achieve a variety of configurations both as internal and external devices for customer ease-of-use.

It is envisioned that OEM PC manufacturers will deploy AccuSafe™ as the intrinsic backup/recovery tool of choice. The creation of a new product, Personal Attached Storage (PAS) is currently in line for development/deployment utilizing COTS hardware and USB, FW, and Ethernet interfaces..

It is further anticipated that the AccuSafe product will grow in terms of feature set, and will migrate beyond the present Microsoft Windows OS family to additional computing platforms (e.g. Mac, Unix, Linux), and will achieve compatibility with a broad range of external storage devices.

3.0 Supported Environments

3.1 Operating Systems

The AccuSafe application will be fully functional, tested and supported on the following operating systems:

Microsoft Windows 95

Supported service release levels and localizations TBD.

Microsoft Windows 98

Supported service release levels and localizations TBD.

Microsoft Windows NT 4.0

Supported service release levels and localizations TBD.

Microsoft Windows 2000

Supported service release levels and localizations TBD. The Windows 2000 operating system will be officially supported only if the final retail version is available to AccuSafe QA efforts at least 2 months prior to the market release of AccuSafe. However, design for Windows 2000 compatibility is a requirement of this product, and testing on Windows 2000 beta releases is required in the event that the final retail version of Windows 2000 is not available in time for official AccuSafe support.

3.2 Computer Platforms

The AccuSafe application will be fully functional, tested and supported on computer platforms meeting the following minimum system requirements:

- A. Intel Celeron, Intel Pentium, or AMD K6 processors
- B. 16 MB available RAM
- C. TBD MB available disk space (for program installation and operational data)
- D. TBD MB available disk space (for file repository)
- E. Single hard disk with single or multiple partitions
- F. 4x CD ROM
- G. 3 ½ " floppy drive
- H. VGA display
- I. Microsoft-approved keyboard and pointing device (serial mouse, bus mouse, trackball, etc.)

3.3 AccuSafe Media Devices

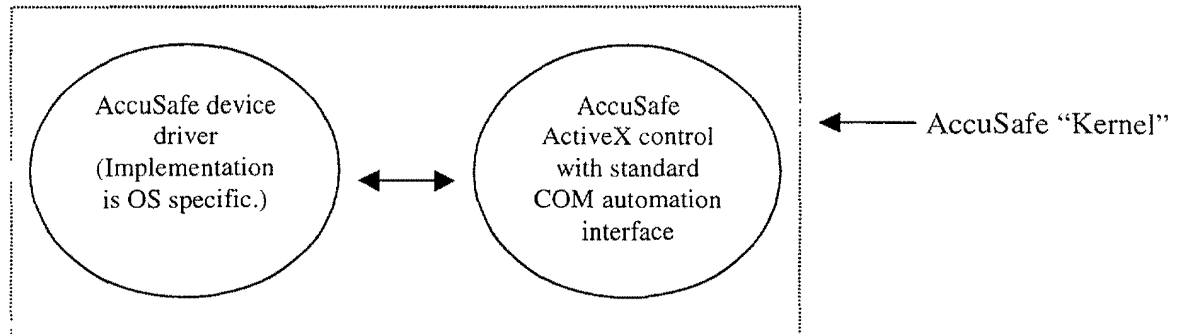
The AccuSafe application will be designed to work with any media device that appears as a drive letter to Microsoft Windows. AccuSafe release 1 will be fully tested and supported with the following media devices:

- A. AccuSafe-dedicated internal hard drives with single or multiple partitions
- B. Single or multiple directories on internal hard drives used for standard and AccuSafe-related file storage
- C. LAN/WAN-connected hard drives
- D. Dial-up-networking-connected hard drives
- E. Anticipated: Fujitsu MO drives on USB or Firewire
- F. Anticipated: Other manufacturers removable drives both internal and external

- G. Anticipated: IPCI-developed external hard drives connected via USB, Firewire, Serial or Parallel ports (the parallel port version is TBD in view of MicroSolutions parallel port storage device patent)
- H. Remainder of list TBD

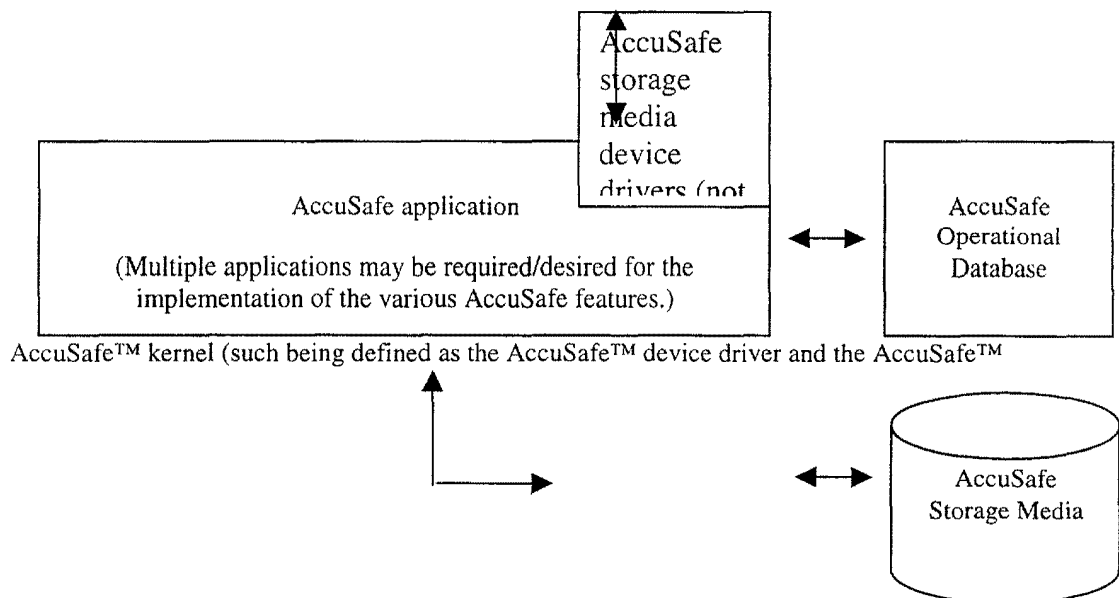
4.0 General Architecture

The following general system architecture is planned, though this can/will be adjusted in pursuit of AccuSafe technical and feature set goals.



This design architecture supports the required ability of AccuSafe™ to work with the Windows 95, 98, NT and 2000 operating systems in standard, Microsoft-supported WDM (Windows Driver Model) technologies. It is TBD as to whether or not WDM is the proper model to be used for integration with Windows NT and Windows 2000. The final architecture of the AccuSafe product must support AccuSafe features on Windows 95, 98, NT and 2000.

This architecture further provides for, and highlights the product requirement for the reuse of the



ActiveX control) in Windows applications beyond the AccuSafe™ application.

To the extent possible, the selected final architecture should be designed to provide efficient opportunities to migrate the AccuSafe™ application to the Mac, Linux, Unix, (etc.) computing platforms.

Further, the selected architecture must result in negligible PC performance degradation on client PCs, and via software features described elsewhere, should also result in low degradation to network resources in the event that the AccuSafe Media Device is located on a network connection.

Communications algorithms between functional blocks (shown by double-headed solid arrows above) should be implemented using standard Microsoft-supported communications techniques. For example, DCOM may be selected as the mechanism of choice between the ActiveX element and the application(s), with ODBC/Jet between the application and a Microsoft Access-based operational database.

5.0 General Theory of Operation

AccuSafe provides the user with true background and real time backup. No scheduling on the part of the user is required. No file selection by the user is required. The features offered may be individually selected or not selected and controlled or not controlled by the user at their choosing. By default, AccuSafe is installed as a complete file integrity and disaster recovery system. Should the user decide to limit AccuSafe to a data file integrity system only, this can be done with ease. The user has nearly complete control of the AccuSafe behavior. There are only a few areas AccuSafe will not allow the user control over for their own protection such as formatting the AccuSafe drive while there is still information on it that does not exist on the system drive. AccuSafe operates in the background and creates no noticeable system performance degradation (less than a 2% increase in average CPU usage and no detectable change in keyboard or mouse operations by a power user is considered not noticeable). There is no new user interface for the customer to learn, AccuSafe being completely integrated with Windows Explorer. The AccuSafe drive can be any Microsoft compatible hard disk, removable disk, mapped network drive, or other continuous read/write device that presents itself as a drive letter to Windows Explorer. AccuSafe tracks file operations at the interrupt level within the Windows OS, creates a database log of relevant file saves and then saves versioned copies of such files on a separate AccuSafe folder on the defined AccuSafe drive. A break in the connection between the user PC and the AccuSafe drive destination does not interfere with the AccuSafe database tracking of changes that occur. Once re-connected to the AccuSafe drive, data will be copied over without user intervention.

6.0 Application

The following key product features and attributes should be supported by the AccuSafe application.

6.1 User interface

The user interface is Windows Explorer. Additionally, the AccuSafe icon appears minimized on the system tray (right side of the Windows task bar). Similar to utilities such as WinZip, AccuSafe is right mouse click context menu driven. Adjustments to the AccuSafe behavior and to achieve file or file folder restoration is available upon point and right mouse click. System restore functions are available by double-clicking the minimized AccuSafe icon. The user should feel new features are now available after installing AccuSafe without a new interface.

6.2 File change monitoring and copying

AccuSafe constantly monitors the Windows OS for file activity. File information is available and responded to in AccuSafe when a file is opened, copied, deleted, renamed, moved or created. High activity system files that are in constant use and updated frequently are screened and captured on a periodic basis to enable complete and reliable system restore without creating performance issues by recording its every operation.

Once a user opens a file (perhaps a Word document for example), AccuSafe records the file properties and then does nothing until the user either closes the file without change, or makes a change and saves the file. When the save operation occurs, AccuSafe informs the IntelliQueuer that the file will require copying to the AccuSafe drive. The capture and copy then occurs in the background while the user continues to work. Versions of the file are maintained up to the number set in the AccuSafe features (or the 4 versions that is the default if not otherwise adjusted by the user). Once the maximum number of versions is reached, and another change is made to the file, the oldest version is dropped and each previous version is incremented by one.

a) Changing file contents

When files are changed on the PC, AccuSafe automatically detects the changes, and conducts the normal backup operations specified for the files.

Users are not allowed to change file contents within the AccuSafe directory structure on the AccuSafe device.

File changes on the AccuSafe device, but outside the AccuSafe directory structure, are detected and handled by AccuSafe normally.

b) Deleting Files

When files are deleted on the PC, AccuSafe responds with a message asking if the corresponding backup files (if any) should simultaneously be deleted on the AccuSafe storage device. (Note that this requires careful design, since the user could see large AccuSafe intrusion in their workflow if this is a frequent event, such as in the automatic deletion of temporary files by various applications [in this case though, the temporary files are probably "excluded" from the AccuSafe backup strategy.])

When files are deleted on the PC that are not backed up on AccuSafe, a copy of the files is made to AccuSafe prior to the delete actually occurring.

When a user deletes files from the AccuSafe directory structure on the AccuSafe storage device, appropriate warnings are presented, but the user is allowed to continue the delete operation if they wish. It is TBD if the corresponding files should, at the user's option, be deleted from the PC as well. Whenever files are deleted on AccuSafe, either directly on AccuSafe, or as a result of deleting them on the PC, all revisions and information files are deleted as well.

File deletions on the AccuSafe device, but outside the AccuSafe directory structure, are detected and handled by AccuSafe normally.

c) Renaming Files

When files are renamed on the PC, AccuSafe performs the same rename operation on the AccuSafe storage device. If the files being renamed are not presently stored on AccuSafe, the rename operation causes the backup to occur immediately.

When a user attempts to rename files on the AccuSafe storage device, appropriate warning messages are presented, but the user is allowed to continue the rename operation if they wish. It is TBD if the corresponding files should, at the user's option, be renamed on the PC as well. Whenever files are renamed on AccuSafe, either directly on AccuSafe, or as a result of renaming them on the PC, all revisions and information files are renamed as well.

File renames on the AccuSafe device, but outside the AccuSafe directory structure, are detected and handled by AccuSafe normally.

d) Copying Files

When files are copied on the PC, AccuSafe detects the file writes associated with the creation of the new copies, and conducts the normal backup operations specified for the files.

When a user copies files on the AccuSafe device, appropriate warning messages are presented, but the user is allowed to continue the copy operation if they wish. It is TBD if the corresponding files should, at the user's option, be copied on the PC as well. Whenever files are copied on AccuSafe, either directly on AccuSafe, or as a result of copying them on the PC, all revisions and information files are copied as well.

File copies on the AccuSafe device, but outside the AccuSafe directory structure, are detected and handled by AccuSafe normally.

e) Moving Files

When files are moved on the PC, AccuSafe detects the file writes associated with the creation of the new copy, and conducts the normal backup operations specified for the files. It is to be investigated if a "move" operation actually results in file writes on the PC, or if it is simply conducted via modifications to directory content "tables." If file writes don't occur, then appropriate file-move message trapping must occur within the AccuSafe kernel in order that AccuSafe can properly detect such operation.

When a user moves files on the AccuSafe device, appropriate warning messages are presented, but the user is allowed to continue the move operation if they wish. It is TBD if the corresponding file should, at the user's option, be moved on the PC as well. Whenever files are moved on AccuSafe, either directly on AccuSafe, or as a result of moving them on the PC, all revisions and information files are moved as well.

File moves on the AccuSafe device, but outside the AccuSafe directory structure, are detected and handled by AccuSafe normally.

6.3 AccuSafe backup file format

At present, all files backed up as a result of AccuSafe operations, are backed up in their native format, but with an AccuSafe-directed file extension. Our selection of native format storage is the result of engineering/functionality/performance tradeoffs of criteria such as:

- a. Keeping the recovery process technically simple
- b. Maintaining a high performance storage process (restore time isn't as important as storage time since restore is a comparatively infrequent event as compared to storage)
- c. Providing a simple recovery opportunity/process in the unlikely event that the AccuSafe software isn't available, becomes corrupted, or fails in some way
- d. Dealing with a very large (and growing) variety of file formats without the necessity to individually code for particular file types

- e. Ability to deal with file formats from non-Windows computing platforms without the necessity for platform-specific or format-specific algorithms within AccuSafe

Obvious exceptions to our current native format "rule" occur when files are compressed and/or encrypted to the AccuSafe target device.

6.4 AccuSafe information file

Information regarding the specifics of each backed-up AccuSafe file is kept in a simple format for many of the same reasons mentioned in the earlier section regarding AccuSafe backup file formats. Such information is kept mainly on the AccuSafe target drive to enable the portability of the drive between different computers (and even platforms) without the necessity to migrate a "master database" from one computer to another.

This design allows backed up files (with a .AccuSafeF extension) and database files (with a .AccuSafeInfo extension) to be moved from AccuSafe device-to-device and/or AccuSafe media-to-media via simple file copy of the backup file (the database information file will always follow the backup file). The AccuSafe information file exists in parallel with the actual backup file for each stored file, including all versions, and contains information such as the following:

- a. original file date and time
- b. original file location
- c. original file attributes
- d. original file checksum (to add a quick consistency check to the restore process, and to help guard AccuSafe files against virus contamination)
- e. links to and/or from duplicate files from other computers attached to an AccuSafe device (not storing duplicate files [until they are changed and therefore are no longer duplicates] assists in minimizing storage requirements, maintaining high CPU performance, minimizing network traffic, etc.)
- f. encryption technique flags and encrypted password
- g. compression technique flags
- h. revision "stack" depth
- i. etc.

General AccuSafe operational information such as global default values for the items mentioned above and extension/basename/directory-based default values are maintained in the AccuSafe application database, which is stored in the AccuSafe installation directory (and backed up in the AccuSafe directory). At present, our "database" files are simple ASCII files. We anticipate retaining this format for the .AccuSafeInfo files, but will employ database files for general AccuSafe operational information as we move forward from prototype to shrink-wrap software.

6.5 AccuSafe Media Device directory structure

AccuSafe utilizes a directory structure on the AccuSafe Media Device that mimics the directory structure on the users computer as closely as possible. The directory structure also allows for multiple computers to be connected to the same AccuSafe device as described below:

\

Root directory where files and/or directories can be saved. This allows the AccuSafe device to be used as general storage as well as AccuSafe-related storage. In other words, AccuSafe doesn't require dedicated and complete use of the AccuSafe device/media.

`\AccuSafe`

Root directory for the AccuSafe-related storage.

`\AccuSafe\PCNAME1`

Root directory for the AccuSafe-related storage for the computer named "PCNAME1". The computer's name can be set within the AccuSafe software, but defaults to the "Computer Name" set within the Network Neighborhood function of Windows.

`\AccuSafe\PCNAME2`

Root directory for the AccuSafe-related storage for the computer named "PCNAME2".

`\AccuSafe\PCNAME1\C`

Root AccuSafe directory for the "C" drive of the computer named "PCNAME1". Below this directory are subdirectories structured exactly as are the directories on the "C" drive of computer "PCNAME1", and so on.

Long file/path names that could exceed 255 characters will be truncated when saved but the actual file/path name of any length will be saved in the AccuSafe information file.

6.6 Redundant file elimination

It is anticipated that AccuSafe will be designed to employ a redundant file elimination techniquesimilar to the following in order to reduce AccuSafe Media Device disk space requirements as well as bandwidth requirements between the PC and the AccuSafe Media Device:

- a. Calculate the checksum for the source file. This step is always accomplished, and is not strictly a part of the redundant file elimination mechanism.
- b. Look to see if the source file exists in the same directory on the AccuSafe device. under each AccuSafe-protected computer's directory structure. For example, if the source file were "C:\Program Files\Microsoft Office\Office\Excel.exe" on a computer named "dan1", and if AccuSafe were storing files for computers named dan1, keith1 and paul1, we'd try to find the following "Candidate Master" files of the same version on the AccuSafe device.

`\AccuSafe\dan1\C\Program Files\Microsoft Office\Office\Excel.exe`
`\AccuSafe\keith1\C\Program Files\Microsoft Office\Office\Excel.exe`
`\AccuSafe\paul1\C\Program Files\Microsoft Office\Office\Excel.exe`

- c. For each "Candidate Master" file found, determine if the file size is the same (or for program files, that the version is identical). This is a quick go/no-go check, and is done first in order to maintain high algorithm performance for the case of non-similar files.
- d. If step "c" indicates file similarity, verify the checksums. If the size (or versions) and the checksum are the same, then perform a bit level difference test to guarantee the files are identical.
- e. If steps "b-d" indicate that the files are identical, then the file of which the source file is a duplicate, is now promoted in AccuSafe's "thinking" from "Candidate Master" to "Master" status. In this case, the source file will not be copied to AccuSafe. Instead,

a tiny placeholder ".AccuSafeFile" file will be created with the same name as the source file, in the normal location on AccuSafe. The ".AccuSafeInfo" file will be created as usual, and populated with a pointer to the discovered "Master" file. (The .AccuSafeInfo file will also carry all the information described elsewhere in this document.) Further, the ".AccuSafeInfo" file for the "Master" file, will be adjusted to carry a pointer back to the placeholder file(s) that duplicate it elsewhere on the AccuSafe device.

- f. Users can restore duplicate file in exactly the same way that we showed you in our meeting. In fact, the user has no knowledge as to whether or not the file(s) they're wanting to restore are duplicate files or not.
- g. Users attempting to delete duplicate files, do so as usual. Users attempting to delete "Master" files do so normally too, but in this case AccuSafe then promotes one of the duplicates that point to the "Master" file to be the new Master file, with corresponding adjustments to all involved .AccuSafeInfo files. Also, "Master" file will be copied to one of the duplicate locations, overwriting the placeholder file created under step 'f' above, with the actual Master file.
- h. A problem with this system has been indicated for network attached AccuSafe devices in that AccuSafe is not running on the file server but on the workstation. A system administrator could therefore delete the "Master" file without AccuSafe awareness. This problem is being worked and may indicate the need for a second generation "Network Manager" product.

For the initial AccuSafe software release, we hope to create and maintain a table of all the AccuSafe-stored files with a particular base name. In the example above, the basename would be a particular version of "Excel.exe". We'd then modify the above algorithm in step "b" to look for all files, in any AccuSafe directories, with the source basename in order to check for duplications. This removes the restriction that the redundant file elimination mechanism works only if the files are at the same place in each connected computer's directory structure.

6.7 File restoration & revision control

AccuSafe file restoration is accomplished via the same right mouse click user interface used for access to other AccuSafe features described in this document.

AccuSafe users must have the ability to select files to be recovered during a restoration operation. Such control should be provided at:

- a) full file name,
- b) base filename (e.g. the full file name without an extension),
- c) file extension,
- d) directory and/or
- e) drive levels.

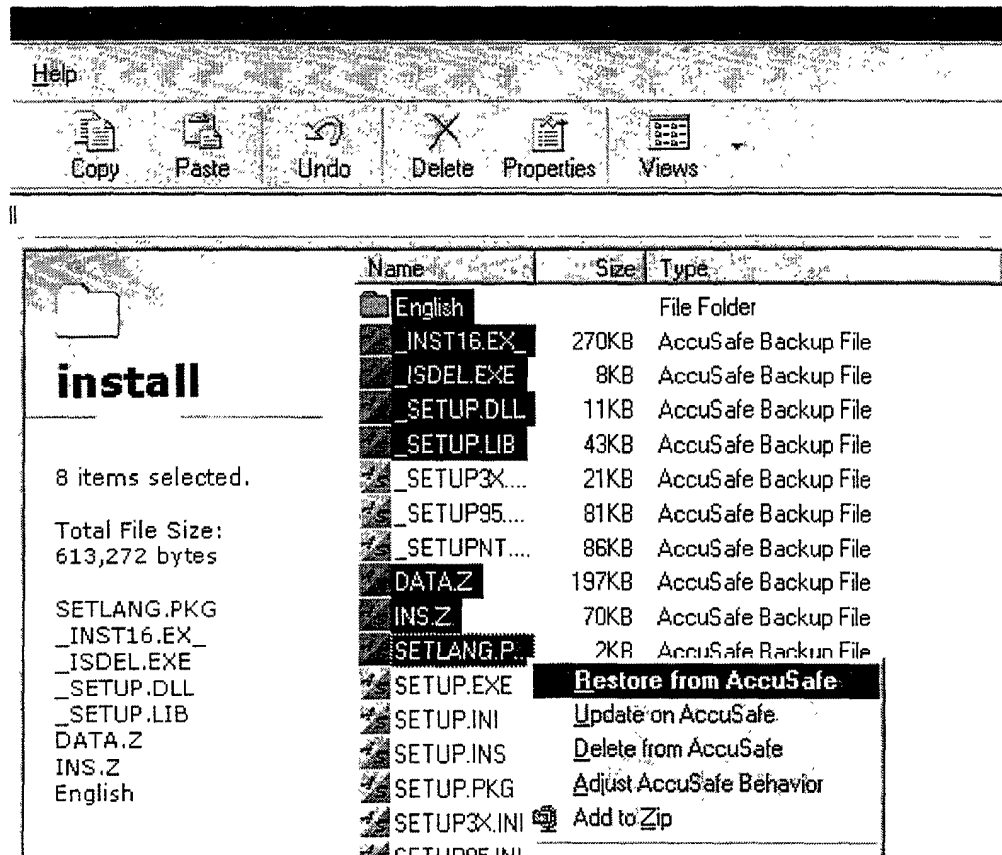
Multiple selection capabilities must also be provided so that users can select on several different items from "a" – "e" above during their specification of what is to be restored.

The user interface for the restoration capability should allow the use of Windows Explorer to select multiple or single drive(s), directory(s) and/or file(s) to be included or excluded. Similar to a standard multiple file copy operation using explorer, the user should be able to right-click over one of the selected items, and the resulting mouse menu should provide direct access to the AccuSafe feature(s) that allow file restoration. From the AccuSafe prototype, the following screen shot illustrates the general intended

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operation. Note the selection of a directory and several files, with the mouse menu containing an item entitled "Restore from AccuSafe."

[illegible]



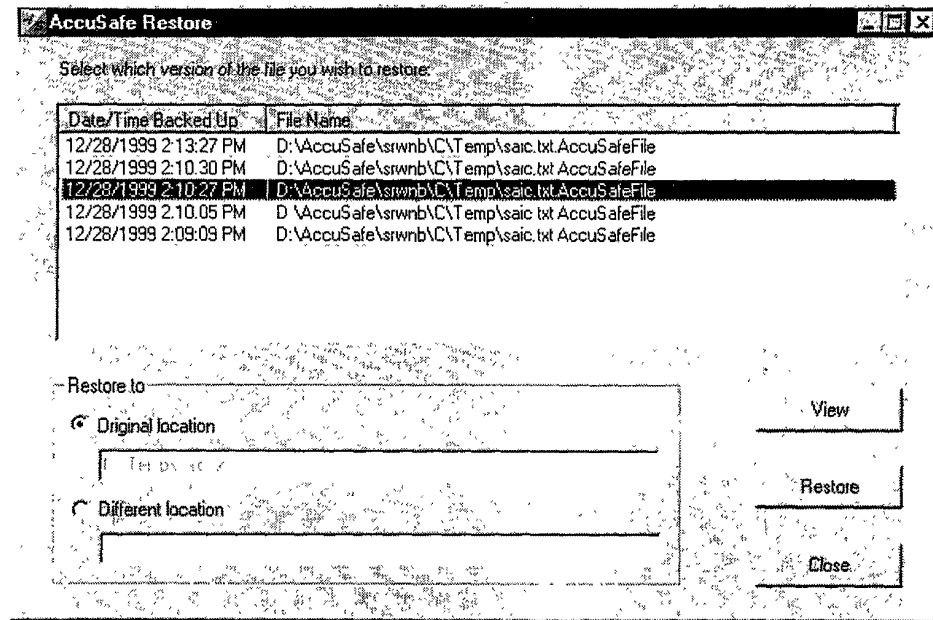
Upon selection of the Restore From AccuSafe menu item, an intuitive user interface such as the one shown on the following page is displayed. From here, the user is provided with relevant information about each file within the selection made via the prior display. Such information would include the file date and timestamp, the original file location, perhaps even a comment supplied by the user to describe a particular revision, etc. A tree control approach to the view may be more easily followed by the user.

The user may select an item (file or directory) from the list presented in this user interface, then click the Restore button in order to restore the file from the AccuSafe Media Device. Depending on the setting of an appropriate user interface widget, the file will be restored to it's original location, or to an alternate location chosen by the user.

Prior to actually restoring the file, the restoration process should determine that the AccuSafe backed up file checksum still matches its checksum when it was originally backed up, and warn the user if this is not the case. This will provide at least some protection against file corruption from viruses or other causes and alert the user to run a virus scan prior to the restore operation.

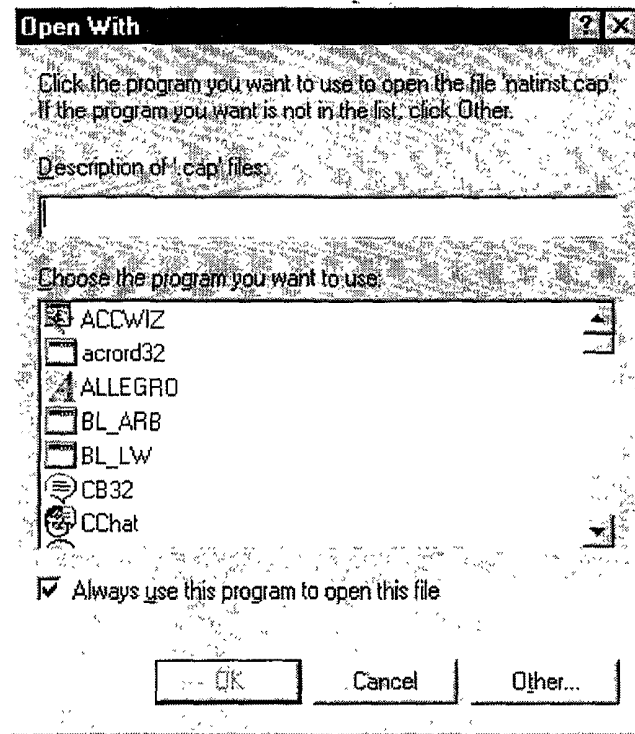
Also prior to actually restoring the file, the restoration process should determine if the backed up file will overwrite a file of the same name on the users PC, and if so, if the version of the file on the users PC is on the top level of the AccuSafe revision "stack". If such is not the case, AccuSafe must first backup the users file to the AccuSafe Media Device, then perform the restoration function. This will assure that no version of a file is lost as a result of the restoration process.

(Note that the restoration user interface shown on the next page, must be extended to cover the multiple file and multiple directory case, and that such extension must be very intuitive to the user.)



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Whenever the restoration user interface is active, the user must be able to easily view the backed up file in order to gain additional information which will allow him to select the proper version to restore. This accomplished by allowing the user to highlight a file, then click a View button, which will open the appropriate viewer for that file type, using the Windows standard mechanism for determining which viewer is appropriate for which file type (e.g. *.doc files use Word as the viewer, *.xls files use Excel, etc.). If the viewer for a particular file type cannot be determined, or if the identified viewer is not present, the user should be offered the standard Windows mechanism for selecting a viewer as shown on the next page.



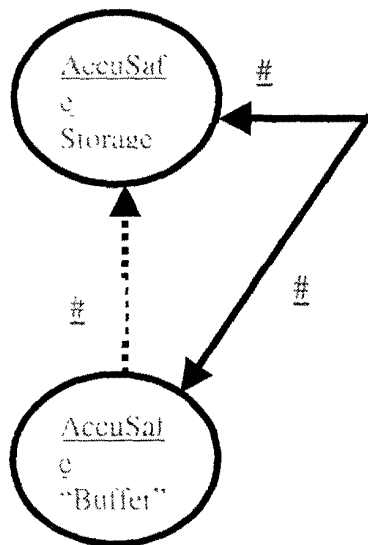
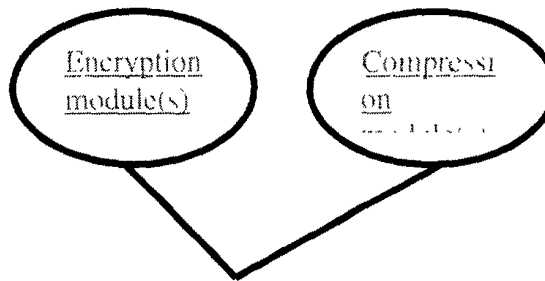
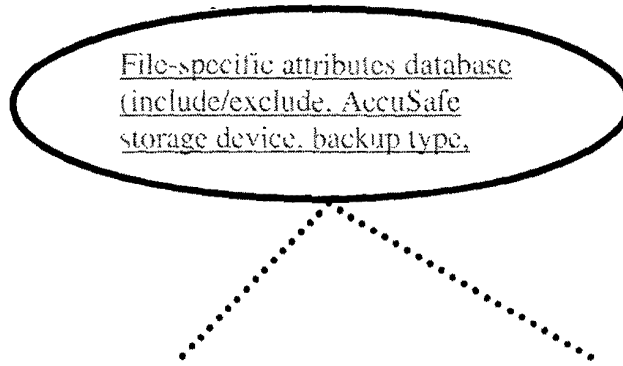
6.8 IntelliQueueing

The IntelliQueueing feature of AccuSafe is the feature that most impacts AccuSafe application performance and that delivers AccuSafe sophistication and marketplace uniqueness. The IntelliQueueer (IQ) is responsible for managing all AccuSafe generated PC-to-AccuSafe-storage-device file transfer requests in a time-ordered fashion. As such, once AccuSafe determines that file transfer is required, it then passes a corresponding transfer request to the IntelliQueueer. The IntelliQueueer, operating concurrently to the AccuSafe application itself, responds to such requests in time-ordered fashion, by performing the requested file transfer.

If for example, the file transfer request cannot be accomplished because the AccuSafe storage device is not available, the IQ then executes alternate operations to perform the requested file transfer to a buffer area, then creates a corresponding "unbuffer" request (one that eventually transfers the file out of the buffer area and back to an AccuSafe storage device) in the event of delayed action on the request.

This buffer/unbuffer mechanism is also useful in situations where the user has set AccuSafe to meter file transfers to the AccuSafe storage device in order to reduce network bandwidth contention during periods of high use.

The general relationship of the IQ to the rest of the AccuSafe application is as shown in the following notional diagram depicting the origination and flow of a file transfer request as a result of the OS detection of a file write operation. (Note that methods other than OS detection of files writes, can generate IQ file transfer requests (e.g. the manual Full Synchronize operation).



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During the course of normal operation, the IQ makes time-ordered file transfers to the AccuSafe storage device as identified by #1 in the diagram above.

If the AccuSafe storage device is unavailable for a normal #1 file transfer, the IQ will perform a #2 file transfer. In this case, the IQ will also create a queue entry that will later perform a #3 file transfer when an AccuSafe storage device is eventually detected by the IQ.

The communications with and implementation of the queue database of the IQ should be implemented using a standard and simple technologies such as Microsoft Jet communications to a Microsoft Access database. It is anticipated that the size of this database will dynamically shrink and grow during the course of AccuSafe operation, based on the number of file transfer requests that are submitted to the IQ and that are processed by it.

The queue database should be maintained on the client PC (in the AccuSafe installation directory), and should have a redundant second copy of constantly updated identical contents under the client computer's directory structure on the AccuSafe storage device.

Notionally, each IQ queue entry contains the following information:

Element #	Description
1	Source path
2	Target path
3	Encryption mode and attributes
4	Compression mode and attributes
5	Operation to be performed
6	Earliest date/time at which to perform the operation (this enables the IQ to handle "interval" and "scheduled" backups, and to handle situations where the user has set AccuSafe to meter file transfers to the AccuSafe storage device (as mentioned earlier))
7	File transfer performance mode (optimize for transfer speed, or optimize for best PC performance)
8	TBD
9	TBD
10	TBD

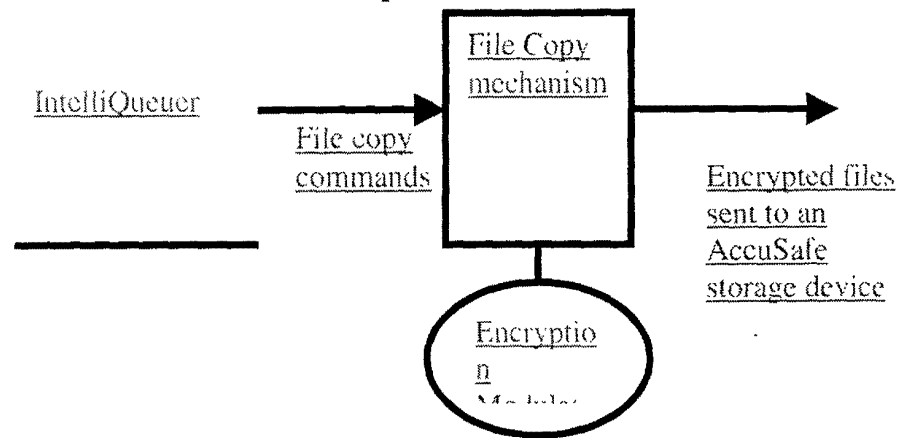
Whether file restoration operations are controlled by the IQ is to be determined.

6.9 File encryption

AccuSafe will provide features that allow files to be encrypted as they are copied to the AccuSafe storage device. Encryption capabilities will be adjustable via the file-specific AccuSafe Behavior tab on the file/directory properties dialog described elsewhere in this document. Default encryption-related settings will be available to the user via the general AccuSafe Behavior tab.

Several types of encryption algorithms, allowing the user to trade-off encryption strength vs. encryption performance, are desired. Such encryption algorithms will include and ability, and corresponding user interface, for the user to specify algorithm specific parameters such as password, key, etc. The selection of encryption algorithms will be based in part on the legality issues associated with their exportation outside the United States. Users will be able to enable/disable encryption via the encryption-related features available on the file-specific AccuSafe Behavior tab.

The encryption capabilities should be engineered so that it is easy to download a new encryption OCX (for example), in order to provide additional encryption algorithms at future points in time. A high level block diagram of the intended "plug-in" nature of the encryption modules is shown below. This concept should be utilized as much as possible within the design and implementation of the entire AccuSafe system.



Users attempting to View or Restore encrypted files (as described elsewhere in this document), will be requested to supply the appropriate security parameters (password, key, etc.) by the AccuSafe user interface prior to the file being viewed or restored.

An “administrator” capability within the AccuSafe client software will provide, among other things, the opportunity to decrypt files even if the original encryption security parameters (password, key, etc.) are not known. This capability, accessible via a user-specific “administrator” password (set during the install process, and adjustable later), will not reveal the security parameters on the encrypted files, but will instead simply provide decryption capabilities for them. This feature exists, for example, so that the files belonging to a departed employee, can be restored in the absence of the required security parameters.

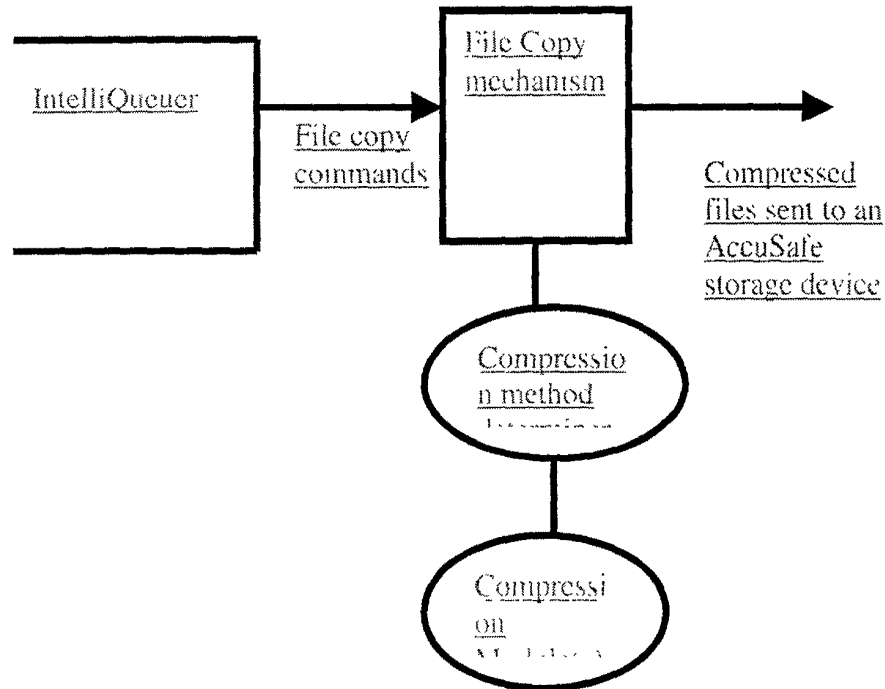
6.10 File compression

AccuSafe will provide features that allow files to be compressed as they are copied to the AccuSafe storage device. This will allow AccuSafe to minimize bandwidth requirements of the PC-to-AccuSafe-storage-device channel, and to minimize storage space requirements on the AccuSafe storage device itself. Compression capabilities will be adjustable via the file-specific AccuSafe Behavior tab on the file/directory properties dialog described elsewhere in this document. Default compression-related controls will be available to the user via the general AccuSafe Behavior tab, also part of this dialog.

Several types of compression algorithms, allowing the user to trade-off compression ratio vs. compression performance, are desired. The selection of available compression algorithms will be based in part on the legality issues associated with their exportation outside the United States. Compression functions within AccuSafe will be intelligent, in that they will examine source file contents in order to determine which of the available algorithms should be used on the source file in order to achieve best compression ratio or best performance as selected by the user. Users will be able to enable/disable compression via the compression-related features available on the file-specific AccuSafe Behavior tab.

As is the case with file encryption capabilities, AccuSafe compression capabilities should be engineered so that it is easy to download a new compression OCX (for example), in order to provide additional compression algorithms at future points in time. A high level block diagram of the intended “plug-in” nature of the compression modules is shown

below. This concept should be utilized as much as possible within the design and implementation of the entire AccuSafe system.



Users attempting to View or Restore compressed files (as described elsewhere in this document), will be exposed to a decompression progress indicator prior to the file being viewed or restored.

6.11 File include/exclude capability

AccuSafe users must have the ability to control which files are included and excluded within the AccuSafe backup process. A control hierarchy will be employed to eliminate contradictions such as selecting a particular file or type within a folder to include, then selecting to exclude the entire folder. Such control should be provided at:

- a) full file name,
- b) base filename (e.g. the full file name without an extension),
- c) file extension,
- d) directory and/or
- e) drive levels.

Multiple selection capabilities must also be provided so that users can select on several different items from "a" – "e" above, and easily set the include/exclude status that will apply each of the selected items.

As an example, it must be possible and intuitive for the user to include several directories in the backup, then to subsequently exclude some files and/or subdirectories underneath the originally selected directory. The reverse case must also be supported.

The user interface for this include/exclude capability should allow the use of Windows Explorer to select multiple or single drive(s), directory(s) and/or file(s) to be included or excluded. Similar to a standard multiple file copy operation using explorer, the user should be able to right-click over one of the selected items, and the resulting mouse menu should provide direct access to the AccuSafe feature(s) that allow inclusion and

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exclusion. From the AccuSafe prototype, the following screen shot illustrates the general intended operation. Note the selection of a directory and several files, with the mouse menu containing an item entitled "Adjust AccuSafe Behavior."

IPCI Confidential

Copy Paste Undo Delete Properties Views

install

7 items selected.

Total File Size:
441,720 bytes

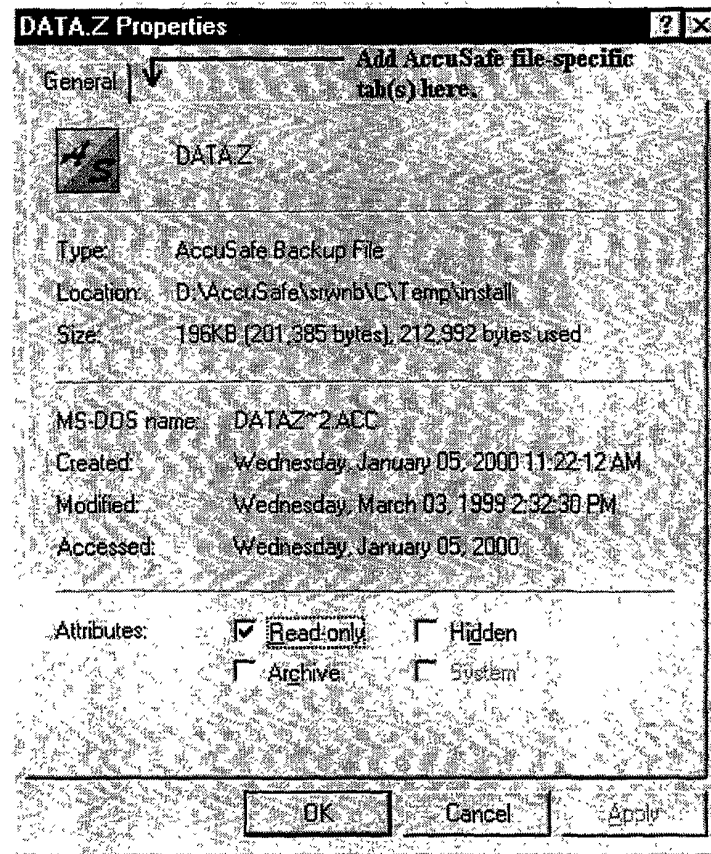
_SETUP95.LIB
INST16.EX
_ISDEL.EXE
_SETUP.DLL
_SETUP.LIB
_SETUP3X.LIB
English

Name	Size	Type
English		File Folder
INST16.EX	270KB	AccuSafe Backup File
_ISDEL.EXE	8KB	AccuSafe Backup File
_SETUP.DLL	11KB	AccuSafe Backup File
_SETUP.LIB	43KB	AccuSafe Backup File
_SETUP3X.LIB	21KB	AccuSafe Backup File
_SETUP95.LIB		fe Backup File
_SETUPNT.LIB		fe Backup File
DATA.Z		fe Backup File
INS.Z		fe Backup File
SETLANG.PKG		fe Backup File
SETUP.EXE		fe Backup File
SETUP.INI		fe Backup File
SETUP.INS		fe Backup File
SETUP.PKG		fe Backup File
SETUP3X.INI		fe Backup File
SETUP95.INI		fe Backup File
SETUPNT.INI		fe Backup File
UTIL.Z		fe Backup File

Restore from AccuSafe
Update on AccuSafe
Delete from AccuSafe
Adjust AccuSafe Behavior
Add to Zip
HP Simple Trax
Send To
Cut
Copy
Create Shortcut
Delete

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Subsequent to a user selection of the "Adjust AccuSafe Behavior" menu item, the standard tabbed dialog the user presently sees via a selection of the "Properties" menu item (see below), should offer users the opportunity to adjust include/exclude criteria (as well as other file-specific AccuSafe behavioral properties). It is possible for an application to add a tab to the standard dialog shown below, and then to have this tab appear whenever an application specific menu item is selected from the mouse menu. This is the preferable implementation for the "Adjust AccuSafe Behavior" user interface.



When the user selects the file-specific AccuSafe Behavior tab, simple checkboxes and other standard control widgets, along with jargon-less text, should be available to the user for selection of the various AccuSafe file-specific capabilities. In the case of the include/exclude operation, a 3-state "Include" checkbox, working similar to the Read-only checkbox in the above dialog, should be sufficient. All selected files will receive the include (box checked) or exclude (box not checked) attribute chosen via the "Include" checkbox.

The user should also be presented here with a control widget that allows the include/exclude specification to be related to all file extensions, as opposed to specific file names and directories, represented within the users selection.

Note that other file-specific AccuSafe Behavior controls will be present on the "AccuSafe Behavior" tab. These include, but are not limited to file encryption on/off, file encryption password, file compression on/off/type options, backup type (automatic, schedule, modified-automatic, etc.), etc.

All persistent information as to the items selected for inclusion and/or exclusion should be stored in the AccuSafe Operational Database.

An additional tab may be added to this "Properties" dialog for the adjustment of general (i.e. non-file-specific) AccuSafe Behavior such as user name, company name, computer name, AccuSafe Media Device location, PC-to-AccuSafe-storage-device master transfer schedule, file copy performance mode, etc. This tab may be accessed when the user clicks on the AccuSafe system tray icon and selects the appropriate operation to adjust general AccuSafe Behavior.

The AccuSafe-modified properties dialog must be available for all files, on all attached devices, whenever the AccuSafe software is present on the client PC. This will allow the user access to all AccuSafe-related features when viewing the AccuSafe Media Device via Explorer, or when viewing non-AccuSafe Media Devices via Explorer.

6.12 Connectivity to AccuSafe Media Device hardware

AccuSafe should be able to communicate with any device that appears as a hard drive to the AccuSafe application. Such devices are referred to as "AccuSafe Media Devices" for the purposes of this ERS. For the initial AccuSafe product release however, connectivity to a) internal hard drives, b) network attached drives and c) the USB-attached (Universal Serial Bus) Fujitsu Magnito-Optical drive family (TBD is it a family or a single device?) is projected. Each of these connectivity options rely on AccuSafe Media Device drivers provided either via Microsoft in terms of standard disk and/or network device drivers, or via Fujitsu (who OEMs SCM Microsystems/Shuttle drivers and hardware components). Creation of AccuSafe Media Device drivers is not a part of the AccuSafe project, although compatibility with them is. It is anticipated that the AccuSafe installation will be called after the completion of the device installation.

A UNC path (including directory specifications) as well as a drive letter prefixed path (including directory specifications) will be allowed for the specification of the AccuSafe storage device.

6.13 System disaster recovery

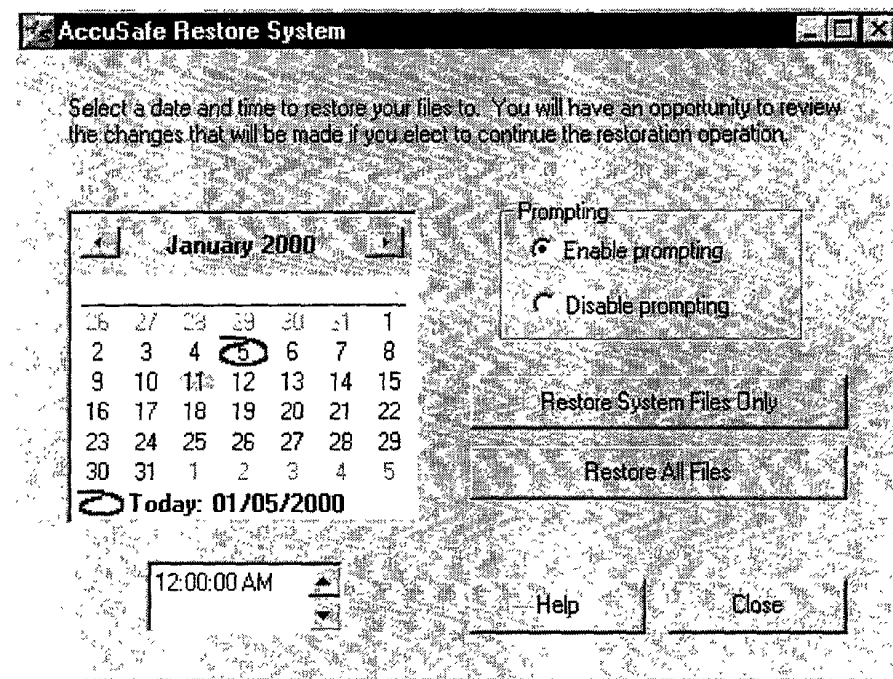
AccuSafe must implement the capability to completely restore a users system in the event of a crashed system hard disk, destroyed files, or other catastrophic event.

This will require that AccuSafe be able to generate an "Emergency AccuSafe Boot Floppy" (3 1/2" media only) at some time prior to the failure. The contents of this emergency boot floppy must be sufficient to redirect the boot device to the AccuSafe drive and completely restart the computer from the AccuSafe Media Device, assuming that the system files necessary to support this functionality are in fact resident on the AccuSafe Media Device, and assuming that the AccuSafe device wasn't the damaged hard drive itself.

Once a restart has been accomplished, the user should be left in a state where they can either proceed immediately to system restoration functions, or operate their system as if the catastrophic event had not occurred. If the user chooses to operate their system normally, they must be able to access the system restoration functions at a later point. This combination of capabilities, for example, lets the user restore a failed hard drive immediately, or restore later when a replacement drive is obtained.

These capabilities also allow users to use AccuSafe for the purposes of upgrading to larger or newer hard drive on their computer, due to the fact that AccuSafe is able to completely rebuild a new hard drive (given that the AccuSafe Media Device is fully synchronized with the users system.

A user interface similar to the following is suggested for easy system restoration functions. TBD is the proper and reasonable breakdown for levels of restoration other than "System Files" and "User Files."

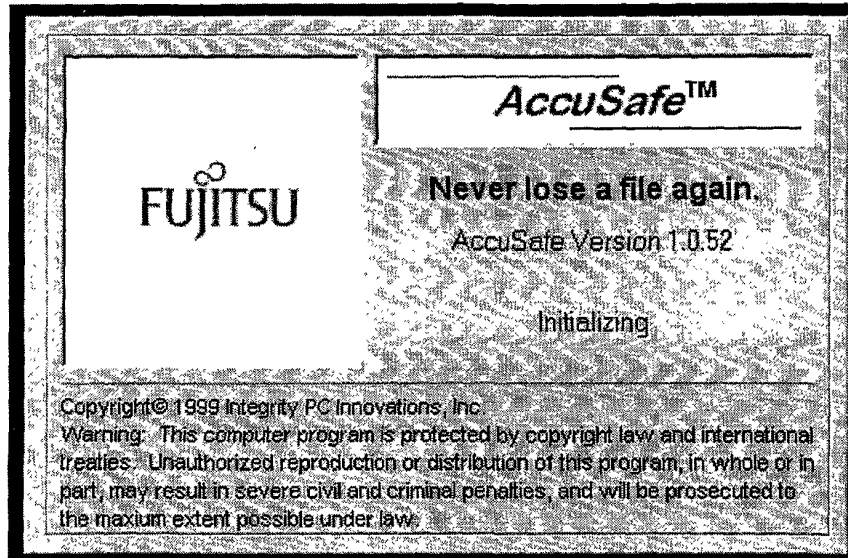


6.14 Splash screen

A splash screen, similar in content to the following should be provided during AccuSafe startup (as Windows is booting up, or via a manual start). The splash screen should appear for a short period of time, but definitely long enough for the user to see that AccuSafe is up-and-running. The splash screen should contain messages that show the progress of the AccuSafe boot process, as shown by example below, that give the user confidence that proper protection is indeed occurring.

Example sequence of splash screen messages which would appear on the splash screen in a location such as that occupied by the text "Initializing" in the example below.

- Initializing AccuSafe software
- Verifying AccuSafe software
- Verifying AccuSafe hardware
- AccuSafe is on the job!



In this splash screen, the displayed company logo (Fujitsu in this example) as well as the copyright information must be easily adjustable.

6.15 AccuSafe Media Device directory look-and-feel

The specific directories and files on an AccuSafe Media Device should have a visual appearance, and operation, that clearly differentiates them from files and directories on a non-AccuSafe Media Device.

An example of possible AccuSafe directory look-and-feel is shown below. Note that the user is confronted with a very-different-from-usual display upon navigating to an AccuSafe directory, and that by selecting the Show Files link on this display, can get to the usual Explorer display. Once the user navigates past “show all files” Explorer operation should be similar to what they are used to in the non-AccuSafe case.

All AccuSafe-related files stored in the AccuSafe Media Device directory must be hidden, and not visible to the user. This accomplishes two goals: a) it maintains a directory structure and file list within the directories, that match the users PC, thus increasing familiarity with, and usability of the AccuSafe directory structure, and b) reduces the opportunity for the user to accidentally or intentionally corrupt or delete AccuSafe-related files.

An example of the necessity to hide AccuSafe-related files, relates to the user confusion that directory clutter that would occur if users could see each file revision which is presently named according to the following general format:

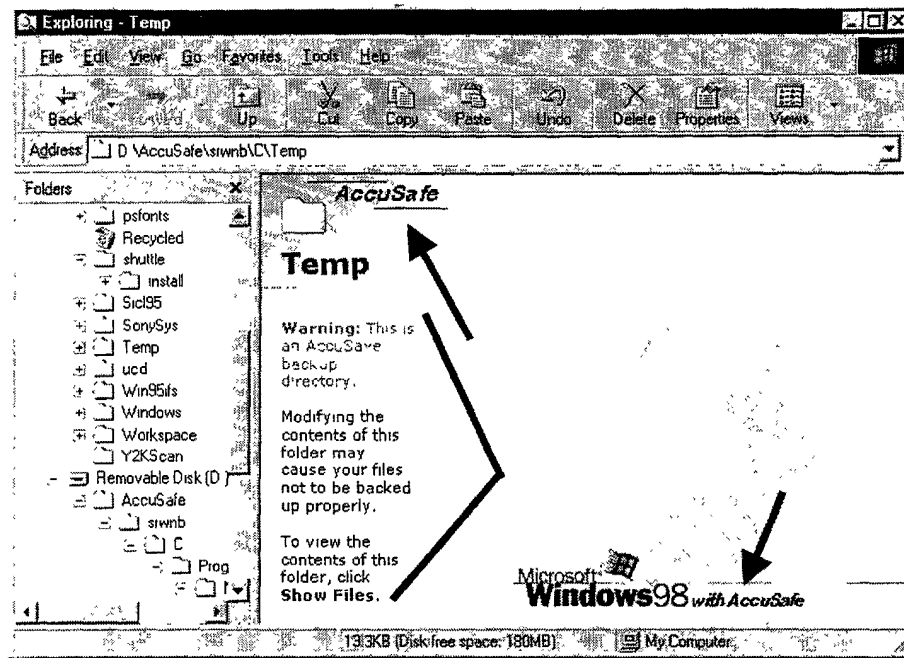
ffff[nnn].txt.AccuSafeBackup

Another similar example relates to the storage of an AccuSafe “housekeeping” file named according to the following general format, and utilized in the storage of various AccuSafe operational parameters (original directory location, original date/time, checksum, etc.).

ffff.txt.AccuSafeInfo

These two examples also give further example to the value in hiding the “.AccuSafeBackup” and “.AccuSafeInfo” file extensions as described elsewhere in this document.

Hiding files by marking them as “hidden files” and hiding directory extensions for “known” file types using Explorer’s Folder Options are not particularly robust mechanisms, since the user can override any automatic AccuSafe settings, resulting in confusing and cluttered displays.

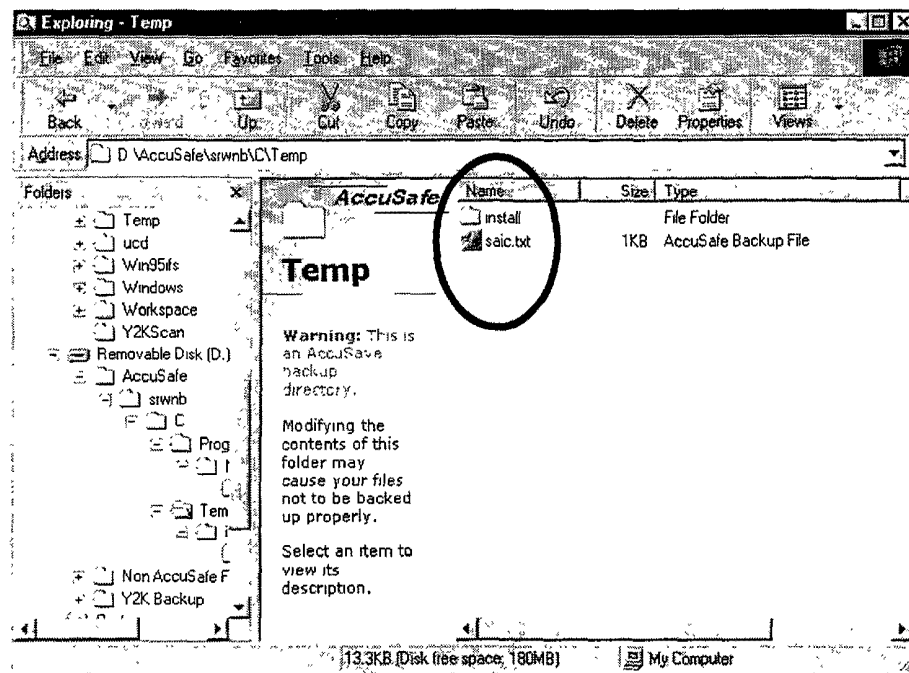


The directory visual appearance shown in the previous display is presently implemented in the prototype via the hidden `desktop.ini` and `folder.htt` files within each AccuSafe directory. This implementation however isn't robust in that users can disable options that allow directories to be displayed in web-content-format, so an alternative method should be implemented that yields similar results. Note also that the current implementation is made with a very simple adjustment to the `desktop.ini` and `folder.htt` files found in the \Windows directory on a Windows 98 PC. There are likely to be Microsoft copyright ramifications to continuing this practice.

6.16 AccuSafe file icons

Files backed up by AccuSafe on the AccuSafe Media Device should be identified with distinctive AccuSafe-related icons, regardless of their native type, when viewing the AccuSafe Media Device directory structure as shown below:

AccuSafe
Media
Device
Directory
Structure
Visual
Appearance

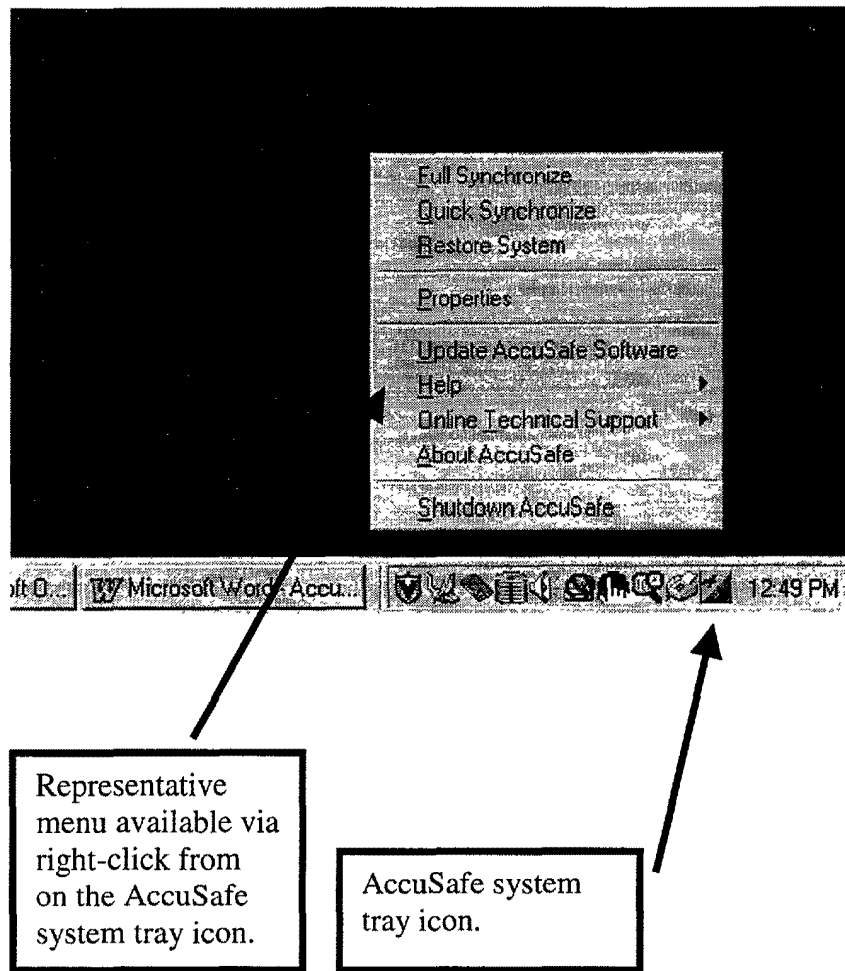


6.17 AccuSafe system tray icon

An AccuSafe icon in the system tray, as shown on the attached, should a) indicate that AccuSafe is operational, b) should provide some visual indication as to the progress of copying files, and c) should allow a right-click to access various AccuSafe functionality.

Item “b” could be implemented in similar fashion to MS-Word’s “pulsating disk” status bar indication when saving large files (such as this ERS!).

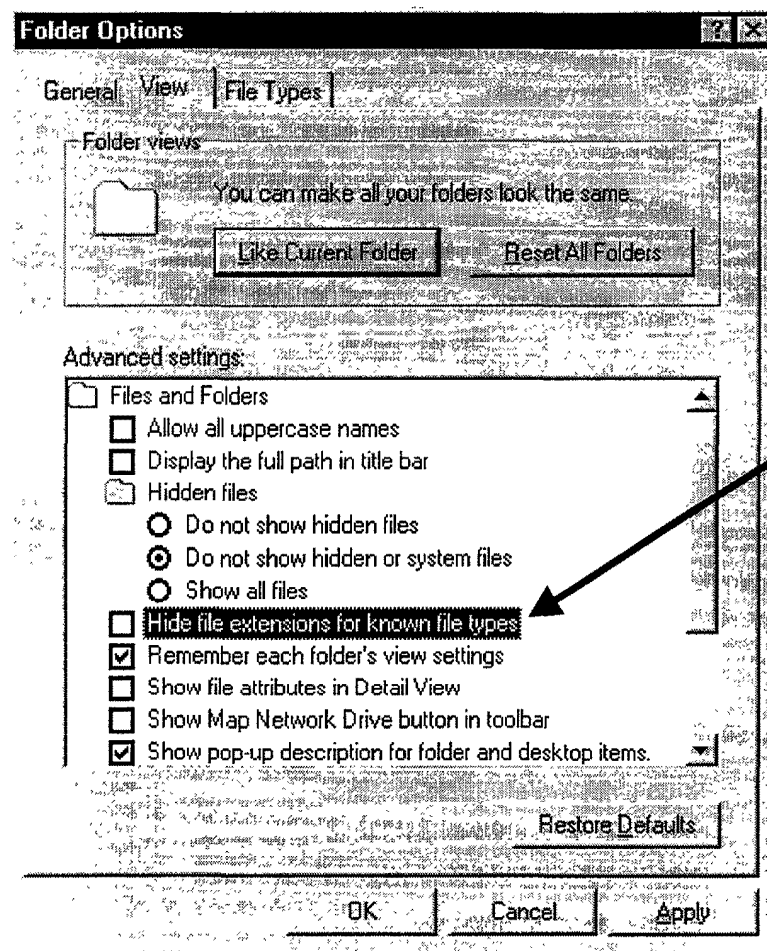
Rolling the mouse over the AccuSafe system tray icon should result in a standard “tool tip” that provides useful AccuSafe operational status information.



6.18 AccuSafe file names

Visible AccuSafe file names should be identical, and in the same directory structure as the user is accustomed to on their PC. Further, the length of the file name, as well as the casing of the file name must be maintained as identical to the file name on the user's PC.

In the case of the prototype, the original native file name is maintained but with an appended AccuSafe-related suffix (".AccuSafeBackup"). This allows for AccuSafe-backed up files to be easily identifiable to various parts of the AccuSafe system software, but requires that the option to "hide file extensions of known types" (see below) be selected in order to avoid seeing file names such as "temp.txt.AccuSafeBackupFile" in Explorer.



This is not a robust implementation, since users can adjust the setting of the “hide file extensions for known file types” and can become confused at the results. An alternate method should be discovered.

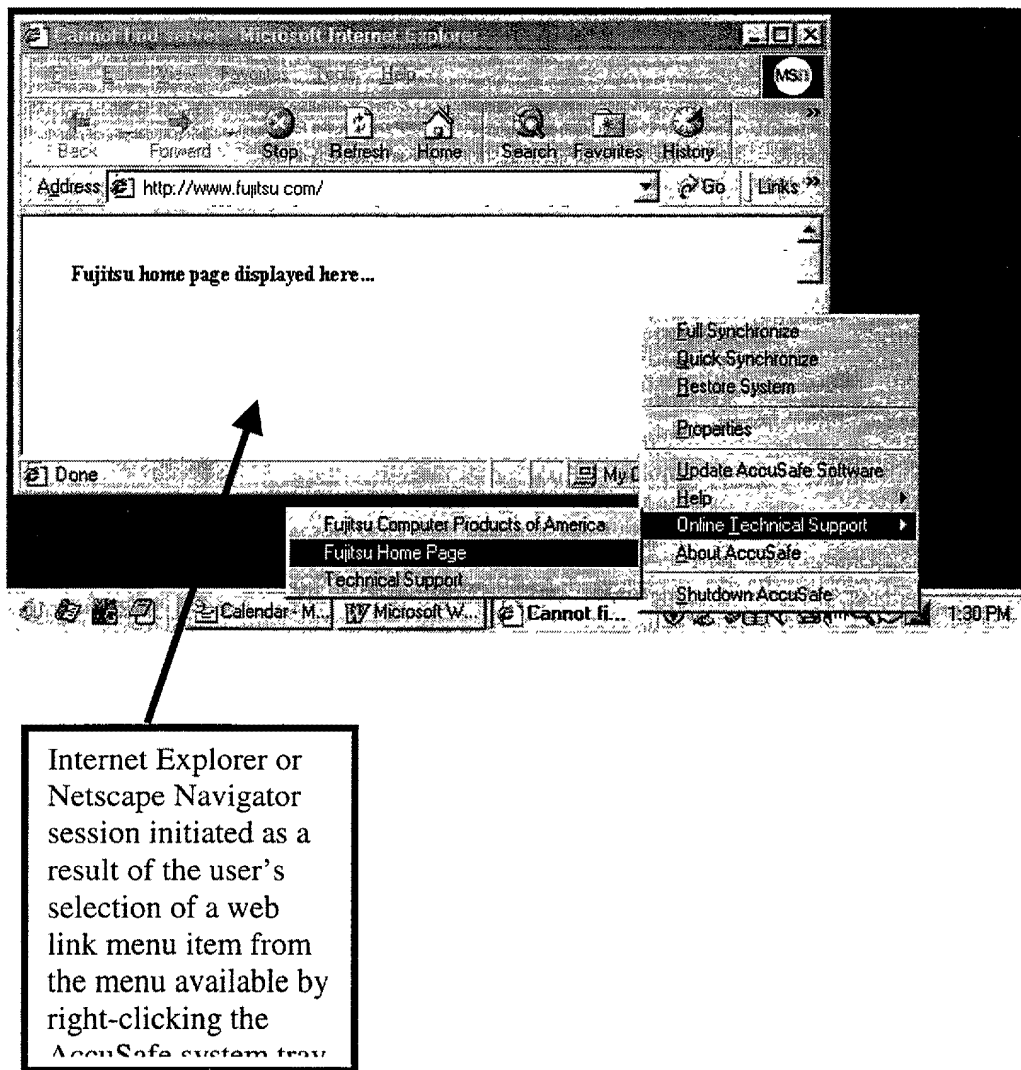
6.19 AccuSafe boot-up operations

During the boot process, AccuSafe will update Windows system files that cannot be easily copied once Windows is up and running. This is particularly true for NT where files like Ntuser.dat and Ntuser.log cannot be copied while operational. They can be copied during DOS boot up and do not require real-time backup during normal operation. AccuSafe will install as a default startup application, unless the user selects otherwise (an NT system start up application by default). The AccuSafe monitor will begin house-keeping checks following Windows boot up and user virus check startup scan completion (if any). The AccuSafe database is briefly checked for queued files and the AccuSafe device is tested for communications link. Once these quick checks are complete, AccuSafe is ready and on the job.

6.20 AccuSafe Web Linkages

AccuSafe must be capable of launching Internet Explorer or Netscape Navigator in order to connect to various URLs that may contain technical support information, product (AccuSafe and non-AccuSafe) sales information, etc. These launches should normally be performed from the AccuSafe system tray icon menu, and must be implemented in a manner that allows them to be very easily adjusted for different menu text and/or changing target URLs.

This feature should also display a pop up message in the event the user does not have Internet access indicating that an Internet browser must be installed before this feature can be enabled.



This linkage must also allow AccuSafe to form an almost-no-user-intervention-required connection to a URL in order to determine if a revision to the AccuSafe software is available, and if the user needs the revision. If the user elects to install an available revision, AccuSafe should handle this activity without undue user intervention.

6.21 AccuSafe Monitor

AccuSafe monitors its own operation on a continual basis, in order to assure optimal data integrity at every possible level. The AccuSafe Monitor and the AccuSafe Advisor together perform these self-checks.

The AccuSafe Monitor performs its checks each time a file is transferred from the PC to the AccuSafe storage device, and does so in a manner that does not interfere with PC performance. Primarily, the AccuSafe Monitor assures that connectivity to the AccuSafe storage device is properly maintained, and that AccuSafe's application data structures and data bases remain internally consistent.

A second mission of the AccuSafe Monitor is to watch for situations, on a file-by-file basis, that may require either automatic or manual intervention to resolve. The AccuSafe Monitor will take corrective action under these circumstances, either automatically, or via simple Yes/No message boxes presented to the user. The automatic or manual "mode" of the AccuSafe Monitor is specified via a related group of settings in the general AccuSafe Behavior tab described elsewhere in this document.

Additionally, all AccuSafe Monitor "threshold" settings are adjustable via the general AccuSafe Behavior tab. Applicable threshold settings are shown via italics below.

The AccuSafe Monitor will detect and attempt to resolve situations such as the following:

- a) **Situation:** *Frequent* modifications of a file that is excluded from the AccuSafe backup mechanism.

Resolution: Automatically add the file to the "include" list, or inform the user of the situation and ask if the file should be added. If the user elects not to add the file, then the AccuSafe Monitor will cease user notification regarding this file until a specified *time period* (N days) has elapsed.

- b) **Situation:** Frequent modifications of a file that is included in the AccuSafe backup mechanism, but whose frequent transfer from the PC to the AccuSafe storage device may unacceptably limit the bandwidth available to other applications that need to communicate on the PC-to-AccuSafe-storage device channel (port, LAN, IDE, etc.). This may relate to frequent modifications of small files, or less-frequent modifications of large files.

Resolution: Automatically or via simple inform-and-ask GUI, change the file's backup type from "automatic" to "interval" or "scheduled" for a specified *time period*.

- c) **Situation:** PC-to-AccuSafe-storage-device communications cannot be established or has been interrupted. This could happen during a file transfer between the PC and the AccuSafe storage device.

Resolution: Warn the user via GUI, then using the IntelliQueuer, redirect all such file activity to the AccuSafe buffer area until the AccuSafe Monitor again detects that connectivity between the PC and the AccuSafe-storage-device can again be

established. Note that this kind of operation is “normal” in many cases, since the AccuSafe device can be disconnected from, then later reconnected to the client PC.

Several special “drive spanning”-related situations exist that may be implemented using this situation/resolution pair. Note that these, and item “c” itself, may more properly be resolved via the IntelliQueuer itself.

1. **Situation:** The media in the AccuSafe storage device is full., as might occur from time to time when AccuSafe is operating with smaller media types such as MO drives, ORB drives, etc.

Resolution: Warn the user via GUI that the media is full, and allow them the chance of inserting new media immediately, or holding off the media change to a future point. The user would be issued periodic reminders of this situation, but it could persist for some time without any adverse affects. Via the IntelliQueuer, redirect all file transfer activity to the AccuSafe buffer area until the full media situation is resolved by the insertion of a new media with suitable storage space. This situation would be automatically detected via AccuSafe, which would then use the IntelliQueuer to perform all “queued” file transfers from the AccuSafe buffer area to the newly inserted media.

2. **Situation:** Similar to c.1 above, the AccuSafe storage device becomes full, or otherwise unavailable, during a file transfer.

Resolution: Same resolution as c.1 above, but note that the “restore from AccuSafe” features are affected by design decisions that may result in some revisions of a file being present on one media, and other revisions on another. The situation is further complicated by situations where a file might actually be split across multiple AccuSafe media (though it is likely that we would want to avoid this situation). Note that as smaller-and-smaller AccuSafe storage devices are incorporated into AccuSafe’s official support list, this situation, and other similar ones, will grow in frequency.

3. **Situation:** The media in the AccuSafe storage device is not the one that contains the revision history for a particular file. This might occur during situations where smaller media devices such as MO drives or ORB drives were in use.

Resolution: Warn the user via GUI that the currently inserted media is not the one used for a particular file, and offer the change of changing the media immediately, or holding off the change until a later point in time. The user would be issued periodic reminders of this situation, but it could persist for some time without any adverse affects. Via the IntelliQueuer, redirect all file transfer activity for the affected file(s) to the AccuSafe buffer area until the situation is resolved by the insertion of a the correct media for the affected file(s). This situation would be automatically detected via AccuSafe, which would then use the IntelliQueuer to perform the “queued” file transfers destined for the newly inserted media. It is possible for file transfers would be queued via the IntelliQueuer for several different media under this condition.

Note: Special attention must be given to the algorithmic design of such a feature, in order that it properly retain knowledge of the association of a particular media with the location of a particular file’s revision history. This may involve the detection of the media’s serial number (in order to detect one media vs. another, or the detection of an AccuSafe-supplied media serial number which might be generated/retained by AccuSafe in a file in the AccuSafe

directory on the AccuSafe media. The algorithm must operate properly with c.1 above, and must allow the user some convenient means for “resetting” AccuSafe so that it can, for example, begin storing a file’s revision history on a media other than the media originally used for that particular file.

- d) **Situation:** AccuSafe detects that bandwidth between the PC and the AccuSafe storage device is causing file transfer times to be elongated beyond *normal* (e.g. the LAN is very busy with other traffic).

Resolution: AccuSafe can temporarily redirect such file transfer activity to the AccuSafe buffer area via the IntelliQueueer, or it may adjust the file backup mode from “automatic” to “interval” or “scheduled.”

- e) Other **situations** and **resolutions** are TBD.

All actions, manual or automatic, taken by the AccuSafe Monitor should be chronologically logged, with the resulting log file being viewable, printable and resizable (maximum number of entries) by the user.

These functions should be implemented so that the user is not constantly barraged with messages concerning such “action-not-immediately-required” situations and their resolutions, but that they are periodically reminded of steps they need to take to resolve the situations. One possibility is to remind the user ever few hours, with a “snooze” button on the reminder dialog (similar to Outlook calendar events). Another possibility is to remind the user of all such pending matters each time AccuSafe starts (immediately after system boot-up for example).

Note also that it is not imperative that AccuSafe’s design include a separate functional block labeled AccuSafe Monitor, nor is it require that if such a block exists, that the above-described functionality would have to be resident there. Many of these functions may be incorporated into AccuSafe within other functional blocks that appear at the proper points in the system’s design (e.g. items “c” and “d” above may more properly be included within the IntelliQueueer itself.

6.22 AccuSafe Advisor

The AccuSafe Advisor is similar in operation to the AccuSafe Monitor. The AccuSafe Monitor is responsible for watching for, and acting on, a limited number fairly time critical situations. As such, the AccuSafe Monitor is invoked with every file transfer from the PC to the AccuSafe storage device. In contrast, the AccuSafe Advisor watches for and responds to a larger set of non-time-critical situations.

The AccuSafe Advisor runs on a scheduled basis, still not impacting PC performance in an appreciable manner.

The AccuSafe Advisor will detect and attempt to resolve situations such as the following:

- a) **Situation:** AccuSafe Advisor detects that X% of the AccuSafe media is occupied by files that haven’t been modified in the last Y days.

Resolution: Present an option to the user asking if they’d like to delete the files in question, or to reduce the number of stored revisions of them (if any), warning them to be sure that they have backups (AccuSafe can create them) of these files if they decide to delete them.

- b) **Situation:** AccuSafe Advisor detects that X% of the AccuSafe media is occupied by files which no longer exist in the original locations on the client PC.

Resolution: Present an option to the user asking if they'd like to delete the files in question, or to reduce the number of stored revisions of them (if any), warning them to be sure that they have backups (AccuSafe can create them) of these files if they decide to delete them.

- c) **Situation:** AccuSafe detects that a system file, or set of them, is not represented in AccuSafe, and that as a result, AccuSafe's "restore system" functions cannot properly perform.

Resolution: Present an option to the user, asking if they'd like for AccuSafe to automatically conduct the proper backups.

- d) **Situation:** AccuSafe detects that a file included in the AccuSafe backup strategy is not represented in AccuSafe in its latest version.

Resolution: AccuSafe conducts the backup automatically.

- e) Other **situations** and **resolutions** are TBD.

All actions, manual or automatic, taken by the AccuSafe Advisor should be chronologically logged, with the resulting log file being viewable, printable and resizable (maximum number of entries) by the user.

These functions should be implemented so that the user is not constantly barraged with messages concerning such "action-not-immediately-required" situations and their resolutions, but that they are periodically reminded of steps they need to take to resolve the situations. One possibility is to remind the user ever few hours, with a "snooze" button on the reminder dialog (similar to Outlook calendar events). Another possibility is to remind the user of all such pending matters each time AccuSafe starts (immediately after system boot-up for example).

Note also that it is not imperative that AccuSafe's design include a separate functional block labeled AccuSafe Advisor, nor is it required that if such a block exists, that the above-described functionality would have to be resident there. Many of these functions may be incorporated into AccuSafe within other functional blocks that appear at the proper points in the system's design.

6.23 Feature for the initial AccuSafe release

To be determined...

6.24 Features for future versions

The following features are contemplated for future revisions of the AccuSafe product, and should therefore be considered during the initial AccuSafe design process so as to not inadvertently preclude the possibility of their implementation. Some of these features may also be added as priced upgrades to the basic AccuSafe program.

These features are listed in no particular order, as their priority has not yet been established:

- A. Enhanced compression functions that briefly analyze the file type being compressed, and the select algorithms for speed or size optimization.

- B. Official support of additional AccuSafe Device Media hardware.
- C. Official support of Mac, Linux and Unix operating systems.
- D. Disk spanning for use with lower storage capacity AccuSafe Device Media. This function would make use of the IntelliQueueing mechanism in order to avoid situations where the user is constantly being asked to insert a different media. Some of this functionality is described under the AccuSafe Monitor and IntelliQueueer sections of this document.
- E. Use of multiple encryption types for optimization of speed and security, and to position encryption capabilities to be legally distributed outside the United States.
- F. Integrated virus scanning capabilities, and enhanced virus protection mechanisms.
- G. Enhanced AccuSafe Monitor capabilities.
- H. Enhanced AccuSafe Advisor capabilities.
- I. Block level, and/or byte level file change recording. This will reduce the disk space requirements currently associated with the storage of the entire file for each revision and will minimize bandwidth requirements on the interface between the client PC and the AccuSafe Media Device.
- J. Tie certain AccuSafe features and/or look-and-feel to firmware codes supplied by AccuSafe Device Media and/or hardware.
- K. Add "In AccuSafe backup files..." to the functionality available via the Windows Start Menu's "Find" menu capabilities.
- L. Add "In AccuSafe backup files..." to the functionality available via the Windows Explorer's "Tools | Find" menu capabilities.
- M. Enhance the redundant file elimination mechanism so that redundant files can be detected and linked (rather than copied) intra-computer or inter-computer.

7.0 Install Program

The AccuSafe installation program will be developed using the industry standard InstallShield product. The general form of the install program will follow the form of the prototype AccuSafe installation program, and will accomplish the following tasks:

- A. Provide an autorun file and capability for the CD.
- B. Provide a splash screen informing the user of the name of the product to be installed. This splash screen should also contain an engaging graphic.
- C. Provide a welcome dialog informing the user of the product name and version they are about to install.
- D. A check to see that the software/hardware environment into which the user is about to install AccuSafe, is officially supported by AccuSafe. The installation should be aborted for most (specific definition of "most" TBD) non-supported environments. See minimum system requirements elsewhere in this document.
- E. A radio-button (or similar) selection for the AccuSafe localization (English, French, German, etc.) they wish to install, defaulted to the language most appropriate to the version of the operating system they are running.
- F. A display of the license agreement in the language they selected. The installation process will not continue past this point without the user clicking on an "I accept the license agreement" button.

- G. The opportunity to build AccuSafe product floppy disks so that it can be installed on systems that have no CD ROM drive. (TBD if this requirement should be deleted since the overwhelming majority of 32-bit operating system machines have CD ROMs.)
- H. The opportunity for the user to enter their name and company name. These items should be populated into the Windows registry so that they can be displayed within the About AccuSafe dialog of the AccuSafe application.
- I. TBD A password should be required for web and email downloads. This password must not be hardcoded, but may be tied algorithmically to a CD serial number, or other such mechanism such that the password will work only for this particular installation.
- J. The user should be able to select between Typical, Compact and Custom installations. The typical installation should install all AccuSafe-related files. The compact installation should install the minimum set of required AccuSafe files (i.e. the help system might be omitted in this case). The custom installation should allow the user to choose which product components will be installed.
- K. The user should be allowed to select the installation directory for the AccuSafe application, with the default being “\Program Files\AccuSafe”. The company name is not included in the default directory, since there may be several companies selling AccuSafe under their name which would require unnecessary differences in the installation program, the application, learning products and the technical support process (to name only several) if the company name were included.
- L. The user should be allowed to select the folder/program group into which the AccuSafe-related application icons will be installed. The default folder/program group will be “AccuSafe” for similar company name issues as mentioned earlier.
- M. The installation process should determine which operating system the user is running, so that it can customize the installation appropriately. Customizations include, but are not limited to, the installation of particular rules for file inclusion/exclusion from the backup/startup processes.
- N. On appropriate operating systems (Windows NT for example), the install program should ask the user if AccuSafe should be available to all users (default), or to the particular installing user.
- O. The install program should determine the network name of the computer, and give the opportunity for the user to use this name, or another user-supplied name, for the AccuSafe media directory structure associated with that user’s computer.
- P. The install program should ask any other (but limited to less than 5 if possible) questions necessary for the configuration of various AccuSafe functions.
- Q. The install program should ask the user for an “AccuSafe administrator” password. This password will provide the ability to bypass encryption security parameters and adjust other vital AccuSafe operational parameters.
- R. The install program should ask the user for the disk drive to use as a temporary “buffer” area for file transfers in the event that the AccuSafe storage device, or it’s media, becomes unavailable.

It is anticipated that the AccuSafe application will be installed in stand-alone fashion, in which case the install process will attempt to identify a pre-installed AccuSafe storage device. If a single AccuSafe device is located, the AccuSafe install program will pre-configure it’s default storage device accordingly. If multiple AccuSafe devices are found, the install program will ask the user which device to use as the default device. The preceding remarks are appropriate also to the projected situation where the AccuSafe install program may be “called” from the driver installation program for an AccuSafe storage device. For example, the Fujitsu MO drive’s install program should call the AccuSafe install program (resident on the same CD as the MO drivers, or on a separate CD), once the MO drive is installed and

operational. Since the installation of hardware drivers often requires a system reboot before the hardware device is present, this process may require that the MO drive install program a) install the MO drivers and appropriately configure the system, b) reboot the system, then c) cause the system to automatically re-enter the install process in order to install the AccuSafe software.

Additionally, the install program should allow the user to “create” an AccuSafe storage device on any read/write media seen as a hard drive by the operating system. This allows the user to designate a directory on an existing media device as the AccuSafe device, without the necessity to actually install a new AccuSafe-related storage device.

The selected install program environment, InstallShield, has the internal capabilities to support the requirements described in this section.

- S. The user should be presented with an opportunity to review, and then if necessary, to change, the user-specified, default, and automatically-determined installation settings prior to the actual start of the product installation.
- T. The installation program should install all files necessary for the AccuSafe product. This process may involve firing of other Microsoft-supplied or third-party-supplied self-extractor installations related to Microsoft or third party subsystem installations such as ODBC, Jet, MS-Access drivers, etc. Multiple system reboots (and corresponding automatic install program restarts) should be kept to an absolute minimum, a single reboot at the end of the installation is the goal. The installation program should create a persistent, cumulative, user-viewable log of its activities for troubleshooting purposes.
- U. The installation process should add all registry entries required by the AccuSafe product, including file associations, class associations, and entries corresponding to the automatic start-up of AccuSafe upon system startup and/or user login. Registry installation areas should be selected so that AccuSafe operation for individual users, as well as for “all” users can occur properly.
- V. The installation process must configure the registry and/or the StartUp folder, such that AccuSafe will be automatically started upon system startup and/or user login.
- W. The installation process should let the user view the ReadMe file at it’s conclusion, and/or startup AccuSafe. If AccuSafe is being started for the first time on the computer, the user should be given the opportunity to accept or decline an automatic background synchronization of the AccuSafe Media Device with their hard drive (TBD “C” only, or all local drives) upon AccuSafe startup.

The installation program must be built with potential localization of the entire installation user interface in mind.

The installation program must be as user-friendly and jargon-sparse as possible, since this application will be used by an extremely wide variety of PC illiterate and PC expert customers, in all areas of the world.

The installation program must be built with consideration to making it easy to adjust the company name associated with the AccuSafe product since it may be distributed by multiple partner companies who may be licensed to sell the “XXX AccuSafe” product, where “XXX” is the name of the authorized selling company.

If necessary, the installation program should be built upon the Windows Installer (TBD) in the case of Windows 2000. However, it is more important that consistency in installation across the various platforms be maintained if at all possible for facilitation of Learning Products, QA and Technical Support commonality.

8.0 UnInstall Program

An UnInstall capability should be created along with the installation program, again using the industry standard InstallShield product. UnInstall must remove all non-shared, and user unmodified files installed during the installation of AccuSafe. Any files that have been modified from their default settings subsequent to the installation of AccuSafe must be retained, in order that access to any AccuSafe backed-up files can still occur manually, or upon reinstallation of AccuSafe.

UnInstall should also remove all appropriately-removable AccuSafe registry entries.

The UnInstall capability should be available via the standard Start | Settings | Control Panel | Add/Remove Programs mechanism within the Windows 95/98/NT mechanism. Windows 2000 uninstall access mechanism is TBD, but is anticipated to be the same as the necessary mechanism for Windows 95/98/NT.

9.0 Learning Products Plan

9.1 Help System

The AccuSafe application will include a comprehensive on-line help system in standard WinHelp format, similar in look and feel to the help system available within Microsoft Word.

HTML format is acceptable alternative to WinHelp format, as long as product installation details and installed component licensing agreements are workable. HTML format is only acceptable if there are no requirements for the user to have Microsoft Internet Explorer installed or selected as the default/only browser.

The help system will be designed to integrate with the user interface of AccuSafe, through specific Help buttons, via right-click "What's This?" functionality, and via F1 key accessibility. Further, the Help system will be accessible via an "AccuSafe Help System" and "AccuSafe Help Contents and Index" right-click menu items from the AccuSafe system tray icon. The help system will also be accessible via an AccuSafe Help System icon in the AccuSafe folder/program group.

The help system will be primarily "how to" oriented, and will cover the major tasks expected to be performed by the user during the course of AccuSafe application use. A "reference" section will be included as well, giving details of each user interface and operational element of the application.

The help system should be developed using the industry standard RoboHelp tool in order to properly prepare for a possible localization process.

A final table of contents for the help system is TBD, but is expected to be similar to the following general outline:

- A. Introduction
 - Welcome
 - How AccuSafe works
- B. System requirements
 - Supported computer hardware
 - Supported computer software (operating systems, etc.)
 - Supported AccuSafe media devices
 - Supported AccuSafe media device drivers

- C. Installation procedure
 - Hardware
 - Software
 - What happens during installation and how to make adjustments later
- D. Getting started
 - High level, quick walk through the major features (may be leveraged from and/or to the Getting Started Guide references below).
- E. How To...
 - Backup a file
 - Restore a backed up file
 - Synchronize AccuSafe media with your computer
 - Work with AccuSafe when there is no external AccuSafe media
 - Create an emergency restart disk for use in case of hard drive failure
 - Restore your system to a new hard drive from the AccuSafe media
 - Restore your system after a corrupted hard drive failure from the AccuSafe media
 - Encrypt files
 - Compress files
 - Work with multiple computers attached to an AccuSafe Media Device
 - Modify AccuSafe's setup settings
 - Adjust individual extension, file and/or directory settings
 - Adjust default extension, file and/or directory settings
 - Etc.
- F. Reference...
 - Describes each dialog and control widget
- G. Troubleshooting
 - Symptom-oriented
 - Step-by-step-oriented
 - References to other documents (printed, electronic, web)
- H. Technical Support
 - Web site connections
 - Email addresses
 - Phone and fax numbers
 - Hours of support
- I. License linkage
- J. Warranty linkage
- K. ReadMe linkage
- L. Windows Help linkage

9.2 ReadMe

An electronic ReadMe file will be created in Microsoft NotePad/WordPad-compatible ASCII *.txt format. This ReadMe file will contain product information generally not carried in the Help System, and will focus on the following general topics (final contents TBD):

- A. Introduction

DRAFT

- B. Installation Procedures
- C. Last minute information received too late for inclusion in the help system
- D. Troubleshooting information
- E. Technical support information

The ReadMe file will be accessible via the help system, and will also be available via a Microsoft NotePad icon in the AccuSafe folder/program group.

9.3 Getting Started Guide

A brief electronic Getting Started Guide will be created in Microsoft Rich Text Format (rtf) very briefly covering the following general topics (final contents TBD). Some of this material may be highly leveraged from the help system.

- A. Introduction
- B. System Requirements, including supported software and hardware
- C. Major feature walk through (mostly screen shots, minimal text, lots of white space)
- D. Where to find more product information
- E. Where to find troubleshooting information
- F. Technical support

The Getting Started Guide will be delivered in electronic form with the AccuSafe product, and will be available via a Microsoft Word Reader icon in the AccuSafe folder/program group.

The Getting Started Guide will be printable by the user.

The Getting Started Guide may also be delivered in printed format to the user with the AccuSafe product as a manual-sized document, or as a CD jewel case front-liner. Delivery as a front-liner will require graphics design not required for the other-mentioned delivery vehicles.

9.4 License File

A license file containing appropriate terms and condition of AccuSafe product usage will be created in Microsoft NotePad/WordPad-compatible ASCII format. The license file will be accessible to the user during the installation process, and the user must agree to it's terms and conditions in order for AccuSafe to install.

Further, the license file will be accessible as a file loaded onto the user's computer, via a Microsoft NotePad icon in the AccuSafe folder/program group, via a License access button and/or menu item within the AccuSafe user interface.

9.5 CD-Front Liner

AccuSafe will be distributed by CD (as well as via web and email distribution mechanisms). In the case of CD distribution, a CD-Front Liner will be created in the event that a jewel case is employed to carry the CD. The front liner may comprise the brief Getting Started Guide as described above. In this case, the visual design of the Getting Started Guide will be important.

9.6 CD-Back Liner

AccuSafe will be distributed by CD (as well as via web and email distribution mechanisms). In the case of CD distribution, a CD-Back Liner will be created in the event that a jewel case is employed to carry the CD.

This CD-Back-Liner will generally contain the following (exact contents TBD):

- A. Product name
- B. Simple artwork
- C. Copyright information
- D. Part number

E. Bar coded part number

9.7 CD Silkscreen

AccuSafe will be distributed by CD (as well as via web and email distribution mechanisms). An attractive silkscreen will be developed in black-and-white and/or four-color formats for the CD. This silkscreen will generally contain the following (exact contents TBD):

- A. The AccuSafe product name (and version number? – TBD)
- B. Engaging artwork
- C. Copyright information
- D. A government restricted rights legend and/or key license information
- E. Technical support links
- F. Part number

9.8 Technical Support Training Materials

A Microsoft PowerPoint-based or Install Shield DemoShield product training package will be created for the AccuSafe product to be used primarily in the training of those responsible for technical support of the AccuSafe product. This training package may assume a high degree of PC knowledge on the part of the user.

The package should include lecture-format material interspersed with product demonstration and hands-on lab exercises and should be target for a time-requirement of no more than 4 hours. Pre-study material should be required, and this material should consist of a review of each of the current versions of the Learning Products, as well as some hands-on experience with the AccuSafe product itself.

The package should quickly address AccuSafe's features and system requirements, and should otherwise heavily focus on troubleshooting techniques and theory of operation.

9.9 Generalization

All learning products should be created within the framework that the AccuSafe product may be released through several different companies, who may be branding the product to their corporate name (e.g. Fujitsu AccuSafe, and Hewlett-Packard AccuSafe). Therefore, to the extent possible, corporate names should be omitted from the learning products as they are created.

9.10 Localization

It is anticipated that AccuSafe's market will contain a high mixture of non-US customers. As a result, all Learning Products should be designed with localization in mind. Primarily, this involves simply the use of standard tools to create the Learning Products, but it also considers the fact that localized text may be longer or short (both in word count and in real-estate requirements) in local languages as contrasted with the English language.

The tools recommended above for the development of the AccuSafe Learning Products are those that are within the skill-set of the Hewlett-Packard Localization Management Center in Grenoble, France. It is likely that this unit of HP will be employed to perform any necessary AccuSafe Learning Products and/or application localization tasks.

In the event that localization is performed on AccuSafe learning products, the following languages are representative of the possible localization set (exact definition TBD):

- A. English
- B. French
- C. German
- D. Italian
- E. Japanese
- F. Korean
- G. Mandarin
- H. Spanish
- I. Taiwanese

The ReadMe file may be excluded from the localization process so that it's localization lead-time doesn't interfere with the timeliness of it's contents.

10.0 Quality Assurance Plan

TBD during the phase 0 process.

11.0 Manufacturing Plan

Known, but not yet written.

12.0 Technical Support Plan

Known, but not yet written.

13.0 ERS Change Process

Changes to this ERS after the initial version non-draft release (ERS revision A.01.00) , must be made via written change order and must be approved and signed by all parties to this ERS. All such change orders should be distributed to all owners of copies of this ERS, and should be attached to each copy of the ERS.

It is specifically understood that changes to this ERS may require schedule, financial and/or product feature adjustments.

14.0 Approvals

IN WITNESS WHEREOF, the parties signing below have caused this ERS to be executed, understood and approved, including knowledge that certain marked items are as yet "to be determined" by their respective duly authorized representatives.

Integrity PC Innovations, Inc.

By: Steven R. Williams

Title: Vice President, Software Development and AccuSafe Project Manager

Date: _____

Signature: _____

Integrity PC Innovations, Inc.

By: Warren P. Roach

Title: President

Date: _____

Signature: _____

Science Applications International, Inc.

By: TBD

Title: TBD & AccuSafe Project Manager

Date: _____

Signature: _____

Science Applications International, Inc.

By: Bradford E. Tyler

Title: TBD

Date: _____

Signature: _____

AccuSafe System Description Document

September 21, 2000~~March 6, 2000~~~~March 5, 2000~~

1. The purpose of this document is to provide a detailed description of the AccuSafe system, including its components, architecture, and operation. This document is intended for use by system administrators and users who need to understand the system's capabilities and limitations.

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1 System Description

This document is the System Description Document for the AccuSafe™ product of Integrity PC Innovations, Inc. (IPCI). AccuSafe™ is a client-based software application that creates data safety, integrity, backup, revision control and disaster recovery for the customer without user action or intervention.

1.1 General Theory of Operation

AccuSafe provides the user with true background and real time backup. No scheduling on the part of the user is required. No file selection by the user is required. The features offered may be individually selected or not selected and controlled or not controlled by the user at their choosing. By default, AccuSafe is installed as a complete file integrity and disaster recovery system. Should the user decide to limit AccuSafe to a data file integrity system only, this can be done with ease. The user has nearly complete control of the AccuSafe behavior. There are only a few areas AccuSafe will not allow the user control over for their own protection such as formatting the AccuSafe drive while there is still information on it that does not exist on the system drive. AccuSafe operates in the background and creates no noticeable system performance degradation (less than a 2% increase in average CPU usage and no detectable change in keyboard or mouse operations by a power user is considered not noticeable). The AccuSafe drive can be any Microsoft compatible hard disk, removable disk, mapped network drive, or other continuous read/write device that presents itself as a drive letter to Windows Explorer. AccuSafe tracks file operations at the interrupt level within the Windows OS, creates a database log of relevant file saves and then saves versioned copies of such files on a separate AccuSafe folder on the defined AccuSafe drive. A break in the connection between the user PC and the AccuSafe drive destination does not interfere with the AccuSafe database tracking of changes that occur. Once re-connected to the AccuSafe drive, data will be copied over without user intervention.

1.2 Supported Platforms/Environments

The following section contain a description of the supported platforms and environments for the AccuSafe product

1.2.1 Operating Systems

The AccuSafe application will be fully functional, tested and supported on the following operating systems:

Microsoft Windows 95

Supported service release levels and localizations TBD.

Microsoft Windows 98

Supported service release levels and localizations TBD.

Microsoft Windows NT 4.0

Supported service release levels and localizations TBD.

Microsoft Windows 2000

Supported service release levels and localizations TBD. The Windows 2000 operating system will be officially supported only if the final retail version is available to AccuSafe QA efforts at least 2 months prior to the market release of AccuSafe. However, design for Windows 2000 compatibility is a requirement of this product, and testing on Windows 2000 beta releases is required in the event that the final retail version of Windows 2000 is not available in time for official AccuSafe support.

1.2.2 Computer Platforms

The AccuSafe application will be fully functional, tested and supported on computer platforms meeting the following minimum system requirements:

- A. Intel Celeron, Intel Pentium, or AMD K6 processors
- B. 16 MB available RAM
- C. TBD MB available disk space (for program installation and operational data)
- D. TBD MB available disk space (for file repository)
- E. Single hard disk with single or multiple partitions
- F. 4x CD ROM
- G. 3 ½ " floppy drive
- H. VGA display
- I. Microsoft-approved keyboard and pointing device (serial mouse, bus mouse, trackball, etc.)

1.2.3 AccuSafe Media Devices

The AccuSafe application will be designed to work with any media device that appears as a drive letter to Microsoft Windows. AccuSafe release 1 will be fully tested and supported with the following media devices:

- A. AccuSafe-dedicated internal hard drives with single or multiple partitions
- B. Single or multiple directories on internal hard drives used for standard and AccuSafe-related file storage
- C. LAN/WAN-connected hard drives
- D. Dial-up-networking-connected hard drives
- E. Anticipated: Fujitsu MO drives on USB or Firewire
- F. Anticipated: Other manufacturers removable drives both internal and external
- G. Anticipated: IPCI-developed external hard drives connected via USB, Firewire, Serial or Parallel ports (the parallel port version is TBD in view of MicroSolutions parallel port storage device patent)

For the initial AccuSafe product release however, connectivity to a) internal hard drives, b) network attached drives and c) the USB-attached (Universal Serial Bus) Fujitsu Magneto-Optical drive family (TBD is it a family or a single device?) is projected. Each of these connectivity options rely on AccuSafe Media Device drivers provided either via Microsoft in terms of standard disk and/or network device drivers, or via Fujitsu (who OEMs SCM Microsystems/Shuttle drivers and hardware components). Creation of AccuSafe Media Device drivers is not a part of the AccuSafe project, although compatibility with them is. It is anticipated that the AccuSafe installation will be called after the completion of the device installation.

A UNC path (including directory specifications) as well as a drive letter prefixed path (including directory specifications) will be allowed for the specification of the AccuSafe storage device.

2 Architecture

The following section discusses the high level architecture of the AccuSafe application.

2.1 Architecture Diagram

The diagram below is the high-level architecture diagram for the AccuSafe application. The individual subsystems shown in this diagram will be described in the following sections.

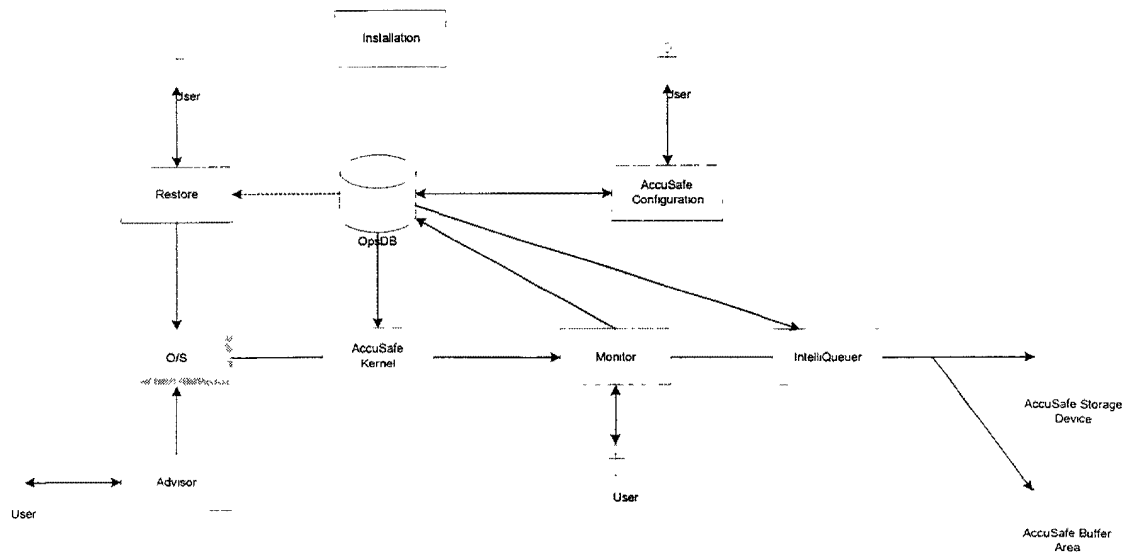


Figure 1 - System Architecture

2.2 Subsystem Descriptions

The following sections contain a brief description of each of the subsystems shown in the Figure above.

2.2.1 AccuSafe Kernel

The kernel watches the operating system, and detects specific events at the operating system level that correspond to file reads, writes, deletes, and other fundamental file system activities. The kernel translates the event into a message that can be sent to the AccuSafe Core Application can use it. This happens real-time, as the user is working as normal on their PC. Once the event is detected at the operating system, the rest of the AccuSafe backup process happens as quickly as it can – to appear instant to the user.

2.2.1.1 Kernel Architecture

< Put General Architecture drawing from Steve's Informal Prototype Code Walkthrough>

2.2.6 Configuration

The Configuration subsystem is responsible for allowing the user to select what files to backup and how to back them up. There will also be application wide settings that can be configured. A user interface will be presented to the user and the configuration information will be stored in the Operational Database (OpsDB).

2.2.7 Operational Database (OpsDB)

The Operational Database is the repository for AccuSafe configuration information and could also hold the IntelliQueue entries.

2.2.8 Installation

The AccuSafe installation program will be developed using the industry standard InstallShield product.

AccuSafe is a registered trademark of AccuSafe Corporation. All other trademarks are the property of their respective owners.

3 Use Cases

The following diagram represents the high-level system use case diagram. Each of these high-level use cases will be further broken down into more detailed use cases.

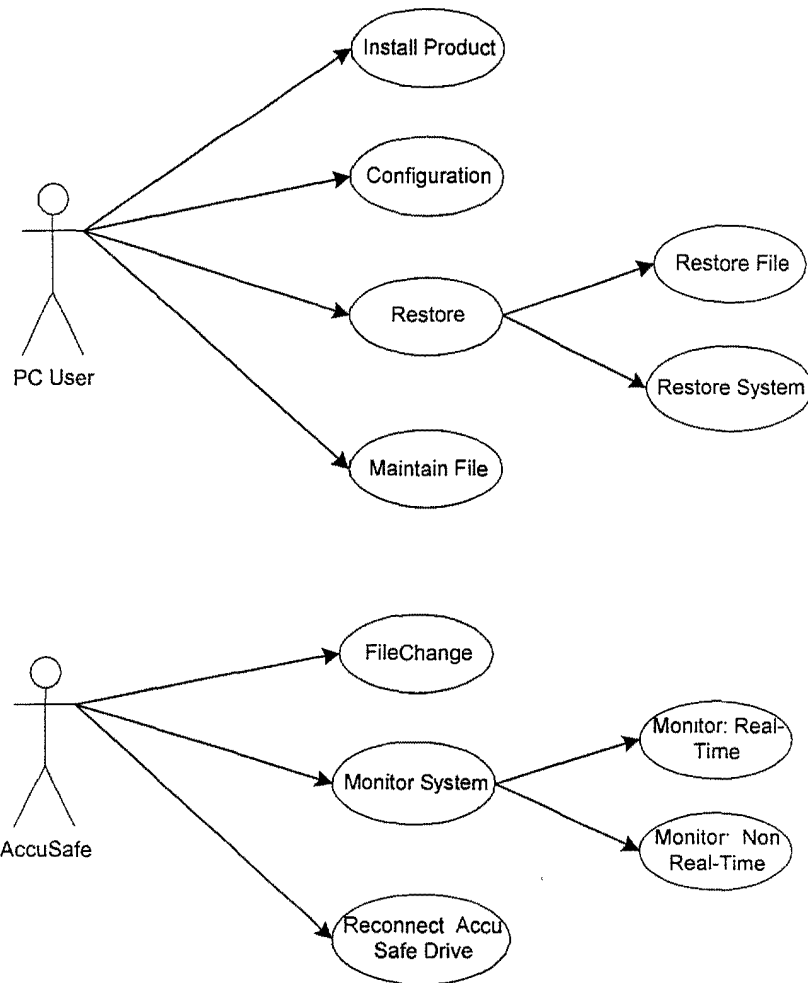


Figure 2 System Level Use Case Diagram

The following sections detail the Use Cases for the AccuSafe application.

3.1 File Change

Description: This use case is responsible for performing the real-time backup of a user's files without user action or intervention.

Initiator: This use case is started indirectly when the user performs an action that causes a file to be created or modified.

Pre-conditions:

- AccuSafe is installed, configured, and operational.

Post-conditions:

- File is backed-up on the AccuSafe drive.

3.1.1 Main Flow

1. AccuSafe detects from the O/S that a file has been created or modified (i.e. saved).
2. If AccuSafe determines that the file is under AccuSafe control:
 - a) AccuSafe determines if there is enough room on the AccuSafe Media Device to perform the copy (this will avoid half written files and cleanup). If not enough space, user is informed and file is sent to temporary buffer area.
 - b) AccuSafe places that file onto the AccuSafe Media Device with the same name and in the same directory hierarchy as the original file.
 - c) An Information file is created, in the same location, for the newly backed up file containing the information described in Section 4.2.3. This file is created in the same directory as the backed up file
3. Operation is chronologically logged, with the resulting log file being viewable and printable by the user.

3.1.2 Alternate Flows

3.1.2.1 *AccuSafe Media Device is not attached (at Step 2) --- IntelliQueuer*

1. User is informed that AccuSafe Media Device is not connected (time delay popup)
2. Files are copied to temporary buffer area on the local hard drive.
3. This operation is logged to the IntelliQueue, so that when the AccuSafe Media Device is reconnected, the file(s) that have been copied to the temporary buffer area will be moved to the AccuSafe Media Device (See Section XXXX for the Use Case describing the reconnection of the AccuSafe Media Device).

3.1.2.2 *Version Control is Active (at Step 2)*

If version control is active, the same steps are performed by AccuSafe except the file and the associated information file are named with a version number on it. Versions of the file are maintained up to the number set in the AccuSafe configuration which can be modified by the user.

3.1.2.3 File Compression (at Step 2)

If the user has configured the application or this specific file to be compressed, the file will be compressed before being copied to the AccuSafe Media Device. See Section 4.3 for a more detailed description of file compression.

3.1.2.4 File Encryption (at Step 2)

If the user has configured the application or this specific file to be encrypted, the file will be encrypted before being copied to the AccuSafe Media Device. See Section 4.4 for a more detailed description of file encryption.

3.1.2.5 Redundant File Elimination (at Step 2)

It is anticipated that AccuSafe will be designed to employ a redundant file elimination technique similar to the following in order to reduce AccuSafe Media Device disk space requirements as well as bandwidth requirements between the PC and the AccuSafe Media Device:

- a. Calculate the checksum for the source file. This step is always accomplished, and is not strictly a part of the redundant file elimination mechanism.
- b. Look to see if the source file exists in the same directory on the AccuSafe device, under each AccuSafe-protected computer's directory structure. For example, if the source file were "C:\Program Files\Microsoft Office\Office\Excel.exe" on a computer named "dan1", and if AccuSafe were storing files for computers named dan1, keith1 and paul1, we'd try to find the following "Candidate Master" files of the same version on the AccuSafe device.

`\AccuSafe\dan1\C\Program Files\Microsoft Office\Office\Excel.exe`
`\AccuSafe\keith1\C\Program Files\Microsoft Office\Office\Excel.exe`
`\AccuSafe\paul1\C\Program Files\Microsoft Office\Office\Excel.exe`
- c. For each "Candidate Master" file found, determine if the file size is the same (or for program files, that the version is identical). This is a quick go/no-go check, and is done first in order to maintain high algorithm performance for the case of non-similar files.
- d. If step "c" indicates file similarity, verify the checksums. If the size (or versions) and the checksum are the same, then perform a bit level difference test to guarantee the files are identical.
- e. If steps "b-d" indicate that the files are identical, then the file of which the source file is a duplicate, is now promoted in AccuSafe's "thinking" from "Candidate Master" to "Master" status. In this case, the source file will not be copied to AccuSafe. Instead, a tiny placeholder ".AccuSafeFile" file will be created with the same name as the source file, in the normal location on AccuSafe. The ".AccuSafeInfo" file will be created as usual, and populated with a pointer to the discovered "Master" file. (The .AccuSafeInfo file will also carry all the information described elsewhere in this document.) Further, the ".AccuSafeInfo" file for the "Master" file, will be adjusted to carry a pointer back to the placeholder file(s) that duplicate it elsewhere on the AccuSafe device.
- f. Users can restore duplicate file in exactly the same way that we showed you in our meeting. In fact, the user has no knowledge as to whether or not the file(s) they're wanting to restore are duplicate files or not.
- g. Users attempting to delete duplicate files, do so as usual. Users attempting to delete "Master" files do so normally too, but in this case AccuSafe then promotes one of the duplicates that point to the "Master" file to be the new Master file, with corresponding adjustments to all involved .AccuSafeInfo files. Also,

5	Operation to be performed
6	Earliest date/time at which to perform the operation (this enables the IQ to handle “interval” and “scheduled” backups, and to handle situations where the user has set AccuSafe to meter file transfers to the AccuSafe storage device (as mentioned earlier))
7	File transfer performance mode (optimize for transfer speed, or optimize for best PC performance)
8	TBD
9	TBD
10	TBD

3.1.4.5 File Deletion

When files are deleted on the PC, AccuSafe responds with a message asking if the corresponding backup files (if any) should simultaneously be deleted on the AccuSafe storage device. (Note that this requires careful design, since the user could see large AccuSafe intrusion in their workflow if this is a frequent event, such as in the automatic deletion of temporary files by various applications [in this case though, the temporary files are probably “excluded” from the AccuSafe backup strategy.])

When files are deleted on the PC that are not backed up on AccuSafe, a copy of the files is made to AccuSafe prior to the delete actually occurring.

When a user deletes files from the AccuSafe directory structure on the AccuSafe storage device, appropriate warnings are presented, but the user is allowed to continue the delete operation if they wish. It is TBD if the corresponding files should, at the user’s option, be deleted from the PC as well. Whenever files are deleted on AccuSafe, either directly on AccuSafe, or as a result of deleting them on the PC, all revisions and information files are deleted as well.

File deletions on the AccuSafe device, but outside the AccuSafe directory structure, are detected and handled by AccuSafe normally.

3.1.4.6 File Renaming

When files are renamed on the PC, AccuSafe performs the same rename operation on the AccuSafe storage device. If the files being renamed are not presently stored on AccuSafe, the rename operation causes the backup to occur immediately.

When a user attempts to rename files on the AccuSafe storage device, appropriate warning messages are presented, but the user is allowed to continue the rename operation if they wish. It is TBD if the corresponding files should, at the user’s option, be renamed on the PC as well. Whenever files are renamed on AccuSafe, either directly on AccuSafe, or as a result of renaming them on the PC, all revisions and information files are renamed as well.

File renames on the AccuSafe device, but outside the AccuSafe directory structure, are detected and handled by AccuSafe normally.

3.1.4.7 File Copy

When files are copied on the PC, AccuSafe detects the file writes associated with the creation of the new copies, and conducts the normal backup operations specified for the files.

When a user copies files on the AccuSafe device, appropriate warning messages are presented, but the user is allowed to continue the copy operation if they wish. It is TBD if the corresponding files should, at the user's option, be copied on the PC as well. Whenever files are copied on AccuSafe, either directly on AccuSafe, or as a result of copying them on the PC, all revisions and information files are copied as well.

File copies on the AccuSafe device, but outside the AccuSafe directory structure, are detected and handled by AccuSafe normally.

3.1.4.8 File Move

When files are moved on the PC, AccuSafe detects the file writes associated with the creation of the new copy, and conducts the normal backup operations specified for the files. It is to be investigated if a "move" operation actually results in file writes on the PC, or if it is simply conducted via modifications to directory content "tables." If file writes don't occur, then appropriate file-move message trapping must occur within the AccuSafe kernel in order that AccuSafe can properly detect such operation.

When a user moves files on the AccuSafe device, appropriate warning messages are presented, but the user is allowed to continue the move operation if they wish. It is TBD if the corresponding file should, at the user's option, be moved on the PC as well. Whenever files are moved on AccuSafe, either directly on AccuSafe, or as a result of moving them on the PC, all revisions and information files are moved as well.

File moves on the AccuSafe device, but outside the AccuSafe directory structure, are detected and handled by AccuSafe normally.

3.1.5 Outstanding Issues

The following section contains outstanding issues regarding this Use Case. This section may contain unsolved issues as well as proposed high-level design issues.

3.1.5.1 Backup Decision

The intelligence for what files should be backed up could be placed in the Kernel or the Monitor. The configuration data for the backup decision will originate from the OpsDB. There are two possible access methods to this data:

1. The data can be loaded from the OpsDB and then stored and referenced in memory. This will provide for the fastest access but will not be able to know about configuration changes made while the application is running (see 'Real-Time configuration changes below).
2. A connection to the database can be maintained and all configuration data is referenced directly from the database. This will provide real-time configuration changes, but has the cost of slower access.

3.1.5.2 Real-Time configuration changes

If the AccuSafe backup configuration can be changed real time, then the object responsible for deciding which files to backup, needs to be tied to the database directly rather than reading the configuration just at start time. Being tied to the database may cause a performance problem versus having information in memory.

3.1.5.3 Handling a set of files (like Quicken) where a single file is not meaningful

How do we handle the situation where a single file is backed up, but it does not stand on its own? Quicken has around 5 files that makeup their whole set. If a full backup was initially done, then this will not be a problem.

3.1.6 Sequence Diagram

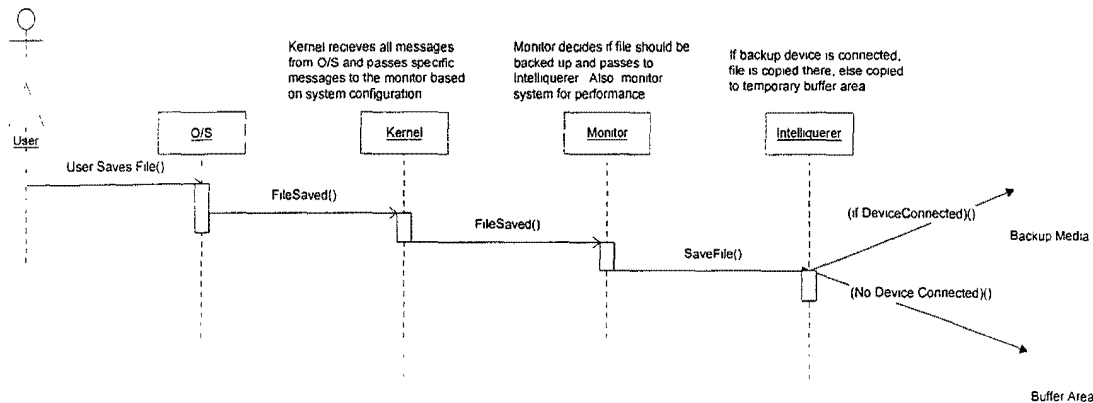


Figure 3 Sequence Diagram: File Change

3.1.7 User Interface (proposed)

None. This use case occurs transparently to the user, except where the user would need to be notified and potentially take action.

3.1.8 Risk Areas

None documented at this time.

3.2 Restore File

Description: This use case describes the restoration process of a file or directory that is under AccuSafe control.

Initiator: The user initiates this use case by executing a restore command via the AccuSafe application.

Pre-conditions:

- AccuSafe is installed and operational.
- User has selected to perform a restore operation.

Post-conditions:

- File is restored to user specified location.

3.2.1 Main Flow:

1. A selection of backed-up files in a directory hierarchy is presented to the user. Information displayed includes (at a minimum) File Name, Date/Time Stamp, and Original Location.
2. The user will have the ability to view a file before restoration. This will be accomplished using the standard windows File Type associations so files will be viewed with their native viewer.
3. User selects directory or file to be restored. This can be a single file/directory or multiple files/directories. If a directory is selected, the user will have the ability to select all files and subdirectories in the selected directory.
4. User selects a destination directory and destination file (original is default). User will have ability to create new directory.
5. Users selects to restore selected file.
6. File(s) residing on AccuSafe drive is/are verified against checksum to make sure there is no corruption of file.
7. File(s)/Directory(s) is/are restored.

3.2.2 Alternate Flows

3.2.2.1 *If Version Control is active (after Step 3)*

1. When a file is selected for restore, all versions of that file will be displayed. These versions are named the same name on the AccuSafe device with the exception of a version number.
2. The user will have the ability to view a particular version and select it for restore.

3.2.2.2 *Overwrite File (before Step 7)*

Also prior to actually restoring the file, the restoration process should determine if the backed up file will overwrite a file of the same name on the users PC, and if so, if the

version of the file on the users PC is on the top level of the AccuSafe revision “stack”. If such is not the case, AccuSafe must first backup the users file to the AccuSafe Media Device, then perform the restoration function. This will assure that no version of a file is lost as a result of the restoration process.

3.2.2.3 *Current AccuSafe Media Device does not contain revision history*

In the case that the AccuSafe Media Device is removable media, it could be the case that current media does not contain the revision history for a particular file. See Section 4.5 for a discussion of drive spanning issues.

3.2.3 Error Flows

3.2.3.1 *AccuSafe configuration files are damaged*

3.2.3.2 *Out of disk space on destination drive*

3.2.3.3 *Error occurs while attempting to restore file*

3.2.4 Other Requirements

The following is a list of other requirements that pertain to this Use Case:

3.2.4.1 *File Information*

The current thought is that the Restore functionality will not need to reference information in the OpsDB. All information will be obtained from informational files associated with each file. The definition of this file is given in Section 4.2.1.

3.2.4.2 *File Selection*

AccuSafe users must have the ability to select files to be recovered during a restoration operation. Such control should be provided at:

- a) full file name,
- b) base filename (e.g. the full file name without an extension),
- c) file extension,
- d) directory and/or
- e) drive levels.

Multiple selection capabilities must also be provided so that users can select on several different items from “a” – “e” above during their specification of what is to be restored.

The user interface for the restoration capability should allow the user to select multiple or single drive(s), directory(s) and/or file(s) to be included or excluded. Similar to a standard multiple file copy operation using explorer, the user should be able to right-click over one of the selected items, and the resulting mouse menu should provide direct access to the AccuSafe feature(s) that allow file restoration.

3.2.5 Outstanding Issues

None documented at this time.

3.2.6 Sequence Diagram

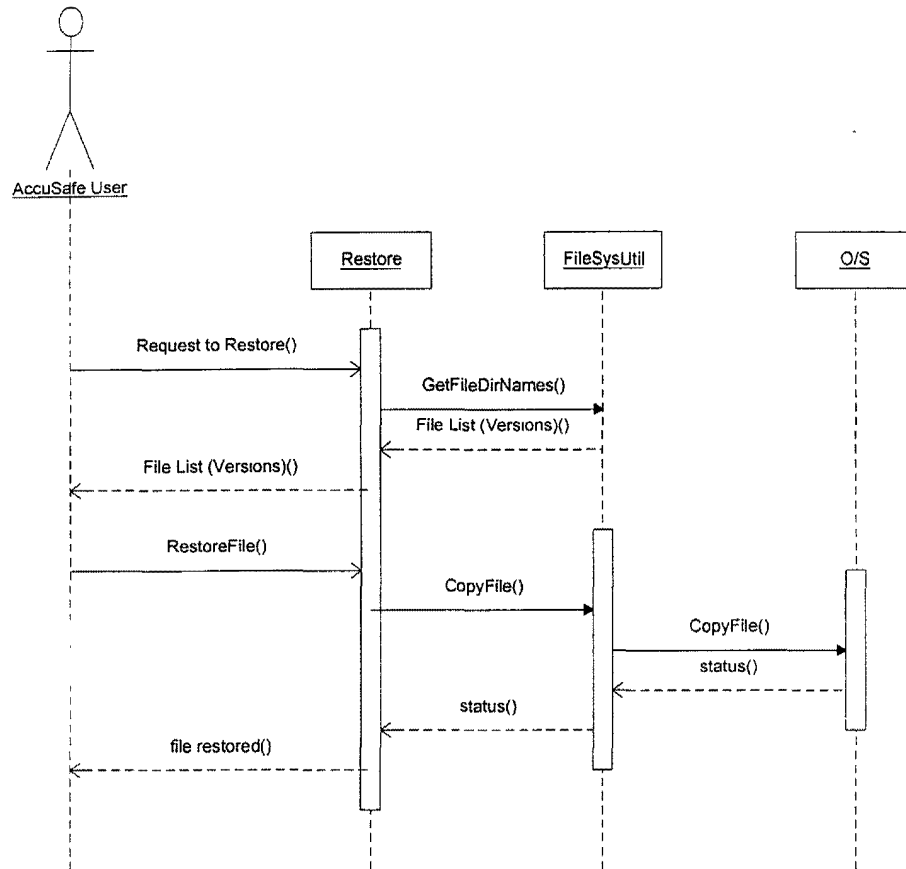


Figure 4 Sequence Diagram – Restore File

3.2.7 User Interface (proposed)

3.2.7.1 Wizard Interface (Novice)

The Novice interface should be a wizard like interface similar to IoMega's 1-Step Restore. At the novice level, a restore could be accomplished without the person having to understand the file system.

3.2.7.2 Window's Explorer Interface (Advanced)

The Advanced Interface will be a Windows Explorer like interface that allows for maximum flexibility and exposes all features of the AccuSafe application.. Custom dialogs are presented only where necessary.

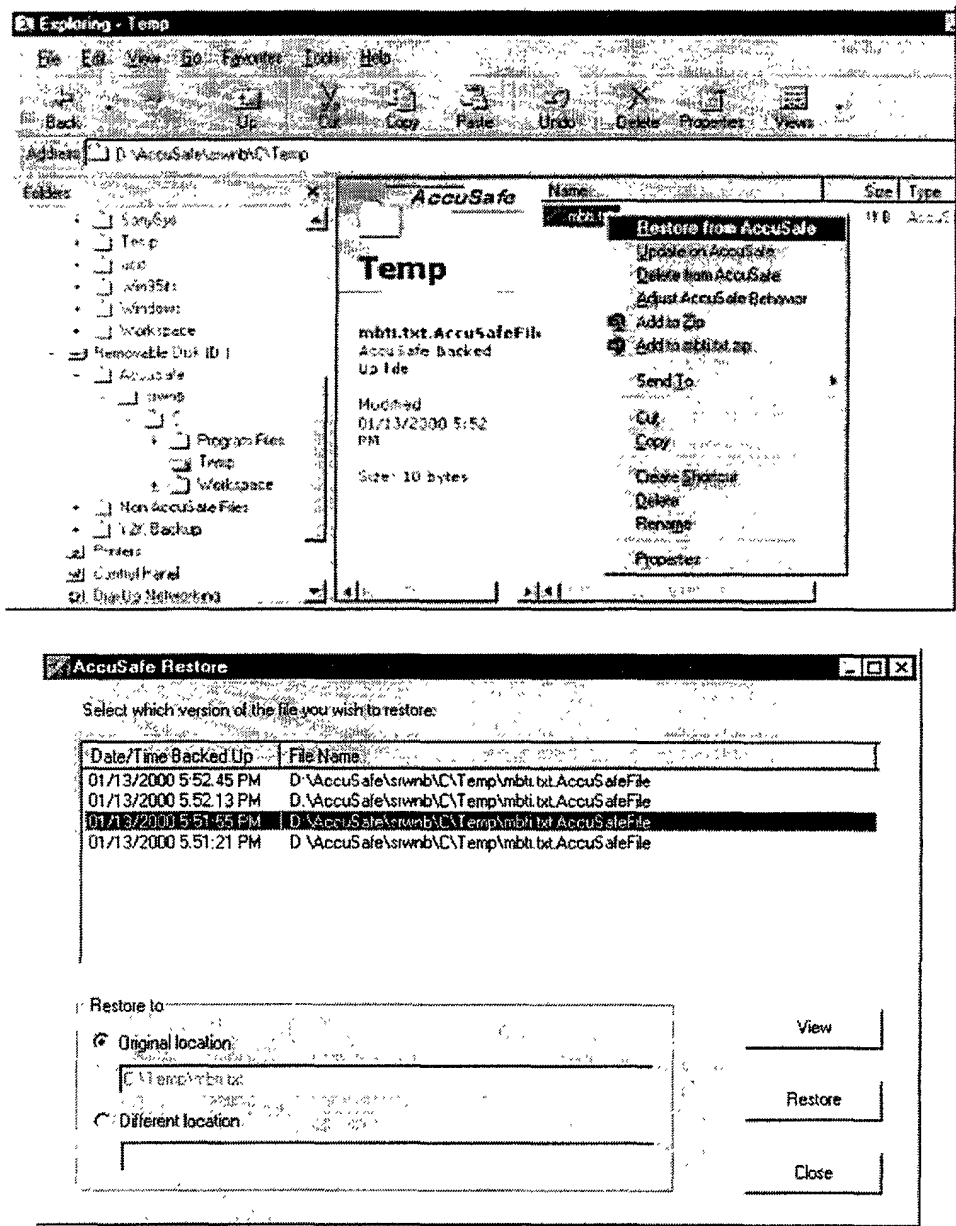


Figure 5 Restore User Interface (Advanced)

3.2.8 Risk Areas

None documented at this time.

3.3 Restore System

AccuSafe must implement the capability to completely restore a users system in the event of a crashed system hard disk, destroyed files, or other catastrophic event.

This will require that AccuSafe be able to generate an "Emergency AccuSafe Boot Floppy" (3 1/2" media only) at some time prior to the failure. The contents of this emergency boot floppy must be sufficient to redirect the boot device to the AccuSafe drive and completely restart the computer from the AccuSafe Media Device, assuming that the system files necessary to support this functionality are in fact resident on the AccuSafe Media Device, and assuming that the AccuSafe device wasn't the damaged hard drive itself.

Once a restart has been accomplished, the user should be left in a state where they can either proceed immediately to system restoration functions, or operate their system as if the catastrophic event had not occurred. If the user chooses to operate their system normally, they must be able to access the system restoration functions at a later point. This combination of capabilities, for example, lets the user restore a failed hard drive immediately, or restore later when a replacement drive is obtained.

These capabilities also allow users to use AccuSafe for the purposes of upgrading to larger or newer hard drive on their computer, due to the fact that AccuSafe is able to completely rebuild a new hard drive (given that the AccuSafe Media Device is fully synchronized with the users system.

TBD is the proper and reasonable breakdown for levels of restoration other than "System Files" and "User Files."

3.3.1 User Interface (proposed)

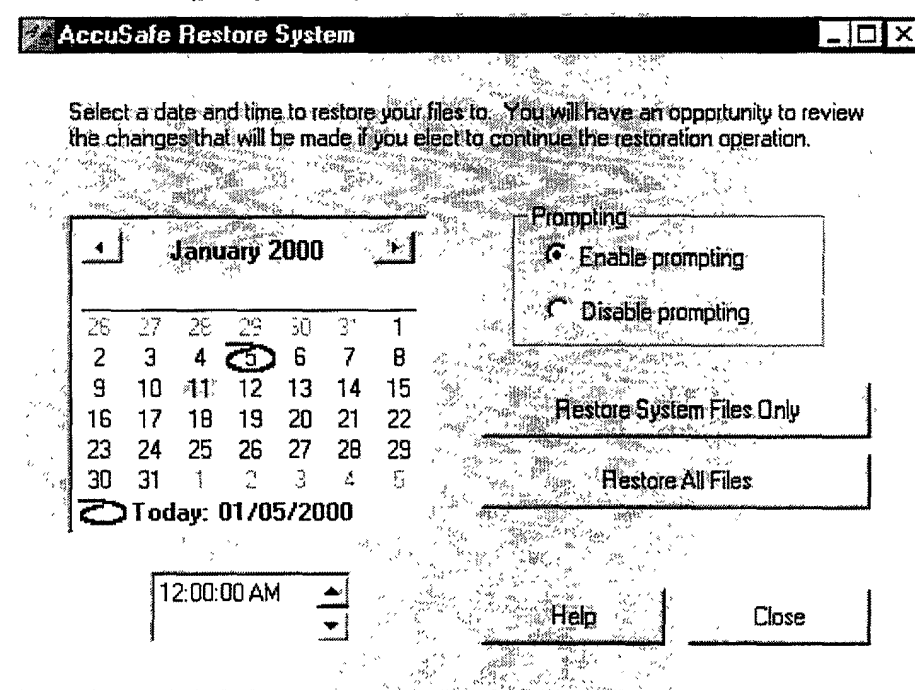


Figure 6 Restore System User Interface

3.3.2 Outstanding Issues

The following section contains outstanding issues regarding this Use Case. This section may contain unsolved issues as well as proposed high-level design issues.

3.4 Maintain File

Description: This use case describes the functionality that allows the user to interact with particular file(s) or directory(s) and perform AccuSafe operations such as update and delete.

Initiator: This use case is initiated when the user right-clicks on a specific file or set of files from the UI (Advanced)

Pre-conditions:

- AccuSafe is installed and operational. This use case could also occur during

Post-conditions:

3.4.1 Main Flow:

3.4.2 Alternate Flows

3.4.2.1 Update file on AccuSafe Media Device

3.4.2.2 Delete from AccuSafe

3.4.3 Error Flows

None documented at this time.

3.4.4 Outstanding Issues

The following section contains outstanding issues regarding this Use Case. This section may contain unsolved issues as well as proposed high-level design issues.

3.4.5 Other Requirements

None documented at this time.

3.4.6 Sequence Diagram

None documented at this time.

3.4.7 User Interface (proposed)

None documented at this time.

3.4.8 Risk Areas

None documented at this time.

3.5 Configuration

Description: This use case describes the process of the User configuring the AccuSafe application. This configuration includes which files to backup, scheduling, and other performance/disk related parameters.

Initiator: The user initiates this use case when desiring to configure how AccuSafe performs its job.

Pre-conditions:

- AccuSafe is installed and operational. Parts of this use case could also occur during AccuSafe installation.

3.5.1 Main Flow

The configuration of the AccuSafe application occurs at both the application level and the file level. Also, the configuration will be divided into Basic configuration and Advanced configuration. Basic configuration will have limited options in order to keep things simple for the novice user. The goal of the Basic configuration will be to abstract the file system away from the user as well as provide for minimal interaction with the user. Advanced configuration will allow the advance user to configure more of the details of how the AccuSafe application does its job.

The flows below describe the different configuration options for the AccuSafe application. Each flow title will contain whether the configuration is a file or application level setting (APP or FILE), and whether that setting is considered Basic or Advanced.

3.5.2 Alternate Flows

3.5.2.1 (APP:Basic) Selection of Novice or Advanced Restore Interface

There will be two interfaces for the Restore interface: Novice and Advanced. This configuration option will be a toggle for selecting either the Novice or Advanced Restore Interface.

3.5.2.2 (FILE:Advanced) Selecting a file or set of files for backup

This flow is considered advanced. The default setting for the Novice user will be to backup all files on all connected drives using default filters (See XXXXX for details on filters). A possible UI is shown in ~~Figure 7~~ ~~Figure 7~~ ~~Figure 7~~ (this is the IoMega 1-Step Backup UI (can I put this in here as an example???).

1. User is presented with a directory/file hierarchy of all connected drives.
2. User selects a set of file(s)/directory(s) to backup using any of the following specifications:

- a. An entire drive, multiple directories and their contents (recursively), or a single file or directory
 - b. files based on file type/extension.
 - c. files based on their size.
 - d. files based on date (e.g. 'Only backup those file with a date > Jan 01, 1999).
 - e. files based on drive type (e.g. Hard Drive, Removable, etc..)
 - f. To NOT backup files based on any of the criteria in the above list. This would include the ability to select files for Non-Inclusion that are contained in directories that have been selected for inclusion.
3. (Optional) If desired, user can select to have version control active for this set of files. The user will also set the # of revisions per file desired for this set of files.
 4. (Optional) If desired, user can select to compress this set of files (see Section 4.3 for more details on file compression)
 5. (Optional) If desired, user can select to encrypt this set of files (see Section 4.4 for more details on file encryption)

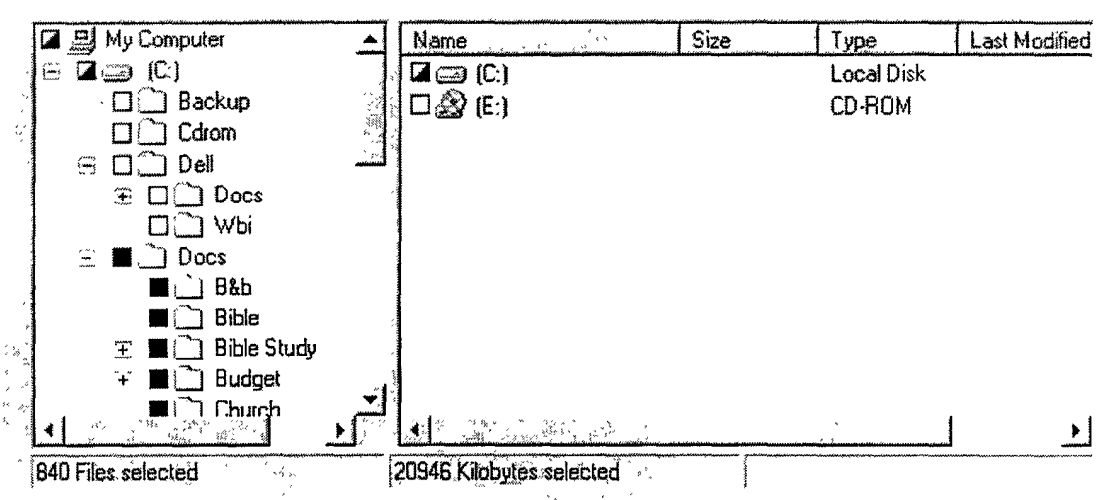


Figure 7 Selecting Files for Backup

3.5.2.3 (FILE:Advanced) Scheduling a file for backup (interval or date specific)

This flow is a continuation of 3.5.2.2. This configuration can occur for a single file all the way up to and including an entire drive. A possible UI is shown in [Figure 8](#) (this is from Microsoft Outlook).

1. User selects to a set of directory/files and then select to schedule them.
2. The user can then select the interval period of daily, weekly, monthly, yearly, or # of saves between backup.
 - a. *Daily*: Select a time
 - b. *Weekly*: Select a day and a time
 - c. *Monthly*: Select a date and a time
 - d. *Yearly*: Select a date and a time
 - e. *# Saves*: Select the # of saves that can occur between a single backup.

3. The user selects the start date to begin the backup
4. The user select the number of times to perform the backup using one of the following options:
 - a. No End Date
 - b. After 'X' amount of times
 - c. After a specified date.

Recurrence pattern

☐ Daily Recur every week(s) on:

☒ Weekly ☐ Sunday ☐ Monday ☐ Tuesday ☐ Wednesday

☐ Monthly ☐ Thursday ☐ Friday ☒ Saturday

☐ Yearly

Range of recurrence

Start: Sat 3/4/00 ☒ No end date

☐ End after: occurrences

☐ End by: Sat 5/6/00

S	M	T	W	T	F	S
27	28	29	1	2	3	
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

Figure 898 Scheduling a Backup

3.5.2.4 (APP:Basic) Selecting the location of the AccuSafe Media Device

1. User is presented a UI that contains a listing of all currently operational drives (with a drive letter).
2. User selects the drive they wish to use as the AccuSafe Media Device.
3. (Advanced) User selects the directory that will be the root directory for the storage of backup files.

NOTE: This use case could be performed during application install.

3.5.2.5 (APP:Advanced) Configuring system monitoring and solutions

The AccuSafe application will perform system monitoring to prevent the AccuSafe backup process from affecting system performance. There are events that could occur that can affect system performance. For each event that can cause a problem, there will be one or more solutions. The user, through the Advanced configuration, will be able to select what events are monitored for, and the default solution to perform in the case that the events arises. The following use cases describe the event/solution pairs for the monitor portion of the AccuSafe application (a description of these monitoring events can be found in Section 3.6 'Monitor: Real-Time' and Section 3.7 'Monitor: NonReal-Time').

3.5.2.5.1 Bandwidth Problem

1. User selects to activate the 'Bandwidth Problem' Event
2. User specifies the minimum threshold for what is considered a bandwidth problem.
3. User specifies one of the following solutions:
 - a. Automatically redirect output to temporary buffer area until bandwidth improves.
 - b. Automatically adjust backup to scheduled/interval backup (see Section 3.5.2.33.5.2.33.5.2.2).
 - c. If version control is active, automatically reduce # of versions being saved to X.
 - d. Automatically turn off AccuSafe backup until bandwidth improves.
 - e. Prompt user for one of the above solutions.
4. User selects whether or not to be informed by a time-delay popup message that this event has occurred and is being solved (for automatic solutions).

NOTE: This problem will typically only occur when dealing with a AccuSafe Media Device that is connected via a network.

3.5.2.5.2 File Changing Frequently

1. User selects to activate the 'File Changing Frequently' event.
2. User specifies the minimum size for a file before it triggers this event.
3. User specifies the frequency threshold in seconds that a file can change before triggering this event.
4. User specifies one of the following solutions:
 - a. Automatically adjust backup to scheduled/interval backup (see Section 3.5.2.33.5.2.33.5.2.2).
 - b. Automatically remove file from backup.
 - c. If version control is active, automatically reduce # of versions being saved to X.
 - d. Prompt user for one of the above solutions.
5. User selects whether or not to be informed by a time-delay popup message that this event has occurred and is being solved (for automatic solutions).

3.5.2.5.3 Frequent modification of a file excluded from AccuSafe backup

1. Users selects to activate the 'Frequent modified of file excluded' event.
2. User specifies one of the following solutions:
 - a. Automatically add the file to the "include" list
 - b. Automatically ignore all files currently excluded from backup.
 - c. Prompt user for one of the above solutions. If the user elects not to add the file, then the AccuSafe Monitor will cease user notification regarding this file until a specified *time period* (N days) has elapsed.
3. User selects whether or not to be informed by a time-delay popup message that this event has occurred and is being solved (for automatic solutions).

3.5.2.5.4 AccuSafe Media Device is full or unavailable

1. User selects to activate the 'Drive Full' monitoring event.
2. User specifies one of the following solutions:

- a. Automatically switch copying of files to the AccuSafe Buffer area on local hard-drive.
 - b. Automatically turn off the backup process.
 - c. Prompt user for one of the above solutions.
 - d. Prompt user to specify a new AccuSafe Media Device or insert a new media disk (in the case of MO or other removable media devices). See Section 4.5 for issues related to drive spanning.
3. User selects whether or not to be informed by a time-delay popup message that this event has occurred and is being solved (for automatic solutions).

3.5.2.5.5 Stagnant files on AccuSafe Media Device

AccuSafe detects that X% of the AccuSafe media is occupied by files that haven't been modified in the last Y days.

1. User selects to activate the 'Stagnant Files' monitoring event.
2. User specifies one of the following solutions:
 - a. Automatically delete the files in question.
 - b. Automatically reduce the number of revision to X number.
 - c. Prompt user for one of the above solutions.
3. User selects whether or not to be informed by a time-delay popup message that this event has occurred and is being solved (for automatic solutions).

3.5.2.5.6 Deleted Original Files

Detection of X% of AccuSafe media is occupied by a file or files which no longer exist in original locations on the Client PC.

1. User selects to activate the 'Deleted Original Files' monitoring event.
2. User specifies one of the following solutions:
 - a. Automatically delete the files in question.
 - b. Automatically reduce the number of revision to X number.
 - c. Prompt user for one of the above solutions.
3. User selects whether or not to be informed by a time-delay popup message that this event has occurred and is being solved (for automatic solutions).

3.5.2.5.7 Detection of missing system files

Detection that a system file required for System Restore function is not present on the AccuSafe drive.

1. User selects to activate the 'Deleted Original Files' monitoring event.
2. User specifies one of the following solutions:
 - a. Automatically conduct proper backups
 - b. Prompt user if they would like to conduct proper backup.
3. User selects whether or not to be informed by a time-delay popup message that this event has occurred and is being solved (for automatic solutions).

3.5.2.5.8 Detection of old file version

Detection that a file included in the AccuSafe backup strategy is not represented in AccuSafe in it's latest version.

1. User selects to activate the 'Old File Version' monitoring event.
2. User specifies one of the following solutions:
 - a. Automatically backup newest version.
 - b. Prompt user if they would like to conduct backup of file to newest version.
3. User selects whether or not to be informed by a time-delay popup message that this event has occurred and is being solved (for automatic solutions).

3.5.2.5.9 Detection of connected device that is not AccuSafe configured

1. User selects to activate the 'Connection of Non-Configured Device' monitoring event.
2. User specifies what type of devices should be monitored for connection (i.e. Zip, MO, etc.)
3. User specifies one of the following solutions:
 - a. Prompt user if they would like to configure this device for AccuSafe use.

3.5.3 Error Flows

None documented at this time.

3.5.4 Other Requirements

3.5.4.1 Default Settings for Novice User

3.5.4.2 Default Settings for Advanced User

3.5.5 Outstanding Issues

None documented at this time.

3.5.6 Sequence Diagram

None documented at this time.

3.5.7 User Interface

None documented at this time.

3.5.8 Risk Areas

None documented at this time.

3.6 Monitor: Real-Time

Description: This use case describes the functionality of AccuSafe that provided real-time monitoring of files and the system to enhance the integrity and performance of the system.

Initiator: This use case is initiated by the user modification of a file (save/delete/rename/copy).

Pre-conditions:

- AccuSafe is installed and operational
- Kernel has detected a modification event

Post-conditions:

- File configuration (e.g. frequency of backup) is modified to improve system performance or user is informed of a concern and can decide on next action.

3.6.1 Main Flow:

1. The monitor is notified of a file modification.
 2. The monitor checks to see if this file is causing performance problems
 3. If file is causing a problem, then the Monitor informs user or preferably makes an automatic adjustment to the backup strategy for this file.
- (See alternative flows for specific situations)

3.6.2 Alternate Flows

3.6.2.1 *Bandwidth Problem*

AccuSafe detects that bandwidth between the PC and the AccuSafe storage device is causing file transfer times to be elongated beyond *normal* (e.g. the LAN is very busy with other traffic). See Section ~~3.5.2.5.13-5.2.5.13-5.2.4.4~~ for a list of possible solutions to this problem.

3.6.2.2 *File Changing Frequently*

Frequent modifications of a file that is included in the AccuSafe backup mechanism, but whose frequent transfer from the PC to the AccuSafe storage device may unacceptably limit the bandwidth available to other applications that need to communicate on the PC-to-AccuSafe-storage device channel (port, LAN, IDE, etc.). This may relate to frequent modifications of small files, or less-frequent modifications of large files. See Section ~~3.5.2.5.23-5.2.5.23-5.2.4.4~~ for a list of possible solutions to this problem.

3.6.2.3 *File Size is large*

See section 3.6.2.1 for handling of this flow.

3.6.2.4 Frequent modification of a file excluded from AccuSafe backup

A file may be frequently modified, but not currently under AccuSafe control. See Section ~~3.5.2.5.33.5.2.5.33.5.2.4.3~~ for a list of possible solutions to this problem.

3.6.2.5 Detection that AccuSafe Media Device is full or unavailable

If the AccuSafe Media Device becomes full, files will not be able to be copied to the AccuSafe Media Device for backup purposes. See Section 3.5.2.5.4 for a list of possible solutions to this problem

3.6.2.6 User attempts to format the AccuSafe Media Device

Formatting the AccuSafe Media Device could cause loss of data. Therefore the AccuSafe application will detect a format request and prompt the user to verify the operation or completely disallow the operation.

3.6.3 Error Flows

None documented at this time.

3.6.4 Other Requirements

None documented at this time.

3.6.5 Outstanding Issues

None documented at this time.

3.6.6 Sequence Diagram

None documented at this time.

3.6.7 User Interface (proposed)

None documented at this time.

3.6.8 Risk Areas

None documented at this time.

3.7 Monitor: NonReal-Time

Description: This use case describes the functionality of AccuSafe that provided NonReal-time monitoring of files and the system to enhance the integrity and performance of the system. All activity performed should be written to the AccuSafe application log

Initiator: This use case is initiated by the AccuSafe application periodically to check on system status.

Pre-conditions:

Post-conditions:

3.7.1 Main Flow:

1. AccuSafe performs a system check for the scenarios describe below in Alternate flows.
2. AccuSafe either automatically or by user interaction performs an operation to remedy the scenario/problem.

3.7.2 Alternate Flows

3.7.2.1 *Detection of stagnant files on AccuSafe Media Device*

AccuSafe detects that X% of the AccuSafe media is occupied by files that haven't been modified in the last Y days. The user may want to conserve space and remove these files. See Section 0 for a list of possible solutions to this problem.

3.7.2.2 *Detection of Deleted Original Files*

Detection of X% of AccuSafe media is occupied by a file which no longer exist in original locations on the Client PC. See Section ~~3.5.2.5.63-3.5.2.5.63-3.5.2.4.6~~ for a list of possible solutions to this problem.

3.7.2.3 *Detection of missing system files*

Detection that a system file required for System Restore function is not present on the AccuSafe drive. See Section ~~3.5.2.5.73-3.5.2.5.73-3.5.2.4.7~~ for a list of possible solutions to this problem.

3.7.2.4 *Detection of old file version*

Detection that a file included in the AccuSafe backup strategy is not represented in AccuSafe in it's latest version. See Section ~~3.5.2.5.83-3.5.2.5.83-3.5.2.4.8~~ for a list of possible solutions to this problem.

3.7.3 Error Flows

None documented at this time.

3.7.4 Other Requirements

None documented at this time.

3.7.5 Outstanding Issues

None documented at this time.

3.7.6 Sequence Diagram

None documented at this time.

3.7.7 User Interface (proposed)

None documented at this time.

3.7.8 Risk Areas

None documented at this time.

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3.8.3 Error Flows

None documented at this time.

3.8.4 Other Requirements

None documented at this time.

3.8.5 Outstanding Issues

None documented at this time.

3.8.6 Sequence Diagram

None documented at this time.

3.8.7 User Interface (proposed)

None documented at this time.

3.8.8 Risk Areas

None documented at this time.

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3.9 Install Software

Description: This use case describes the process of installing the AccuSafe software.

Initiator: This use case is started when the AccuSafe install CD is inserted into the CD-ROM drive of the user, or when they explicitly start the install program.

Pre-conditions: See Minimum System Requirements.

Post-Conditions: AccuSafe is installed and operational.

Need to include idea of selecting Novice or Advanced User during the install process. This will set the default configuration for the AccuSafe application.

The AccuSafe installation program will be developed using the industry standard InstallShield product. The general form of the install program will follow the form of the prototype AccuSafe installation program, and will accomplish the following tasks:

- A. Provide an auto run file and capability for the CD.
- B. Provide a splash screen informing the user of the name of the product to be installed. This splash screen should also contain an engaging graphic.
- C. Provide a welcome dialog informing the user of the product name and version they are about to install.
- D. A check to see that the software/hardware environment into which the user is about to install AccuSafe, is officially supported by AccuSafe. The installation should be aborted for most (specific definition of "most" TBD) non-supported environments. See minimum system requirements elsewhere in this document.
- E. A radio-button (or similar) selection for the AccuSafe localization (English, French, German, etc.) they wish to install, defaulted to the language most appropriate to the version of the operating system they are running.
- F. A display of the license agreement in the language they selected. The installation process will not continue past this point without the user clicking on an "I accept the license agreement" button.
- G. The opportunity to build AccuSafe product floppy disks so that it can be installed on systems that have no CD ROM drive. (TBD if this requirement should be deleted since the overwhelming majority of 32-bit operating system machines have CD ROMs.)
- H. The opportunity for the user to enter their name and company name. These items should be populated into the Windows registry so that they can be displayed within the About AccuSafe dialog of the AccuSafe application.
- I. TBD A password should be required for web and email downloads. This password must not be hardcoded, but may be tied algorithmically to a CD serial number, or other such mechanism such that the password will work only for this particular installation.
- J. The user should be able to select between Typical, Compact and Custom installations. The typical installation should install all AccuSafe-related files. The compact installation should install the minimum set of required AccuSafe files (i.e. the help system might be omitted in this case). The custom installation should allow the user to choose which product components will be installed.
- K. The user should be allowed to select the installation directory for the AccuSafe application, with the default being "Program Files\AccuSafe". The company name is not included in the default directory, since there may be several companies selling AccuSafe under their name which would require unnecessary differences in the installation program, the application, learning products and the technical support process (to name only several) if the company name were included.

- L. The user should be allowed to select the folder/program group into which the AccuSafe-related application icons will be installed. The default folder/program group will be "AccuSafe" for similar company name issues as mentioned earlier.
- M. The installation process should determine which operating system the user is running, so that it can customize the installation appropriately. Customizations include, but are not limited to, the installation of particular rules for file inclusion/exclusion from the backup/startup processes.
- N. On appropriate operating systems (Windows NT for example), the install program should ask the user if AccuSafe should be available to all users (default), or to the particular installing user.
- O. The install program should determine the network name of the computer, and give the opportunity for the user to use this name, or another user-supplied name, for the AccuSafe media directory structure associated with that user's computer.
- P. The install program should ask any other (but limited to less than 5 if possible) questions necessary for the configuration of various AccuSafe functions.
- Q. The install program should ask the user for an "AccuSafe administrator" password. This password will provide the ability to bypass encryption security parameters and adjust other vital AccuSafe operational parameters.
- R. The install program should ask the user for the disk drive to use as a temporary "buffer" area for file transfers in the event that the AccuSafe storage device, or it's media, becomes unavailable.

It is anticipated that the AccuSafe application will be installed in stand-alone fashion, in which case the install process will attempt to identify a pre-installed AccuSafe storage device. If a single AccuSafe device is located, the AccuSafe install program will pre-configure it's default storage device accordingly. If multiple AccuSafe devices are found, the install program will ask the user which device to use as the default device. The preceding remarks are appropriate also to the projected situation where the AccuSafe install program may be "called" from the driver installation program for an AccuSafe storage device. For example, the Fujitsu MO drive's install program should call the AccuSafe install program (resident on the same CD as the MO drivers, or on a separate CD), once the MO drive is installed and operational. Since the installation of hardware drivers often requires a system reboot before the hardware device is present, this process may require that the MO drive install program a) install the MO drivers and appropriately configure the system, b) reboot the system, then c) cause the system to automatically re-enter the install process in order to install the AccuSafe software.

Additionally, the install program should allow the user to "create" an AccuSafe storage device on any read/write media seen as a hard drive by the operating system. This allows the user to designate a directory on an existing media device as the AccuSafe device, without the necessity to actually install a new AccuSafe-related storage device.

The selected install program environment, InstallShield, has the internal capabilities to support the requirements described in this section.

- S. The user should be presented with an opportunity to review, and then if necessary, to change, the user-specified, default, and automatically-determined installation settings prior to the actual start of the product installation.
- T. The installation program should install all files necessary for the AccuSafe product. This process may involve firing of other Microsoft-supplied or third-party-supplied self-extractor installations related to Microsoft or third party subsystem installations such as ODBC, Jet, MS-Access drivers, etc. Multiple system reboots (and corresponding automatic install program restarts) should be kept to an absolute minimum, a single reboot at the end of the installation is the goal. The installation program should create a persistent, cumulative, user-viewable log of its activities for troubleshooting purposes.
- U. The installation process should add all registry entries required by the AccuSafe product, including file associations, class associations, and entries corresponding to the automatic start-up of AccuSafe upon system startup and/or user login. Registry installation areas should be selected so that AccuSafe operation for individual users, as well as for "all" users can occur properly.
- V. The installation process must configure the registry and/or the StartUp folder, such that AccuSafe will be automatically started upon system startup and/or user login.

- W. The installation process should let the user view the ReadMe file at it's conclusion, and/or startup AccuSafe. If AccuSafe is being started for the first time on the computer, the user should be given the opportunity to accept or decline an automatic background synchronization of the AccuSafe Media Device with their hard drive (TBD "C" only, or all local drives) upon AccuSafe startup.

The installation program must be built with potential localization of the entire installation user interface in mind.

The installation program must be as user-friendly and jargon-sparse as possible, since this application will be used by an extremely wide variety of PC illiterate and PC expert customers, in all areas of the world.

The installation program must be built with consideration to making it easy to adjust the company name associated with the AccuSafe product since it may be distributed by multiple partner companies who may be licensed to sell the "XXX AccuSafe" product, where "XXX" is the name of the authorized selling company.

If necessary, the installation program should be built upon the Windows Installer (TBD) in the case of Windows 2000. However, it is more important that consistency in installation across the various platforms be maintained if at all possible for facilitation of Learning Products, QA and Technical Support commonality.

UnInstall Program

An UnInstall capability should be created along with the installation program, again using the industry standard InstallShield product. UnInstall must remove all non-shared, and user unmodified files installed during the installation of AccuSafe. Any files that have been modified from their default settings subsequent to the installation of AccuSafe must be retained, in order that access to any AccuSafe backed-up files can still occur manually, or upon reinstallation of AccuSafe.

UnInstall should also remove all appropriately-removable AccuSafe registry entries.

The UnInstall capability should be available via the standard Start | Settings | Control Panel | Add/Remove Programs mechanism within the Windows 95/98/NT mechanism. Windows 2000 uninstall access mechanism is TBD, but is anticipated to be the same as the necessary mechanism for Windows 95/98/NT.

4 General Requirements

This section contains requirements that do not necessarily belong to a single use case. Some of these requirements are currently in the “proposed” stage

4.1 Operational Database (OpsDB)

The operational database (OpsDB) will be the configuration data store for the AccuSafe Application. Optionally, the OpsDB could also be the store for the IntelliQueuer queue entries.

4.2 Backup File/Directory Description

The following section contains proposed ideas for the file content and directory structure for the backup process.

4.2.1 Backup File Format

At present, all files backed up as a result of AccuSafe operations, are backed up in their native format, but with an AccuSafe-directed file extension. Our selection of native format storage is the result of engineering/functionality/performance tradeoffs of criteria such as:

- a. Keeping the recovery process technically simple
- b. Maintaining a high performance storage process (restore time isn't as important as storage time since restore is a comparatively infrequent event as compared to storage)
- c. Providing a simple recovery opportunity/process in the unlikely event that the AccuSafe software isn't available, becomes corrupted, or fails in some way
- d. Dealing with a very large (and growing) variety of file formats without the necessity to individually code for particular file types
- e. Ability to deal with file formats from non-Windows computing platforms without the necessity for platform-specific or format-specific algorithms within AccuSafe

Obvious exceptions to our current native format "rule" occur when files are compressed and/or encrypted to the AccuSafe target device.

4.2.2 AccuSafe Media Device directory structure

AccuSafe utilizes a directory structure on the AccuSafe Media Device that mimics the directory structure on the users computer as closely as possible. The directory structure also allows for multiple computers to be connected to the same AccuSafe device as described below:

\

Root directory where files and/or directories can be saved. This allows the AccuSafe device to be used as general storage as well as AccuSafe-related storage. In other words, AccuSafe doesn't require dedicated and complete use of the AccuSafe device/media.

\AccuSafe

Root directory for the AccuSafe-related storage.

\AccuSafe\PCNAME1

Root directory for the AccuSafe-related storage for the computer named "PCNAME1". The computer's name can be set within the AccuSafe software, but defaults to the "Computer Name" set within the Network Neighborhood function of Windows.

\AccuSafe\ PCNAME2

Root directory for the AccuSafe-related storage for the computer named " PCNAME2".

\AccuSafe\ PCNAME1\C

Root AccuSafe directory for the "C" drive of the computer named " PCNAME1". Below this directory are subdirectories structured exactly as are the directories on the "C" drive of computer " PCNAME1", and so on.

Long file/path names that could exceed 255 characters will be truncated when saved but the actual file/path name of any length will be saved in the AccuSafe information file.

4.2.3 Information File Format (proposed)

Information regarding the specifics of each backed-up AccuSafe file is kept in a simple format for many of the same reasons mentioned in the earlier section regarding AccuSafe backup file formats. Such information is kept mainly on the AccuSafe target drive to enable the portability of the drive between different computers (and even platforms) without the necessity to migrate a "master database" from one computer to another.

The AccuSafe information file exists in parallel with the actual backup file for each stored file, including all versions, and contains information such as the following:

- a. original file date and time
- b. original file location
- c. original file attributes
- d. original file checksum (to add a quick consistency check to the restore process, and to help guard AccuSafe files against virus contamination)
- e. links to and/or from duplicate files from other computers attached to an AccuSafe device (not storing duplicate files [until they are changed and therefore are no longer duplicates] assists in minimizing storage requirements, maintaining high CPU performance, minimizing network traffic, etc.)
- f. encryption technique flags and encrypted password
- g. compression technique flags
- h. revision "stack" depth
- i. etc.

4.2.4 Version Numbers

If version control is active, each version of the file will be given the same name on the AccuSafe Media Device with the exception of a version number will be placed on the file.

E.g. OriginalFileName → OriginalFileName(1) → OriginalFileName(2)

The associated information file will follow the same convention.

4.2.5 AccuSafe Media Device directory look-and-feel

The specific directories and files on an AccuSafe Media Device should have a visual appearance, and operation, that clearly differentiates them from files and directories on a non-AccuSafe Media Device.

An example of possible AccuSafe directory look-and-feel is shown below. Note that the user is confronted with a very-different-from-usual display upon navigating to an AccuSafe directory, and that by selecting the Show Files link on this display, can get to the usual Explorer display. Once the user navigates past “show all files” Explorer operation should be similar to what they are used to in the non-AccuSafe case.

All AccuSafe-related files stored in the AccuSafe Media Device directory must be hidden, and not visible to the user. This accomplishes two goals: a) it maintains a directory structure and file list within the directories, that match the users PC, thus increasing familiarity with, and usability of the AccuSafe directory structure, and b) reduces the opportunity for the user to accidentally or intentionally corrupt or delete AccuSafe-related files.

An example of the necessity to hide AccuSafe-related files, relates to the user confusion that directory clutter that would occur if users could see each file revision which is presently named according to the following general format:

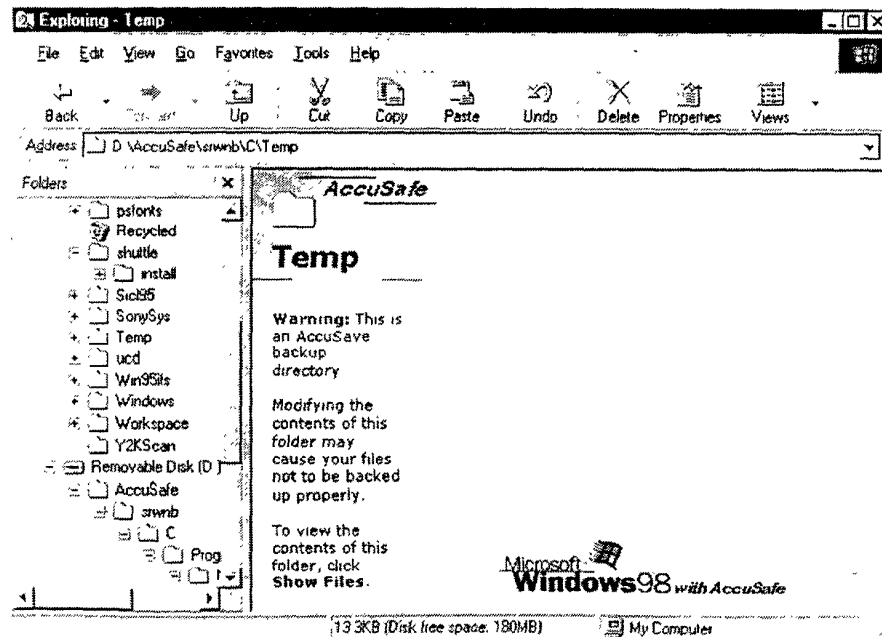
ffff[nnn].txt AccuSafeBackup

Another similar example relates to the storage of an AccuSafe “housekeeping” file named according to the following general format, and utilized in the storage of various AccuSafe operational parameters (original directory location, original date/time, checksum, etc.).

ffff.txt.AccuSafeInfo

These two examples also give further example to the value in hiding the “.AccuSafeBackup” and “.AccuSafeInfo” file extensions as described elsewhere in this document.

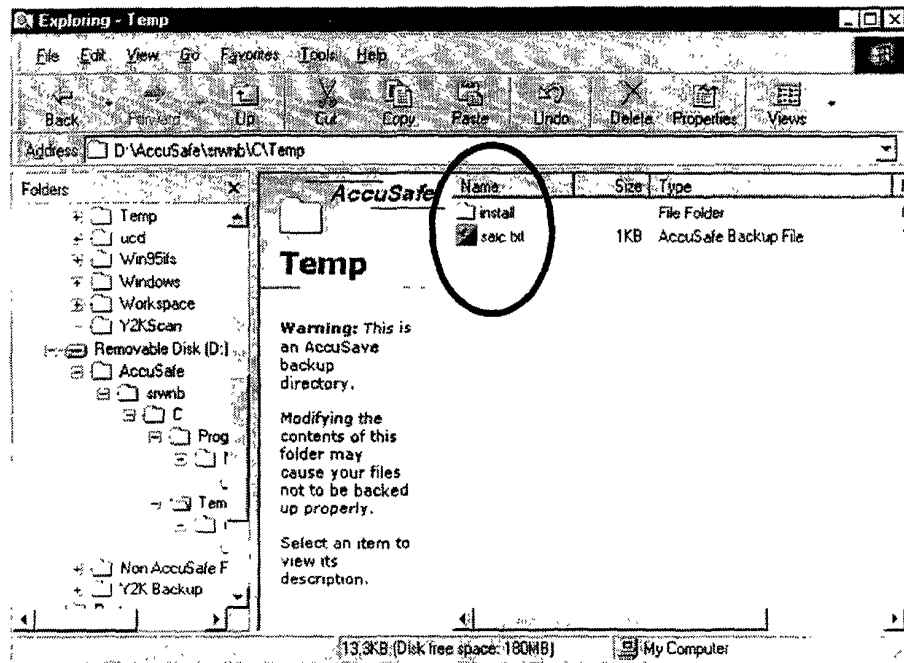
Hiding files by marking them as “hidden files” and hiding directory extensions for “known” file types using Explorer’s Folder Options are not particularly robust mechanisms, since the user can override any automatic AccuSafe settings, resulting in confusing and cluttered displays.



The directory visual appearance shown in the previous display is presently implemented in the prototype via the hidden desktop.ini and folder.htt files within each AccuSafe directory. This implementation however isn't robust in that users can disable options that allow directories to be displayed in web-content-format, so an alternative method should be implemented that yields similar results. Note also that the current implementation is made with a very simple adjustment to the desktop.ini and folder.htt files found in the \Windows directory on a Windows 98 PC. There are likely to be Microsoft copyright ramifications to continuing this practice.

4.2.6 AccuSafe file icons

Files backed up by AccuSafe on the AccuSafe Media Device should be identified with distinctive AccuSafe-related icons, regardless of their native type, when viewing the AccuSafe Media Device directory structure as shown below:

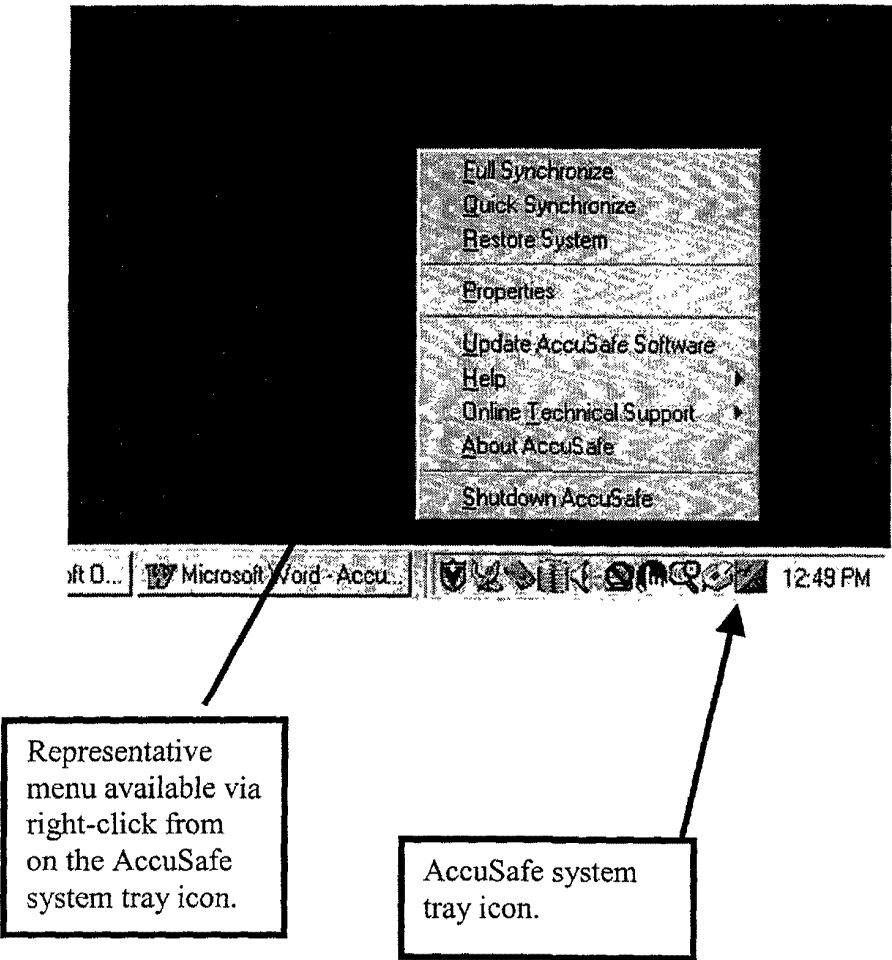


4.2.7 AccuSafe system tray icon

An AccuSafe icon in the system tray, as shown on the attached, should a) indicate that AccuSafe is operational, b) should provide some visual indication as to the progress of copying files, and c) should allow a right-click to access various AccuSafe functionality.

Item "b" could be implemented in similar fashion to MS-Word's "pulsating disk" status bar indication when saving large files (such as this ERS!).

Rolling the mouse over the AccuSafe system tray icon should result in a standard “tool tip” that provides useful AccuSafe operational status information.



4.3 File Compression

AccuSafe will provide features that allow files to be compressed as they are copied to the AccuSafe storage device. This will allow AccuSafe to minimize bandwidth requirements of the PC-to-AccuSafe-storage-device channel, and to minimize storage space requirements on the AccuSafe storage device itself. Compression capabilities will be adjustable via the file-specific AccuSafe Behavior tab on the file/directory properties dialog described elsewhere in this document. Default compression-related controls will be available to the user via the general AccuSafe Behavior tab, also part of this dialog.

Several types of compression algorithms, allowing the user to trade-off compression ratio vs. compression performance, are desired. The selection of available compression algorithms will be based in part on the legality issues associated with their exportation outside the United States. Compression functions within AccuSafe will be intelligent, in that they will examine source file contents in order to determine which of the available algorithms should be used on the source file in order to achieve best compression ratio or best performance as selected by the user. Users will be able to enable/disable compression via the compression-related features available on the file-specific AccuSafe Behavior tab.

As is the case with file encryption capabilities, AccuSafe compression capabilities should be engineered so that it is easy to download a new compression OCX (for example), in order to provide additional compression algorithms at future points in time. A high level block diagram of the intended "plug-in" nature of the compression modules is shown below. This concept should be utilized as much as possible within the design and implementation of the entire AccuSafe system.

Users attempting to View or Restore compressed files (as described elsewhere in this document), will be exposed to a decompression progress indicator prior to the file being viewed or restored.

4.4 File Encryption

AccuSafe will provide features that allow files to be encrypted as they are copied to the AccuSafe storage device. Encryption capabilities will be adjustable via the file-specific AccuSafe Behavior tab on the file/directory properties dialog described elsewhere in this document. Default encryption-related settings will be available to the user via the general AccuSafe Behavior tab.

Several types of encryption algorithms, allowing the user to trade-off encryption strength vs. encryption performance, are desired. Such encryption algorithms will include an ability, and corresponding user interface, for the user to specify algorithm specific parameters such as password, key, etc. The selection of encryption algorithms will be based in part on the legality issues associated with their exportation outside the United States. Users will be able to enable/disable encryption via the encryption-related features available on the file-specific AccuSafe Behavior tab.

The encryption capabilities should be engineered so that it is easy to download a new encryption OCX (for example), in order to provide additional encryption algorithms at future points in time. A high level block diagram of the intended "plug-in" nature of the encryption modules is shown below. This concept should be utilized as much as possible within the design and implementation of the entire AccuSafe system.

Users attempting to View or Restore encrypted files (as described elsewhere in this document), will be requested to supply the appropriate security parameters (password, key, etc.) by the AccuSafe user interface prior to the file being viewed or restored.

An "administrator" capability within the AccuSafe client software will provide, among other things, the opportunity to decrypt files even if the original encryption security parameters (password, key, etc.) are not known. This capability, accessible via a user-specific "administrator" password (set during the install process, and adjustable later), will not reveal the security parameters on the encrypted files, but will instead simply provide decryption

capabilities for them. This feature exists, for example, so that the files belonging to a departed employee, can be restored in the absence of the required security parameters.

4.5 Drive Spanning

Several special “drive spanning”-related situations exist that may be implemented using this situation/resolution pair.

Situation: The media in the AccuSafe storage device is full., as might occur from time to time when AccuSafe is operating with smaller media types such as MO drives, ORB drives, etc.

Resolution: Warn the user via GUI that the media is full, and allow them the chance of inserting new media immediately, or holding off the media change to a future point. The user would be issued periodic reminders of this situation, but it could persist for some time without any adverse affects. Via the IntelliQueuer, redirect all file transfer activity to the AccuSafe buffer area until the full media situation is resolved by the insertion of a new media with suitable storage space. This situation would be automatically detected via AccuSafe, which would then use the IntelliQueuer to perform all “queued” file transfers from the AccuSafe buffer area to the newly inserted media.

Situation: Similar to c.1 above, the AccuSafe storage device becomes full, or otherwise unavailable, during a file transfer.

Resolution: Same resolution as c.1 above, but note that the “restore from AccuSafe” features are affected by design decisions that may result in some revisions of a file being present on one media, and other revisions on another. The situation is further complicated by situations where a file might actually be split across multiple AccuSafe media (though it is likely that we would want to avoid this situation). Note that as smaller-and-smaller AccuSafe storage devices are incorporated into AccuSafe’s official support list, this situation, and other similar ones, will grow in frequency.

Situation: The media in the AccuSafe storage device is not the one that contains the revision history for a particular file. This might occur during situations where smaller media devices such as MO drives or ORB drives were in use.

Resolution: Warn the user via GUI that the currently inserted media is not the one used for a particular file, and offer the change of changing the media immediately, or holding off the change until a later point in time. The user would be issued periodic reminders of this situation, but it could persist for some time without any adverse affects. Via the IntelliQueuer, redirect all file transfer activity for the affected file(s) to the AccuSafe buffer area until the situation is resolved by the insertion of a the correct media for the affected file(s). This situation would be automatically detected via AccuSafe, which would then use the IntelliQueuer to perform the “queued” file transfers destined for the newly inserted media. It is possible for file transfers would be queued via the IntelliQueuer for several different media under this condition.

Note: Special attention must be given to the algorithmic design of such a feature, in order that it properly retain knowledge of the association of a particular media with the location of a particular file’s revision history. This may involve the detection of the media’s serial number (in order to detect one media vs. another, or the detection of an AccuSafe-supplied media serial number which might be generated/retained by AccuSafe in a file in the AccuSafe directory on the AccuSafe media. The algorithm must operate properly with c.1 above, and must allow the user some convenient means for “resetting” AccuSafe so that it can, for example, begin storing a file’s revision history on a media other than the media originally used for that particular file.

4.6 AccuSafe Application Log File (ALF)

Operations performed by the AccuSafe application will be logged to the AccuSafe Application Log File (this is not the IntelliQueueer log). This will include backup operations as well as system monitoring/advising operations. The contents of the log file will at a minimum be:

- Date/Time stamp operation occurred
- Description of the operation
- If file operation, source and destination of file.

The storage for the ALF is TBD. Possible options are:

- Operational Database
- Text File on the user's hard drive
- In the case of NT/2000, the NT Application log could be used. Since this is O/S dependent, this option will probably not be used.

Whatever storage option is used, the information should be part of the AccuSafe backup process.

4.7 AccuSafe boot-up operations

During the boot process, AccuSafe will update Windows system files that cannot be easily copied once Windows is up and running. This is particularly true for NT where files like Ntuser.dat and Ntuser.log cannot be copied while operational. They can be copied during DOS boot up and do not require real-time backup during normal operation. AccuSafe will install as a default startup application, unless the user selects otherwise (an NT system start up application by default). The AccuSafe monitor will begin house-keeping checks following Windows boot up and user virus check startup scan completion (if any). The AccuSafe database is briefly checked for queued files and the AccuSafe device is tested for communications link. Once these quick checks are complete, AccuSafe is ready and on the job.

4.8 AccuSafe Web Linkages

AccuSafe must be capable of launching Internet Explorer or Netscape Navigator in order to connect to various URLs that may contain technical support information, product (AccuSafe and non-AccuSafe) sales information, etc. These launches should normally be performed from the AccuSafe system tray icon menu, and must be implemented in a manner that allows them to be very easily adjusted for different menu text and/or changing target URLs.

This feature should also display a pop up message in the event the user does not have Internet access indicating that an Internet browser must be installed before this feature can be enabled.

This linkage must also allow AccuSafe to form an almost-no-user-intervention-required connection to a URL in order to determine if a revision to the AccuSafe software is available, and if the user needs the revision. If the user elects to install an available revision, AccuSafe should handle this activity without undue user intervention.

5 Future Features

The following features are contemplated for future revisions of the AccuSafe product, and should therefore be considered during the initial AccuSafe design process so as to not inadvertently preclude the possibility of their implementation. Some of these features may also be added as priced upgrades to the basic AccuSafe program.

These features are listed in no particular order, as their priority has not yet been established:

- A. Enhanced compression functions that briefly analyze the file type being compressed, and the select algorithms for speed or size optimization.
- B. Official support of additional AccuSafe Device Media hardware.
- C. Official support of Mac, Linux and Unix operating systems.
- D. Support for Network Attached Storage (disk farms)
- E. Disk spanning for use with lower storage capacity AccuSafe Device Media. This function would make use of the IntelliQueuing mechanism in order to avoid situations where the user is constantly being asked to insert a different media. Some of this functionality is described under the AccuSafe Monitor and IntelliQueuer sections of this document.
- F. Use of multiple encryption types for optimization of speed and security, and to position encryption capabilities to be legally distributed outside the United States.
- G. Integrated virus scanning capabilities, and enhanced virus protection mechanisms.
- H. Enhanced AccuSafe Monitor capabilities.
- I. Enhanced AccuSafe Advisor capabilities.
- J. Block level, and/or byte level file change recording. This will reduce the disk space requirements currently associated with the storage of the entire file for each revision and will minimize bandwidth requirements on the interface between the client PC and the AccuSafe Media Device.
- K. Tie certain AccuSafe features and/or look-and-feel to firmware codes supplied by AccuSafe Device Media and/or hardware.
- L. Add "In AccuSafe backup files..." to the functionality available via the Windows Start Menu's "Find" menu capabilities.
- M. Add "In AccuSafe backup files..." to the functionality available via the Windows Explorer's "Tools | Find" menu capabilities.
- N. Enhance the redundant file elimination mechanism so that redundant files can be detected and linked (rather than copied) intra-computer or inter-computer.

MACRO LEVEL RISKS

Resource Risks

RISK: Not enough time

The product must be robust and reliable within what is anticipated to be a very short period of time. The end result could be either a product that is incomplete or unreliable by the projected delivery date. Risks are primarily financial – a longer than anticipated development time will increase the product cost, and potentially create a customer that is so dissatisfied that a partnering agreement could be broken.

RISK: Not enough money

If financial resources are not available to complete ALL phases of the project, the project will not succeed. Any unanticipated costs, regardless of the source, should be considered a threat. Of primary concern are development and testing costs.

RISK: Not enough manpower

If enough manpower resources are not available for planning and development, milestone schedules will be difficult to maintain, and product robustness is potentially compromised.

Market Risks

RISK: No hardware vendor partner

Without a hardware vendor to partner with, it will be difficult to penetrate the market fully and quickly.

RISK: Too slow to market

Right now there isn't another product that has the same anticipated feature set; the introduction of AccuSafe will be welcome. If, however, another competitor enters the market before we do, or at about the same time with a bigger 'bang' it will be more difficult to get marketing attention and early sales from feature hungry users.

RISK: Vendor requirements not met

Technology Risks

RISK: Software conflicts

The centrality of the product might interfere with other pieces of software. This is particularly true if those software packages do not abide by Microsoft standards.

RISK: Runtime error rate too high

The viability of the product rests upon a very low error rate (support costs). Given the large heterogeneous operating environment, this will be difficult to achieve.

RISK: Basic architecture won't work

The first release of AccuSafe is supposed to operate on current Microsoft Windows versions. The technology, however, has only been proven at the prototype level on Windows 98 and Windows 95. The current prototype available is operable on Windows 98. The development team does not know if the architecture will work on all of the operating systems slated for release in Version 1.

RISK: Performance impact too high

AccuSafe performs almost all of its activities real-time, while the user is working. It will be difficult, if not impossible, to keep AccuSafe from requiring a If AccuSafe has a significant (noticeable) impact on performance, chances are the user will be dissatisfied with the product and will either discontinue use or uninstall the product.

RISK: A key feature won't work

RISK: Too many features in V1

Feature-glut is a possibility – too many features scheduled for the first version can have 2 (minimum) negative consequences. First, trying to squeeze too much development and testing into too short a time period can negatively impact the schedule. Second, if all of the features are successfully implemented and released, the upgrade path can be difficult to plan. There may not be any significantly different features to offer to the user so that they stay interested in the product and peruse the website for upgrades (and exposure to advertising).

Auxiliary Product Risks

RISK: *Unable to support vendor after sale*

RISK: *Unable to support end user after sale*

Inadequate support availability is a risk because there is currently (that I know of) no infrastructure at IPCI capable of providing support to the extent required by a large and successful product deployment.

Mit: The product must be built to have minimal support needs. The support structure must be built to be very efficient.

RISK: *Learning products not ready by ship date.*

There aren't any specifications, plans, or outlines for the learning products. These documents and tutorials, or whatever form they take, must be complete, accurate, and tested with the product – all lengthy and involved tasks. With no plans, little time, and no staff of technical writers available, it will be tough to complete this task on time.

This effort must be started early in order to meet target delivery dates.

RISK: *Install program insufficient*

These programs are always difficult to write and very difficult to test completely.

RISK: *Not enough resources for localization.*

This effort takes considerable time and investment per language. Support costs can be high as outsourcing is the typical approach (first level).

Project Management Risks

RISK: *Excessive recurring engineering costs*

The need for early delivery must be balanced with the recurring costs associated with multiple releases or updates. Recurring costs should be kept as decoupled as possible from external vendor actions.

RISK: *Feature Creep*

Late addition of R1 features (receipt of any new information) can add to planning and development time, possibly other complications

Testing Risks

RISK: *Unanticipated Configurations*

The only viable test approach makes reasoned reduction in the number of configurations to uniquely test. The probability of missing some is non-zero.

RISK: *Unanticipated use patterns*

The large number of users will likely use the product in unexpected ways. This may cause support issues. This might include someone using the OCX for internal reasons.

RISK: *Insufficient Testing*

RISK: *Slow Testing*

RISK: *Expensive Testing*

1. Vision Statement

Create a software application, AccuSafe, which provides data safety, integrity, real-time backup and simple recovery of data for the customer without user action or intervention. AccuSafe should be able to back up data to any device that can be made to look like a drive letter (or UNC path) to the operating system. Create recovery mechanisms at the file, directory, and system level that are simple, reliable, fast, and complete. Position this product for the end user in the home, small business, and medium business markets. Provide a foundation for follow on specialty products and/or features to extend marketability. Market the product to large hardware vendors for bundling with specific data storage products with the ultimate goal that AccuSafe ships with every new PC sold. Create the first shippable version of the product by the middle of the second quarter of 2000.

2. User Research

Most of the research that specifically addresses user's wants and needs regarding backup and recovery software has been gathered from the project team's experience with computer users in home and business settings. Although there is the risk that the project team has a greater depth of understanding of the technical aspects of backup and recovery than the average user, generally the users' need for simplicity and reliability is well understood. It is the awareness of that need, in fact, that is driving the development of the AccuSafe product.

Typical problems reported with current backup and restore technology are:

- Often the process involves remembering each evening to replace a backup tape or other media if the process is automated, or remembering to initiate the backup if it is done manually.
- There is no easy verification that the backup has worked except through viewing of a report log file. Examples of potential undetected errors include the tape or diskette-based media may sustain degradations with time and hence low integrity, the tape drive may fail, the media may be over-written or even break with no one to notice because the backup is occurring when the PC is not being used.
- Most backups are done on a periodic basis – all file changes, moves, and deletions in between are subjected to risk of loss. Even if backups are successfully performed daily there is potentially 24 hours of work lost between backups.
- Existing backup and recovery programs do not adequately compensate for the 'ohno' second – that smallest measurable unit of time defined as the amount of time it takes between a user pressing the delete key (without the use of the recycle bin) and the realization that the file just deleted is one the user has been working on for hours and that it is not on last night's backup tape because it didn't exist yesterday.
- Often backups must be spread across multiple media volumes – unless RAID technology or newer larger capacity tape drives are being used, and it may become problematic or impossible to back up an entire hard drive to one volume of backup media.
- Many backup programs take advantage of portable, small media such as floppies, tapes, and ZIP disks. The cost associated with the number of media needed to accomplish rotation along with capacity is large when you compare how many 100 MB ZIP disks are needed to have enough storage for your 10 GB hard drive backups, and other similar scenarios.
- The restoration process for anything other than a single file can be confusing and seem complex to the user. The complexity increases with the number of files or directories to be restored, and the task can seem impossible when the user is faced with recovering a crashed system. There is often little information available to a user on how to restore their system fully, easily, and quickly, much less a tool to help them do so.
- The expense associated with loss of use of the computer while experts are called in to effect a system rebuild and restore are motivating factors for the consumer to purchase a truly "hands-off" backup and recovery system that does it for them.

Some features that users like about existing products, or would like to see in them include:

- Simple installation and use
- Easy to use, intuitive interface that doesn't require much 'off screen' documentation
- Customization capability at the file, directory, and file type levels for more sophisticated users to select which files are backed up and which are to be restored.
- Real time detection of file changes, resulting in hands-off, automatic backup without loss of changes since the last backup job
- Fast (instant), easy, restoration of files
- 'Invisible' behind the scenes operation that doesn't require user interaction to process
- A product that is not tied to one particular type of backup media
- A lower cost backup option

Details of use cases describing the anticipated interactions a user will have with AccuSafe and their possible outcomes are detailed in Appendix XX:

- User installing with default "typical" configuration
- User installing with "custom" configuration
- User uninstalling
- User adjusting the default selection of all files and directories to backup
- User adjusting the default number of versions of data files to maintain
- Admin creation of a scripted set up for everyone**
- User needs help
- User wants to restore a file or directory
- User wants to restore system files to a previous known working condition by date/time
- User wants to restore the entire system to a new hard disk drive
- User must recover from a failed primary hard disk or failed system that will no longer boot
- User wants to browse backed up files
- User wants to delete backed up files
- User upgrades software
- User changes storage location or options
- The backup device is not available or has no media inserted
- User uses product on a laptop not currently attached to backup device

AccuSafe will be marketed not only to users on the individual, small business, and medium business levels, but also to large vendors of backup media. The needs of the hardware vendors are on a scale relative to their size – the product must enhance the integrity and customer perception of their company and products.

Hardware vendor considerations:

- Large vendors require that the products they bundle with their hardware be 100% reliable with their hardware to ensure that users will not have installation or runtime errors when the product is used as directed.
- Large vendors typically require support for branding (pursue this with a bit more detail).
- Follow on marketing opportunities can be attractive if the initial product is very successful.
- Second and third level technical support is generally provided by the software provider; with first level support provided by the hardware vendor.
- Vendors need assurance that the product meets an important customer need and does exactly what it says it does.

- The vendors want the opportunity to differentiate their otherwise commodity product to the end user and PC manufacturers.
- The vendors must see that the product will produce increased sales, value, and revenue without generation of large start up or on-going technical support issues.
- The product is easy to install and to use and on-line help and learning products are well thought out and of high quality and usability.
- The product awareness material, in addition to training material emphasizes the value of AccuSafe as part of the hardware.

AccuSafe is designed to not require 3rd party licensing of products for incorporation in the AccuSafe product. AccuSafe is anticipated to sell at a retail price of \$49 unbundled. Updates to the software will be provided as free downloads from the Internet. Additional feature modules (if any) will be sold separately. It is anticipated that the majority of the sales of the product will occur as AccuSafe is bundled with vendor hardware however, Internet download sales will be significant if the marketing is done effectively. Retail store, catalog and Internet distribution sales are also viable sales avenues. If market acceptance is high, the PC OEM channel will be approached for shipment with PC's as a low cost value add (much like anti-virus programs).

3. Environment Analysis

There are market trends and characteristics that are both opportunities and threats, depending on the development approach taken. They can be divided into 3 categories for discussion – Technology, Users, and Competition.

Technology

On the technology forefront, high volume storage media is considerably less expensive now than it was even a year ago, and it is expected that cost per GB will continue to decrease.

(Strategic Response in italics)

This makes the AccuSafe product attractive, as AccuSafe's technology does not rely on removable media for operation but rather any device that looks like a drive letter (or UNC path) to the Windows OS (including some tape devices). It could cause potential problems, though. As storage media becomes cheaper and larger, the potential for very large files being manipulated grows. The AccuSafe backup methodology should be tested with 'very large files' so that limits can be explored.

“Operating System not included” terminals are being touted as the next wave in user computing and interface to world-wide Internet connected appliances. Both the computing capability of today's PC and the data created will be stored remotely and no longer locally within a PC box or appliance.

This environment, if it ever gains acceptance, is several years away and has some major hurdles to overcome. There is a huge installed PC base that is growing each year. A simple to connect and to use data integrity device should enjoy marketability for several more years.

The number and type of storage devices is proliferating quickly. The planned flexibility of AccuSafe, that, in a nutshell, it can backup to any device that a PC can successfully assign a drive letter (or UNC path) and then read/write to, puts the product in good position to exploit this trend. There is the potential for having more than one storage device attached to a machine. On the other hand, as the number and type of devices increase, so do potential compatibility issues.

The development and support plans necessarily need to include ongoing testing, update, maintenance, and technical support functions so that the product remains robust and reliable. During the planning and development stages, designing the product for testability will help mitigate some of the risks presented by increasing variety of hardware and software available to consumers. A growing hardware compatibility list is anticipated as AccuSafe is bench tested and "certified" with more devices each year. This necessitates an on-going test and compliance program that will also serve to allow new features to be quickly tested and offered.

Not only is the variety of hardware increasing, but the number of active operating systems, their service releases, and applications is growing as well. There are four 32-bit Microsoft Windows operating systems that are widely used, each of those have multiple service releases as well as some OEM versions. Macintosh, Unix, and Linux also each have their own versions and service releases. A product that is able to support all of these would be powerful, but difficult to develop for and support.

However, if the product is developed in stable, reusable modules that are consistent in theory, if not application, across multiple platforms, the problem and hopefully the future product releases should be manageable. AccuSafe's architecture lends itself easily to modularity at this level.

General compatibility issues are compounded by the proliferation of both hardware and software. The number of possible combinations of hardware and software is next to impossible to count, much less specifically address in development or testing.

Although it isn't evident what can be done to address this, and nothing can be done to control it, placing the responsibility of getting the backup media to work with the system on the hardware vendors and the successful installation of the hardware on the user, rather than the AccuSafe software, the problem can be reduced and addressed.

Designing the product to reduce recurring engineering costs will reduce the cost (and pain) of keeping up with hardware and software changes. Developing a test strategy by application class, that is carefully defined and efficient will also reduce costs and risk associated with keeping pace with quickly moving technology.

Users

Users present another set of challenges and opportunities. The number of home and small/medium business users is growing, as is their dependence on PC's for daily activities essential to their home or business. As the number of users grow, one might assume that the 'technical savvy' of experienced users is increasing, but so is the number of novice users who just aren't ready for complicated solutions to their data safety problems.

A primary design goal should be designing the product for usability. Interfaces should be intuitive, the help system should be comprehensive, and status information should be presented pictorially when possible. Configuring the product to a user's needs should be simple. Designing the product to be customizable addresses the needs of more advanced users who are prepared to stray from the 'out of the box' setup.

An inherent threat, and real risk, is the fact that software integrity and reliability is not only critical, but always on fragile ground. Disgruntled customers are good communicators, and forums such as product reviews on Internet vendor sites provide them a receptive audience to their complaints. If AccuSafe was a word processor that had some malfunctioning formatting features, perhaps the product integrity could survive, but it isn't – it will be marketed as a product that safely and reliably protects your data. A software bug that compromises in any way, a user's data has to be considered a potentially devastating situation.

Choosing a feature set for the first release that is stable and effective, rather than comprehensive, and then thoroughly testing that feature set will be the two most effective actions that can be taken to combat this threat. Delivering a product that is not stable cannot be done.

The perception of the product will begin as soon as the software is opened and the installation begins. The appearance and packaging must convey quality. If there is a 'bug' or mistake, or the user has any installation problems that are not anticipated and handled by the installation program, the 'scare' could be sufficient enough for the user to mistrust the product and abort the installation.

The install must be completely safe, and provide the user with many opportunities to see how complete and reliable the program is.

To summarize the user's needs, the product should be as easy to setup as inserting the CD, and as reliable as a toaster.

Competition

There does not appear to be any competitor with AccuSafe that offers as complete a feature set (based on the feature set that is currently targeted for the first release). Appendix YY contains a product comparison chart. However, speed to market, perceived and real product reliability, successful differentiation, and the ability to take advantage of a partnership with a large hardware vendor are going to be deciding factors in the success of the product. The prototype architecture for the product relies on features of the operating systems that already exist, which are available for anyone to exploit. Competitive products will abound if the marketplace successfully accepts AccuSafe. Potential hardware vendor partners will not be willing to wait for long lead time development projects that make promises while the competitors gain market share with "similar" products.

A feature-by-feature analysis of the four closest competitive products provided three categories of features:

1. Ones we must have to be as feature-rich as the other products,
2. Ones AccuSafe will have that are either not in any other products or are not well represented,
3. Ones that are unique design features not found in competitive products.

(NOTE: Second Copy 2000 has not been evaluated and is not included in this analysis. It appears to be the closest existing competitor, and should be reviewed. It appears to require a manual start to the back up process, and to use date/time stamps and the archive attribute to manage its backups. Intel is shipping it with one of their new storage devices.)

1. Features Required to Meet Competition

- Operable across Windows 95/98/NT4
- True real time detection of file changes* (methods vary and affect performance)
- Easy to use and learn
- Instant restore capability* (file level, not system level)
- Customizable backup list
- Ability to include and control files at directory level

- Ability to include and control files at the file level
 - Revision control
 - Invisible operation
2. Differentiating Features Not Common in Competition
- Integrated to OS
 - Distinctive look target drive
 - Hardware and software solution
 - Control and inclusion of files by type (wildcards)
 - Encryption and compression control
 - AccuSafe System Monitor
 - AccuSafe Advisor (interception of user actions for reconsideration or options)
 - IntelliQueuing- file capture
 - ActiveX, VXD controls
3. Features Not In Above Categories
- Instant disaster recovery
 - Complete mirroring (synchronization)
 - Off-Line change capturing (IntelliQueuing)
 - Multiple backup file destination control
 - No measurable (*user detectible*) system performance degradation

4. Feature Category Descriptions

The AccuSafe Kernel (the combination of the Virtual Device Drivers and ActiveX Control) [WATCHMAN]

The kernel watches the operating system, and detects specific events at the operating system level that correspond to file reads, writes, deletes, and other fundamental file system activities. The kernel translates the event into a message that can be sent to the ActiveX Control so that the AccuSafe Core Application can use it. This happens real-time, as the user is working as normal on their PC. Once the event is detected at the operating system, the rest of the AccuSafe backup process happens as quickly as it can – to appear instant to the user.

The AccuSafe Core Application [COACH]

The AccuSafe core application (and the kernel to some extent for performance enhancement) acts as a filter for all of the messages sent from the ActiveX control. It accesses the AccuSafe Operational Database to determine if the intercepted message regarding a specific file must be acted upon or not. The hierarchy of rules in the operational database is interpreted here, and the AccuSafe attributes for a particular file, directory or set thereof are collected. If the core application determines that action is required, it composes an action message, which is sent to the AccuSafe IntelliQueuer.

The AccuSafe IntelliQueuer [TRAFFIC COP]

The AccuSafe IntelliQueuer is the 'traffic cop' of the AccuSafe application. All file transfers to be performed by AccuSafe are queued through the IntelliQueuer, although if there is a 'green light' at the operating system level for the transfer to occur, the queue may exist only momentarily if requests are processed immediately. It is the IntelliQueuer that allows AccuSafe to safely protect data if the AccuSafe media device is not available – actions are queued and logged, and files are backed up to a temporary buffer area. When the device is available again, IntelliQueuer automatically processes the queue for actions that can be executed immediately as well as actions that are to be performed later. All IntelliQueuer file transfers are logged in FIFO manner up to some pre-set limit on size. The log is available to the user, and can be sized according to the user's needs.

The AccuSafe Operational Database [REFEREE]

The AccuSafe Operational Database is the where the core application gets its filter information. It contains the system defaults (installed and/or customized) for AccuSafe behavior, and individual file and directory specific information as well. Information for every AccuSafe attribute that a file can have is contained here for each file or directory that has been selected to receive behavior that is different from the system defaults. If no file or directory specific information has been indicated, there is not a corresponding entry into the database.

The AccuSafe Monitor [HOUSEKEEPER]

The AccuSafe Monitor is responsible for keeping the AccuSafe program running smoothly during normal operation (effecting module restarts within the application if required). The Monitor analyzes the file transfers made by the IntelliQueuer, keeps track of the availability of the AccuSafe media device, and the user's system performance – then sends messages to the AccuSafe Advisor about items that need attention to keep the system running smoothly.. The Monitor also makes some decisions on its own, if the user has allowed it during set up. For example, the Monitor can determine that a file is being accessed and saved frequently, and that the frequent backups are interfering with system performance. The Monitor can then decide it would be better for overall system health if the file was backed up on an interval or scheduled basis rather than every time it is saved. Rather than asking the user's permission, the Monitor will make the change, log the update such that the action can be reversed as well, then send the message to the Advisor so that the user can be notified. System files are also under the care of the Monitor so that the system can be restored easily to a recent 'safe' period in time.

The AccuSafe Advisor [BUTLER]

The AccuSafe Advisor receives all of the messages that the Monitor sends, but it 'knows' the preferences of the user – perhaps the user has told the Advisor that it's okay that fileabc.doc has 15 revisions available – when the Monitor sends this message, the Advisor ignores it and does not present this as an issue to the user again. The Advisor is what keeps the user from being barraged with information he doesn't want and keeps the user informed of potential problems and how to fix or avoid them. The Advisor also looks at both hardware and software issues that may eventually require action from the user, but not immediately. An example would be that on one of its regularly scheduled runs, the Advisor notices that 30% of the AccuSafe media device capacity is being used by files that the user has not altered on his PC for 2 months – the Advisor would notify the user of the situation and offer suggestions on what to do.

Installation, Configuration, and User Help [ASSISTANT]

This category includes the install and uninstall programs, as well as the parts of the program that handle how the user will 'tell AccuSafe what they want'. Simplicity, unobtrusiveness, consistency, and integrity are characteristics that most features in this category support.

The Graphical User Interface [LANDSCAPE]

The User Interface for AccuSafe builds upon and extends the Operating System via the Windows Explorer, rather than presenting a new interface that the user must learn. Extensive use of right-click menu access, Windows Explorer customization, standard file dialog boxes, property pages, and the system tray icon make AccuSafe more invisible than visible to the user. Users will know it is there, but they don't have to 'make' AccuSafe do anything.

The AccuSafe Backup Device [STORAGE]

As a simple explanation, anything that a user's PC can successfully assign either a drive letter or a UNC path to qualifies as an AccuSafe Backup Device. On the backup device, whatever it is, is a directory structure that mirrors each connected user's PC, AccuSafe backup files, an AccuSafe information file for each backed up file, and all the AccuSafe system files necessary for AccuSafe operation. The backup files are in native format, except if compression or encryption has been applied. Any information required to restore the file is in the information file so that ease of portability or restoration is not compromised. There isn't any 'control' programming required for the AccuSafe Backup Device, only rules for its setup and use. The IntelliQueuer, Monitor, and

Advisor all interact with the backup device to maintain system health, data integrity, and data restoration capability.

The System and File Recovery Features [LIFEGUARD]

The Recovery Features are among the most critical in the application – providing an easy backup process is only the beginning. Users are provided with simple ways to restore their files and or directories – easy access, selection, and restoration. In addition to file restoration, AccuSafe's disaster recovery features should allow a user to quickly recover from a 'crashed' system and begin working again– either as a return to a working system because of system files that were rendered non-operational due to corruption or as a tool to complete disk recovery.

5. Feature Set Priorities

The features identified as required for inclusion in the first release of AccuSafe are:

Required Operating System Support

- Windows 95SR2 and SR2.5 (B and C) and Windows 98SR1 and SR2

Required Core Application Features

- Complete install/uninstall using InstallShield and user registration/license agreement
- Disaster Recovery from system file corruption (requires Safe mode functionality and a boot floppy if Safe mode will not start that runs something like a "RescueMe" application from a DOS prompt). We understand that we have not discussed this very much but it is really essential to our target market.
- Scheduled (not real-time) capture of critical system files to effect system recovery (during windows boot process at start up and then every xx minutes during operation) saving the last yy entries.
- Real-time tracking and backup of file saves, changes, deletions, renames, and copies
- IntelliQueuing with real-time tracking and continued buffered backup if no backup device is present or the device is full (what happens when full)
- Easy restore of individual files, selected files and directories
- Versioning control

Required Application Landscape and Connectivity

- Fused to Windows Explorer
- Online Help system and Getting Started Guide
- Files can be viewed and copied *without* the AccuSafe application being active (native file formats)

Required Hardware Support

- Intel Pentium I/II/III processors
- Internal hard disks
- Internal Removable disks
- External parallel port storage devices that support Windows drive letter
- External USB port storage devices that support Windows drive letter
- Network mapped drive or UNC path (complete disaster recovery not supported in this mode since network support is required, however system file corruption is supported since the registry copies are stored locally, not on the network drive).

The second set of features have been identified as features that should be included in release one if at all possible:

#2 Operating System Support

- NT4 and SP3, 4, 5

#2 Core Application Features

- Complete disaster recovery from a failed/crashed hard disk including emergency boot to the AccuSafe device with complete written step-by-step instructions (requires boot floppy that runs a "SaveMe" application from a DOS prompt)
- Localization options other than English
- Double byte character set support
- Media spanning
- Compression of files with standard utility like DynaZip (user selection only and only user files)
- Monitor file change frequency and move to schedule –vs- real-time backup

#2 Application Landscape and Connectivity

- AccuSafe directories have differentiating look
- AccuSafe directory structure mirrors user(s) drive(s)
- AccuSafe files have unique file icon
- Web links for tech support and more product information

#2 Hardware Support

- AMD K6/7 processors
- AccuSafe device portable between PC's with same (identical) OS

A third set of features has been identified as best for inclusion in the second release, but again, if they can be included in the first release they should be:

#3 Operating System Support

- Mac, Linux, Unix

#3 Core Application Features

- Encryption of files (user selection only)
- Network traffic detection for LAN AccuSafe device and green light despooling

#3 Application Landscape and Connectivity

- Software update downloads link (requires version comparisons and authentication coding)

#3 Hardware Support

- RISC and Alpha processors
- IPCI PAS device

MICRO LEVEL RISKS

There are several specific pieces of the AccuSafe application that have been identified as both difficult to code and as critical to the success of the application. There are many features of the application that fall into one or the other category – but for the purposes of risk analysis the items that fall into both are the ones that need the most attention. The features are divided into their respective feature categories as identified in the Vision Document. The number preceding each risk is the ‘headache factor’ that was applied by the development team. Five (5) is the maximum number, indicating the most difficult rating. There are not priority or other criticality ratings at this time, if they are applied this document will be updated to reflect them.

Administrative

RISK: Technical Support Training Package - 4

The technical support training package will be critical for supporting large vendor’s requirements for support. The difficulty of providing a comprehensive training packages is in that the best technical information won’t be available until after testing is complete; users won’t be calling wanting to know why things work – only why things don’t work – many technical issues stemming from hardware and software compatibility issues may not surface until the test phase is complete.

RISK: The Installation Program - 3.5

The installation program must be flawless and intelligent – one of the tasks it must perform is to determine early in the installation process the viability of the installation on the user’s particular hardware and software configuration. It must identify and recognized hardware and software that is not compatible with AccuSafe, and suggest ‘workarounds’ or solutions if they exist, and exit gracefully after explaining the problem if there is no simple solution. It should also recognized any particular file types or application types (ie- scanner software) that are known to cause problems with AccuSafe – very large video files or frequently changing database files, for example. As with the technical support package – many of these problems may not be known until the test phase is completed.

AccuSafe Advisor

RISK: Running the AccuSafe Advisor on a Scheduled Basis - 3

The AccuSafe Advisor will run on a scheduled basis, which for Windows NT and Windows 98 is not an issue as a Task Scheduler is included with the base operating system. However, Windows 95 does not provide a scheduler in its base product – instead it must be purchased by the user. One of the most appealing aspects of the Advisor is that it does not require a user to manually start it, but the product is not structured such that either requiring or including an application that adds to the cost of the product is feasible.

RISK: The AccuSafe Advisor - 3.75

The AccuSafe Advisor as a whole was identified as a difficult part of the program to write – the complexity of both the ‘watching’ and ‘interpreting’ aspects of the Advisor drive the rating. It is a differentiating feature, however so moving to phase two is not the best first option.

RISK: Performance Impact of AccuSafe Advisor - 4.5

The performance impact must be minimal. This is a difficult yet critical aspect of the program as a whole, not just the Advisor – but it will be mentioned in each feature that it is expected to be a significant challenge. A 2% CPU performance impact has been set as the threshold of acceptability – the user must not perceive that the AccuSafe application is in anyway decreasing the performance of his PC.

Backup Media

RISK: Portability of Backup Media – 10 (ten)

Portability of the AS target drive between platforms...

Means: Different hardware – same OS version and SR – is this still a difficulty of 10?

AccuSafe Core Application

RISK: Fully Client Based Application - 3

AccuSafe is intended to be a client-based application with no server side app required. Some features, however, may not be feasible in a network or other multi-user environment without a server side application to perform some of the 'watching' and rule-enforcing aspects of the program.

RISK: The AccuSafe Kernel Theory and Technology - 4

RISK: Windows 2000 and NT 4.0 Compatibility - 4.5

The core of the AccuSafe application is its ability to monitor the user's file system and detect file activities real-time. The core of the product is based on a Windows 95 [I'm using the wrong words here...could use technical word-smithing...] file system monitor written by O'Reilly. It detects these changes at the operating system level and after a series of manipulations, AccuSafe is able to interpret and act upon them. A goal of the project is for the first version of AccuSafe to run on not only Windows 95, but also Windows 98, Windows 2000, and Windows NT operating systems. The technology is only proven on Windows 95 and 98 (is this true?) – if it is not similar enough to Windows NT and, eventually, Windows 2000 – the development timeline will be impacted significantly.

RISK: Encryption Capability During Backup - 16.5

An encryption requirement is a risky venture for version 1 – basically we don't know how to do it and it adds another element to the backup schema that would have significant performance impact.

RISK: Performance Impact of AccuSafe Core Application - 4.5

The performance impact must be minimal. This is a difficult yet critical aspect of the program as a whole, not just the Advisor – but it will be mentioned in each feature that it is expected to be a significant challenge. A 2% CPU performance impact has been set as the threshold of acceptability – the user must not perceive that the AccuSafe application is in anyway decreasing the performance of his PC.

RISK: Determining and Implementing the Rule Hierarchy for AccuSafe - 4

While it is relatively simple to allow the user to indicate what their backup strategy is – it is much more difficult to implement that strategy consistently. The potentially complicated set of rules will be stored in a database, which will be queried whenever AccuSafe needs to know what to do with a file or directory.

GUI

RISK: Extensive, Customized, yet Controllable Use of the Windows Explorer as the main GUI - 4

We don't know if we can integrate AccuSafe's GUI with the Windows Explorer to such an extent that the user cannot override AccuSafe's settings.

IntelliQueuer

RISK: Boot Up Process - 5

RISK: Using the IntelliQueuer to Monitor File Transfer Performance and Adjust Accordingly

AccuSafe Monitor

RISK: Watch and Respond to a Variety of Complex Events - 4

RISK: Manage Multi-'Disk' Backup Strategies - 7

RISK: Performance Impact - 5

The performance impact must be minimal. This is a difficult yet critical aspect of the program as a whole, not just the Advisor – but it will be mentioned in each feature that it is expected to be a significant challenge. A 2% CPU performance impact has been set as the threshold of acceptability – the user must not perceive that the AccuSafe application is in anyway decreasing the performance of his PC.

RISK: *Detect and Prevent Redundant File Backups* -- 4

Restore

RISK: *Simple and Full System Recovery* - 5

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AccuSafe Risk Assessment

This document contains the primary risks identified for the development of AccuSafe. Risks associated solely with marketing and management issues that cannot be mitigated by actions of the Development Team are not included. Risks are separated into two main categories, Macro Level Risks and Micro Level Risks. Macro Level Risks are all risks above the code level – resources, market, technology, testing, and project management. Micro Level Risks are those associated with specific sections of the AccuSafe application. If a part of the program has been identified as both critical to the application, and potentially very difficult to write, it is included as a risk here.

An associated spreadsheet, MASTERRISK.XLS, should be considered the Master Risk Document and should be updated as such. The Master Risk Document, which has not been completed, should contain quantitative measures of perceived risk and impact, as well as assigned action items to mitigate each risk. The Master Risk Document is a living document that should be updated and reviewed periodically through the design process. The first draft of the document should be completed before the planning phase commences in full. However, it cannot be considered comprehensive or very useful until all documents (ERS and Use Cases, primarily) are finished and evaluated.

MACRO LEVEL RISKS

Resource Risks

RISK: Not enough time

The product must be robust and reliable within what is anticipated to be a very short period of time. The end result could be either a product that is incomplete or unreliable by the projected delivery date. Risks are primarily financial – a longer than anticipated development time will increase the product cost, and potentially create a customer that is so dissatisfied that a partnering agreement could be broken.

RISK: Lack of timely knowledge

Compressed timeframe does not allow time for development team to learn any new technology that may be required to complete the development successfully.

RISK: Not enough money

If financial resources are not available to complete ALL phases of the project, the project will not succeed. Any unanticipated costs, regardless of the source, should be considered a threat. Of primary concern are development and testing costs.

RISK: Not enough manpower

If enough manpower resources are not available for planning and development, milestone schedules will be difficult to maintain, and product robustness is potentially compromised.

Market Risks

RISK: Too slow to market

Right now there isn't another product that has the same anticipated feature set; the introduction of AccuSafe will be welcome. If, however, another competitor enters the market before we do, or at about the same time with a bigger 'bang' it will be more difficult to get marketing attention and early sales from feature hungry users.

RISK: Vendor requirements not met

Part of the problem is that no one knows what the vendor's requirements are – the second part of the problem is that if we determine what they are, and the product misses them, the vendor may not want to include AccuSafe in their product.

RISK: Product too sophisticated, or not sophisticated enough, for target market

RISK: Product not successfully differentiated in market after release
Whether by actual features or perceived features

RISK: Competitive response (kills) product

Competition will immediately appear if they aren't there already – the biggest risk is that AccuSafe won't be ready to respond back with a continuously differentiated and improving product

Technology Risks

RISK: Software conflicts

The centrality of the product might interfere with other pieces of software. This is particularly true if those software packages do not abide by Microsoft standards.

RISK: Runtime error rate too high

The viability of the product rests upon a very low error rate (support costs). Given the large heterogeneous operating environment, this will be difficult to achieve.

RISK: Basic architecture won't work

The first release of AccuSafe is supposed to operate on current Microsoft Windows versions. The technology, however, has only been proven at the prototype level on Windows 98 and Windows 95. The current prototype available is operable on Windows 98. The development team does not know if the architecture will work on all of the operating systems slated for release in Version 1.

RISK: Performance impact too high

AccuSafe performs almost all of its activities real-time, while the user is working. If AccuSafe has a significant (noticeable) impact on performance, chances are the user will be dissatisfied with the product and will either discontinue use or uninstall the product.

RISK: A key feature can't be made to work

RISK: Too many features in V1

Feature-glut is a possibility – too many features scheduled for the first version can have 2 (minimum) negative consequences. First, trying to squeeze too much development and testing into too short a time period can negatively impact the schedule. Second, if all of the features are successfully implemented and released, the upgrade path can be difficult to plan. There may not be any significantly different features to offer to the user so that they stay interested in the product and peruse the website for upgrades (and exposure to advertising).

RISK: Hardware requirements miss target market

AccuSafe's runtime resource requirements may be too high for most of the PC's in the target market.

Auxiliary Product Risks

RISK: Unable to support vendor after sale

RISK: Unable to support end user after sale

Inadequate support availability is a risk because there is currently (that I know of) no infrastructure at IPCI capable of providing support to the extent required by a large and successful product deployment.

RISK: Learning products insufficient for target customer's needs

RISK: Learning products not ready by ship date.

There aren't any specifications, plans, or outlines for the learning products. These documents and tutorials, or whatever form they take, must be complete, accurate, and tested with the product – all lengthy and involved tasks. With no plans, little time, and no staff of technical writers available, it will be tough to complete this task on time.

This effort must be started early in order to meet target delivery dates.

RISK: *Install program insufficient*

These programs are always difficult to write and very difficult to test completely.

RISK: *Not enough resources for localization.*

This effort takes considerable time and investment per language. Support costs can be high as outsourcing is the typical approach (first level).

Project Management Risks

RISK: *Excessive recurring engineering costs*

The need for early delivery must be balanced with the recurring costs associated with multiple releases or updates. Recurring costs should be kept as decoupled as possible from external vendor actions.

RISK: *Feature Creep*

Late addition of R1 features (receipt of any new information) can add to planning and development time, possibly other complications

Testing Risks

RISK: *Unanticipated Configurations*

The only viable test approach makes reasoned reduction in the number of configurations to uniquely test. The probability of missing some is non-zero.

RISK: *Unanticipated use patterns*

The large number of users will likely use the product in unexpected ways. This may cause support issues. This might include someone using the OCX for internal reasons.

RISK: *Insufficient Testing*

RISK: *Slow Testing*

RISK: *Expensive Testing*

Product Support Strategy for AccuSafe

1.0 Background

The AccuSafe support strategy is driven by the need to keep costs down while serving a very large and diverse customer set. This necessarily provides for strategic trade-offs and the need for a significant support infrastructure.

2.0 First Level Support

It is assumed that first level support will be performed by the customer support organization of the major partner(s). This is typical in order to preserve branding, gather market intelligence, and manage QA levels. IPCI will need to develop the support material and help desk database files required by the support agents. We also recommend that during partner negotiations, IPCI access to market intelligence data be included. An efficient strategy would be to create the 'Help' material aimed at both the broad audience and the support agents. This is not always possible and must be considered based upon the specifics of each partner.

Support materials must be easily localizable and be a proper combination of lecture, self-study and hand-on exercises. Market intelligence is important, particularly for the portions of the support materials that will be made available to sales folks rather than technical support folks. Part of the market intelligence study may require studies of local/regional products (e.g. those not available on a worldwide market scale). Good technical content must be provided, but with higher level approaches to learning the product, and solid low level approaches to common problems, solutions and troubleshooting.

A mechanism whereby support issues can be collected at the first level, and fed back-and-forth between the secondary levels must be established. This collection should present itself as a localizable "knowledge base" containing problem/solution/configuration/customer information. It will be used for spreading support knowledge to a vast audience of support personnel, but should also provide an opportunity to conduct studies of frequency vs. problem in order to make future improvements to the product and/or it's ancillary materials (support training materials, user interface, feature-set, learning products, install program, etc.)

It is contemplated that the knowledge base may exist in several language versions simultaneously, so it must be of a structure that provides for easy determination of recent changes, then surgical strike localizations of those changes.

To the extent possible, this knowledge base should be implemented using systems and procedures that are already known to the major partner(s). Though even here, it will likely be up to IPCI to drive the proper deployment of the tracking mechanism.

Customer access to this knowledge base will allow us to reduce costs, but not requiring the involvement of our customer support staff to address each customer question/issue. Localization will be important here.

Similarly, we need an incident tracking mechanism to keep track of current customer issues, to assign them to various people for execution responsibilities, to monitor and track commitments made to customers, and to be sure that no customer issues “fall into the crack” without being addressed.

3.0 Second Level Support

We recommend the following general approach to second level support, usually the most costly level for well-crafted products. Given the mass-market target and diverse skill sets this is the level that warrants focus.

First, toll free number support is essential followed with FAQ's available via toll free fax or web links. A web page with the most current information and patches must be maintained.

Second, it will be necessary to instrument the code to remotely determine performance, host configuration and fault records. The instrumentation must be integrated with a ‘Second Level Support’ server. We need to be able to have the application, under user control, to send instrumented results back to the server. This implies databases to match serial number to user and potentially account information. This server must also provide web support for FAQ's, service pack upgrades, new product data etc. It will also require email support with at least an auto-acknowledge function. It is important to recognize that from an engineering development perspective this system represents significant investment. It will need to be scaled or phased into the product plan as partnerships become viable and as the product markets develop.

Both second and third level support will require a toll free number support. At least one toll-free number, perhaps multiple numbers for different language requirements and time-zone requirements may be required. Email, web, fax and FTP connectivity are also important.

4.0 Third Level Support

It is important to retain the services of your initial engineering team (at least in part) and bench test facility to provide third level support. Should outsourcing be used, include a line item for this support. The other option is to have sufficient follow up product development to retain the development team. If the job is done right on the product (incentive scheme?), third level support should be minimal and hence performed by the team on an ad hoc basis.

A very key differentiator between companies these days is not so much product innovation (though that remains high on the list), but rather excellence of support. We want to absolutely lead in this area.

There are hardware and software configuration availability requirements for proper third level support. We must be able to duplicate most anticipated target systems very quickly. This includes a process/engineering issue, not just an issue of equipment, since it will not be possible to have all manner of equipment on hand and dedicated to the support task. We will need several computer hardware configurations that represent items like least possible hardware set, best possible hardware set, most frequent hardware set. Additional requirements include the ability to quickly load a clean machine with any OS/ServiceRelease/Localization release being supported and access to all AccuSafe device hardware and drivers being supported. The ability to access potential conflicting application mixes must also be maintained from the original development cycle.

5.0 International Support

It will be necessary to contract out international support at the first level. Should foreign language speakers be needed for second level support that too will need to be contracted out. Options to consider are is to have a 'thin' foreign language support team that can translate back to the second level support function.

At this time, most web support is in English but rapidly becoming multi-lingual. I would recommend that the cost for this activity be considered in the planning for each localization effort.

6.0 Conclusion

Given that market, it will be necessary to have a reasonable sophisticated support structure or labor costs will not be contained. This implies building support infrastructure that is fully integrated with the product. Planning should include this effort and the resources necessary to build and operate.

ajitsu AccuSafe™ Prototype Walk-through

Integrity PC Innovations, Inc.
1220 Lake Plaza Drive
Colorado Springs, CO 80906
719-579-9734

**All information in this briefing is
confidential to Integrity PC
Innovations, Inc.**

**This information is provided under
Non-Disclosure Agreement (NDA).**

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2

software accompanying these slides is a prototype
 on, intended to prove/demonstrate major technical
 nts, and therefore technical feasibility of the
 Safe product.

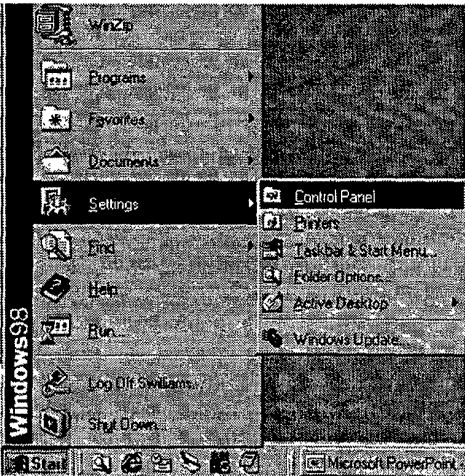
ch...

atures are missing and/or incomplete
 e user interface is incomplete
 performance does not match final plans
 fects, known and unknown, exist

report all problems, questions and comments
 eve Williams, steve@ipci-inc.com, 719-579-9734

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3



Windows 98

Start

WinZip

Programs

Favorites

Documents

Settings

Find

Help

Run...

Log Off Williams

Shut Down...

Control Panel

Printers

Taskbar & Start Menu...

Folder Options

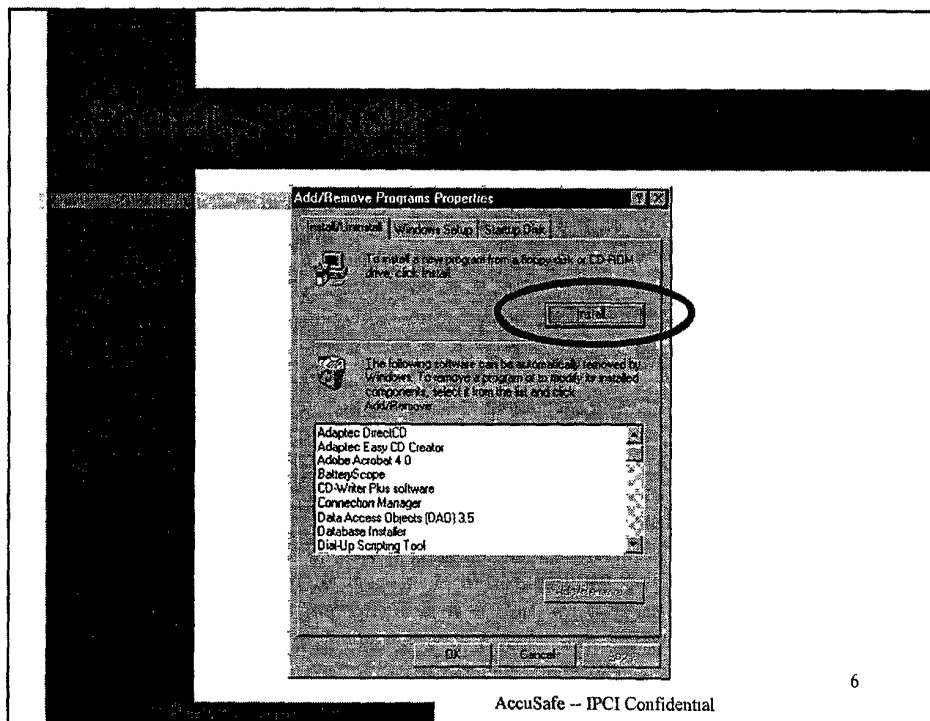
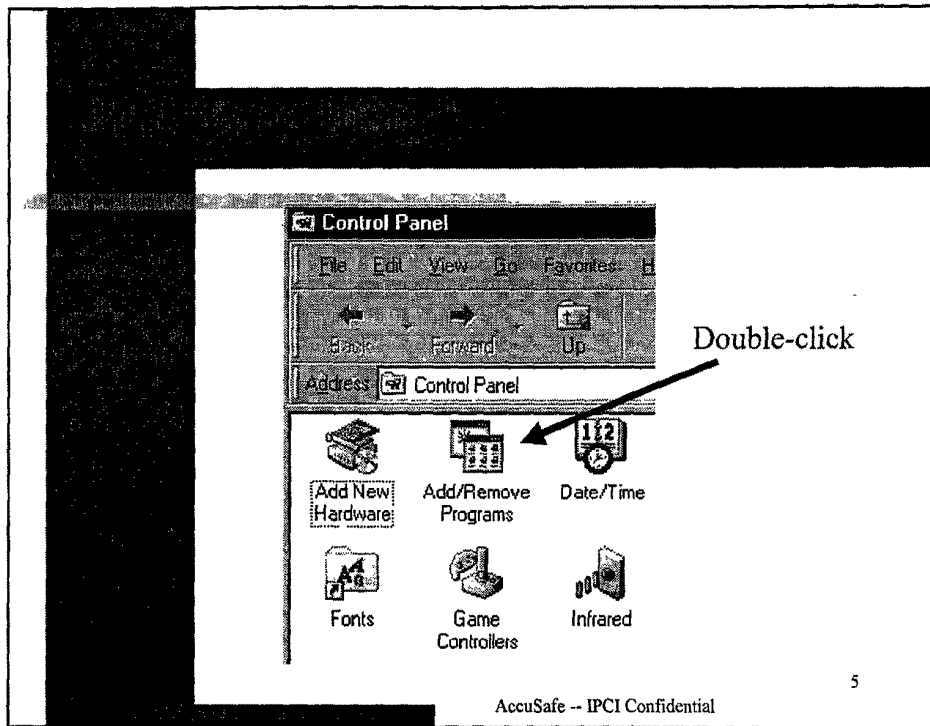
Active Desktop

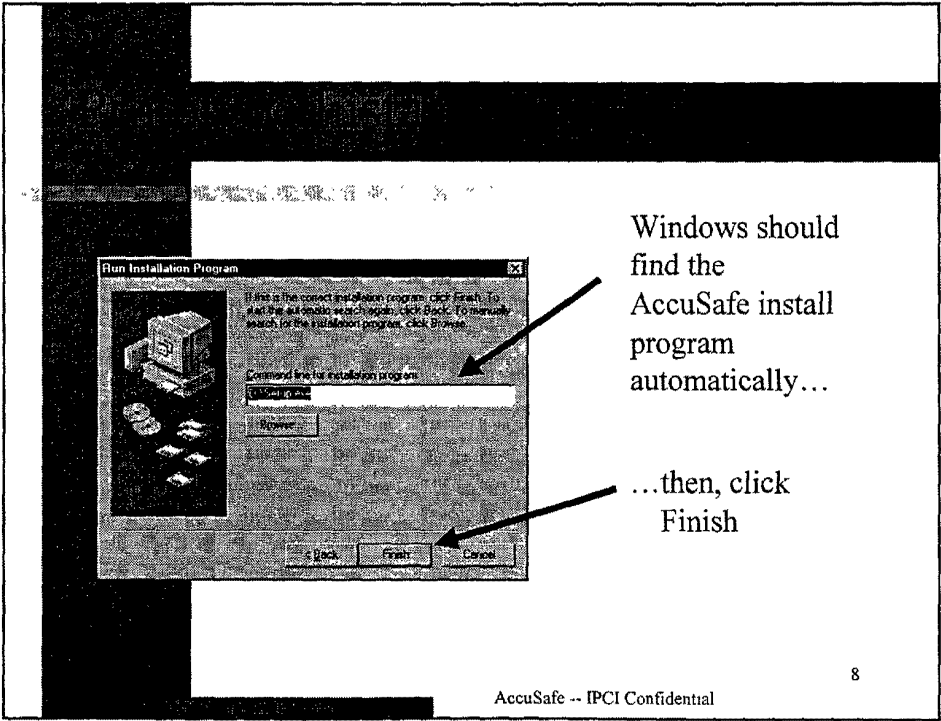
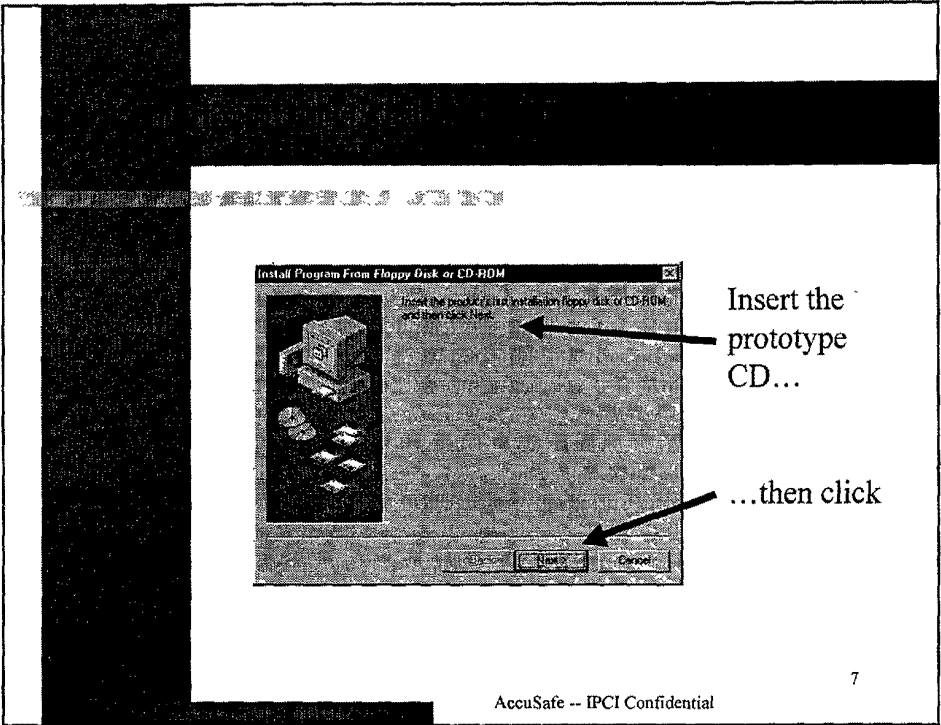
Windows Update

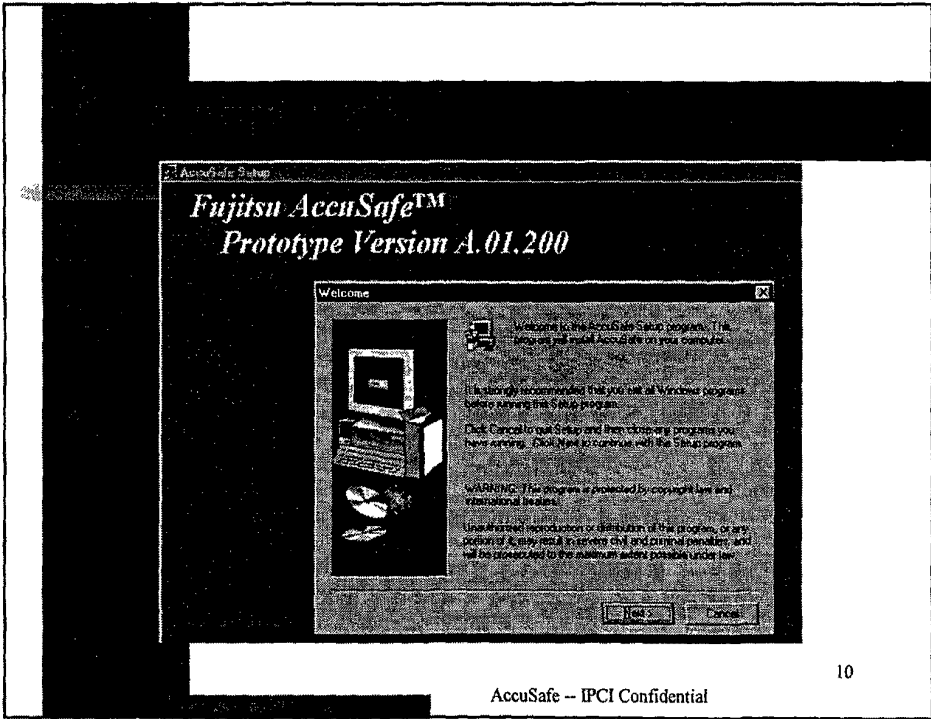
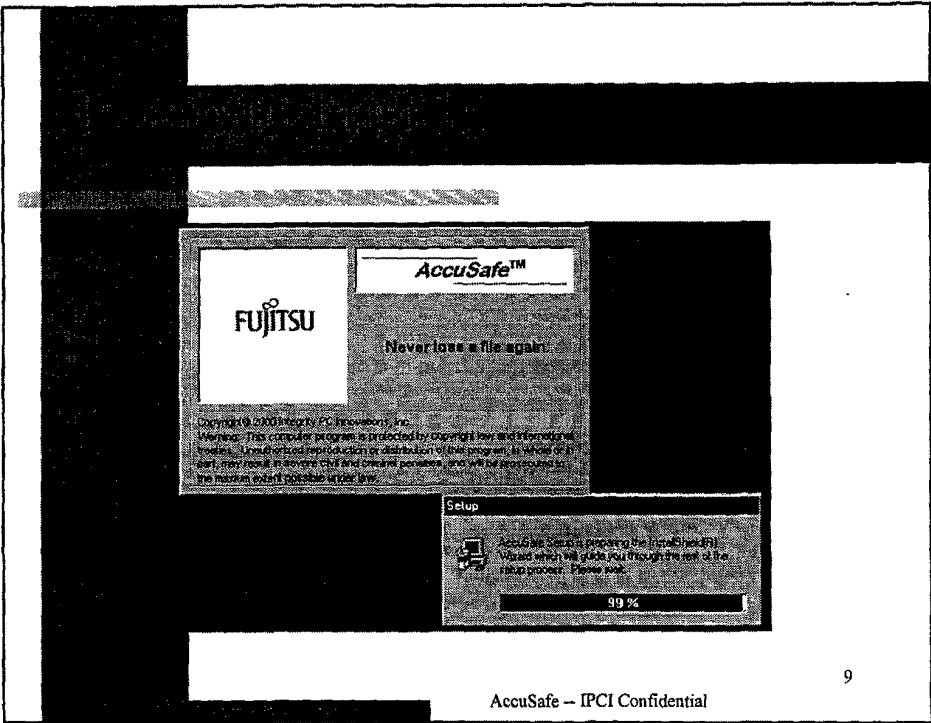
Microsoft PowerPoint

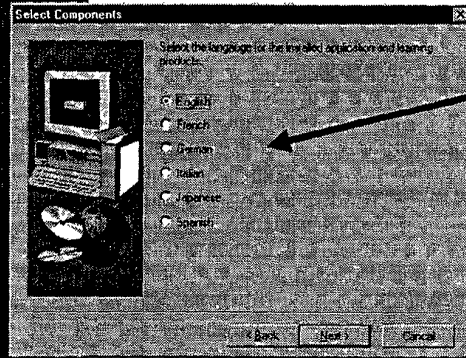
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4





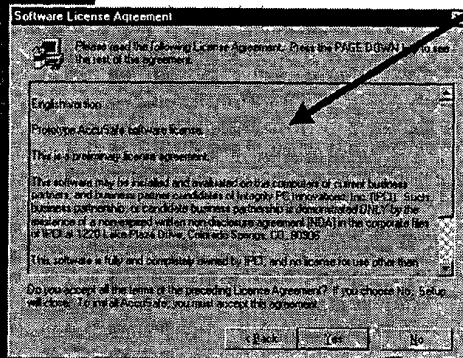




Set of supported localizations is being finalized.

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11

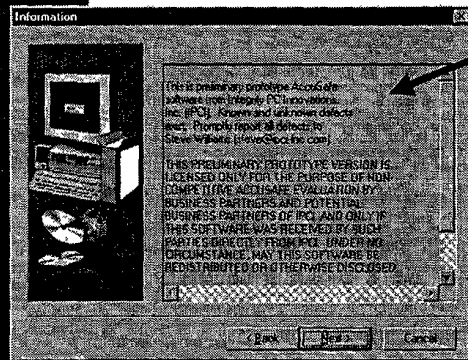


This is a license agreement for the prototype, and in the final product, this will appear in the language chosen in the previous wizard step. As well, the entire install program may appear in the language of the user's choice.

Product will not install

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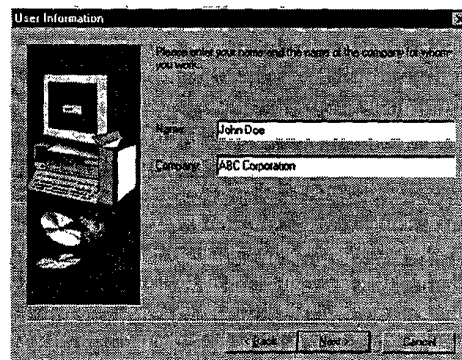
12



Information relevant to the current prototype is displayed. In the final product, this may be a localized display of the ReadMe file or other information

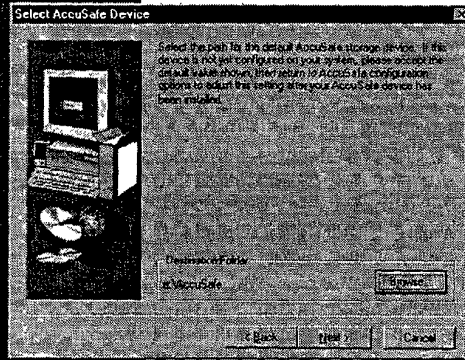
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13



AccuSafe -- IPCI Confidential

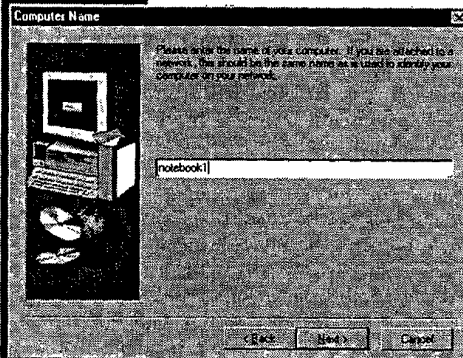
14



This should point to a directory named "AccuSafe" at the root level of the media and device you wish to use as AccuSafe data storage. The prototype install program may or may not find a connected AccuSafe device automatically, but this is a planned feature.

15

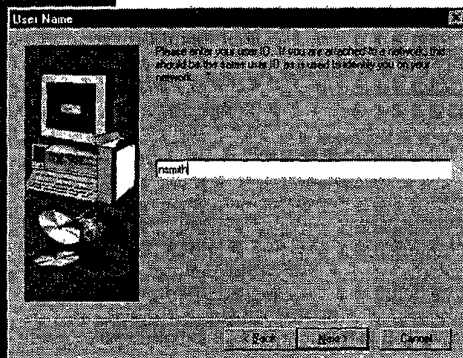
AccuSafe -- IPCI Confidential



This information lets AccuSafe keep the files from one computer segregated from the files from another computer, since especially with large AccuSafe media, multiple computers may be attached to one AccuSafe storage device.

16

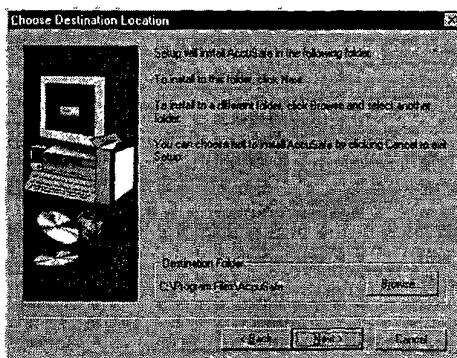
AccuSafe -- IPCI Confidential



This information lets AccuSafe keep the files from one user segregated from the files from another user, since especially with large AccuSafe media, multiple users may share a single AccuSafe storage device.

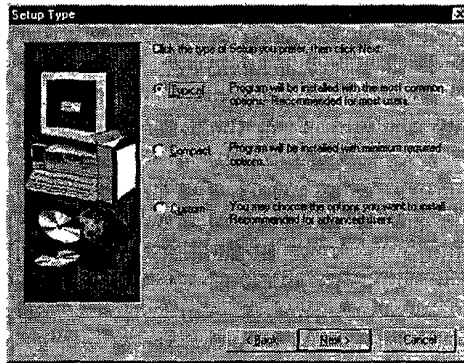
AccuSafe -- IPCI Confidential

17



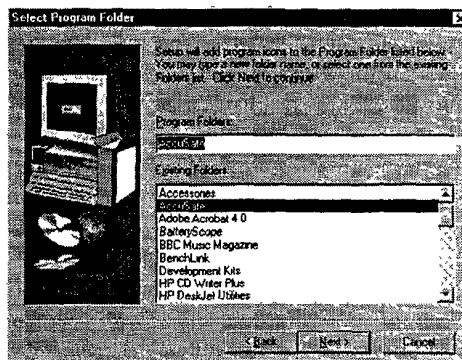
AccuSafe -- IPCI Confidential

18



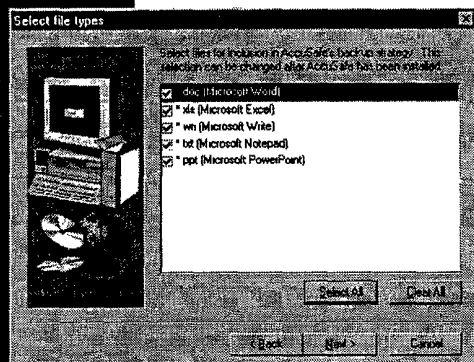
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19



AccuSafe -- IPCI Confidential

20

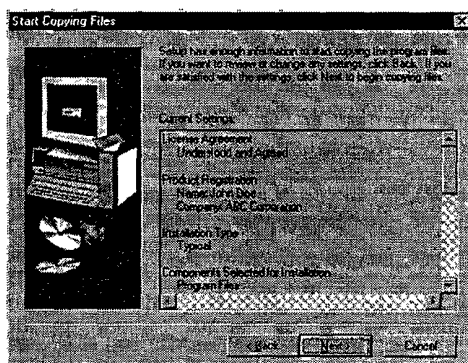


This is an artifact of the prototype software. The final software will not include such a dialog, but will allow fully hierarchical inclusion and exclusion by:

- a. File name
- b. Extension
- c. Base name
- d. Directory

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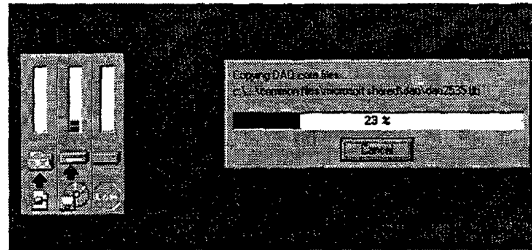
21



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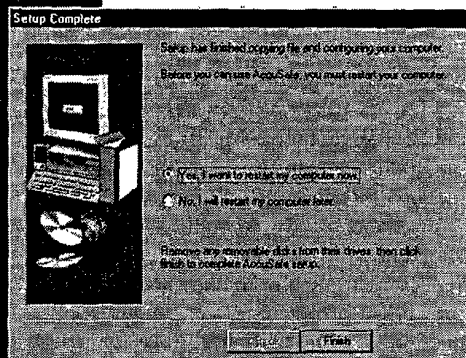
22

Installation progress indications...



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23



The computer must be restarted at the end of the installation. This causes AccuSafe's drivers to load and lets AccuSafe start during system bootup.

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24

on 1 missing features

AccuSafe installation will be combined with hardware
installation for maximum ease-of-use.

tion to view the ReadMe file at the end of install

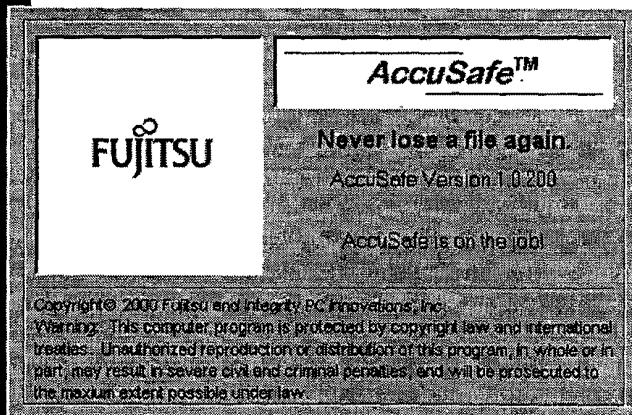
tion to start a full system backup (in the background) after
the system reboots at the end of install

tions to allow power-users to configure AccuSafe at the end
of install. Normal users would not need to perform any
configuration.

ernal install processing to examine OS and application mix,
that "recommended" include/exclude and backup-type
information can be preset during install

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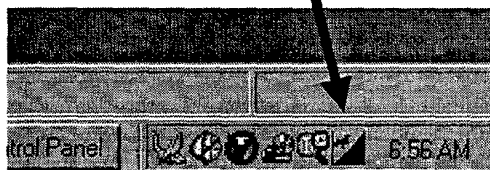
25



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26

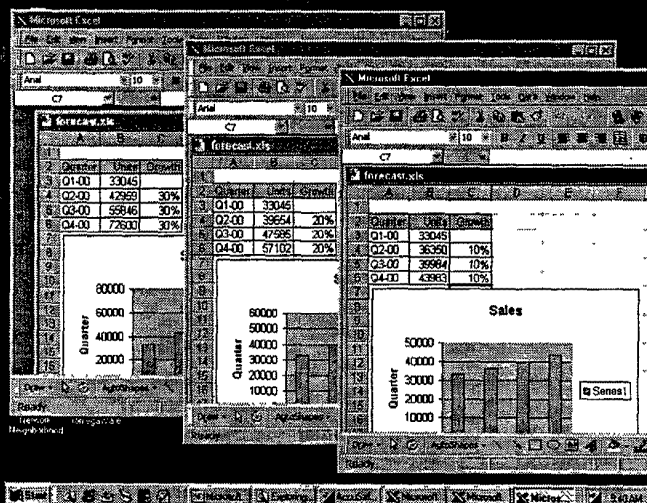
System tray animated activity indicator...



...can be right-clicked for additional control options (described later)

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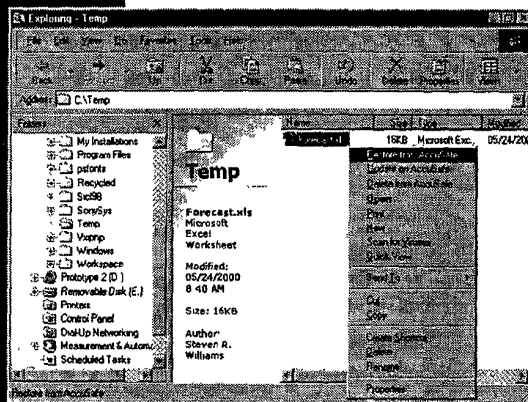
27



User develops 3 versions of a spreadsheet, accidentally overwriting the previous versions with the later versions...

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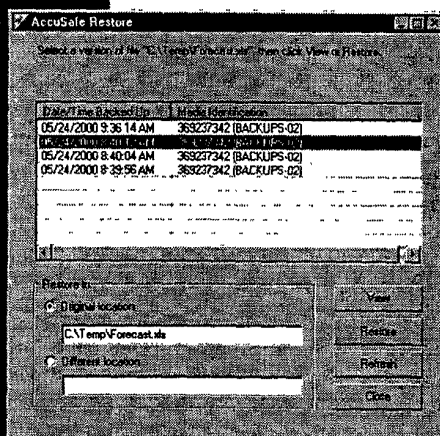
28



The user realizes that he's overwritten his file. Via explorer (or any other file selection dialog), the user can right-click on the file he's been working with, then select AccuSafe's restore function to retrieve the lost versions.

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29

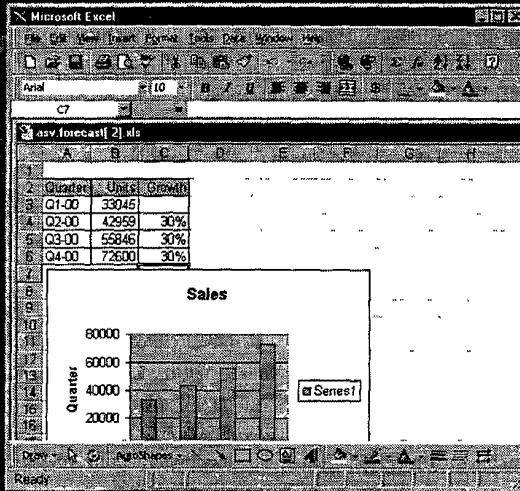


AccuSafe displays the list of revisions it has captured.

The user selects a version from this list, then clicks the View button to determine if this is the version he wishes to restore...

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30

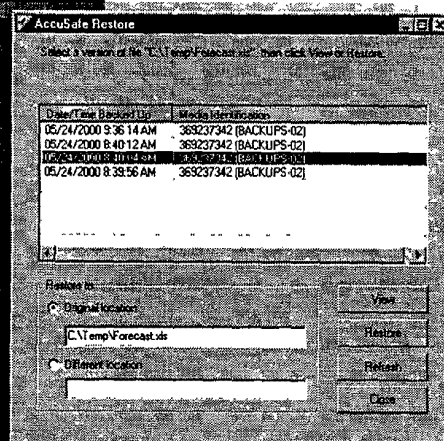


AccuSafe displays the revision selected, using the application that created the file.

If this isn't the version that the user wanted...

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31

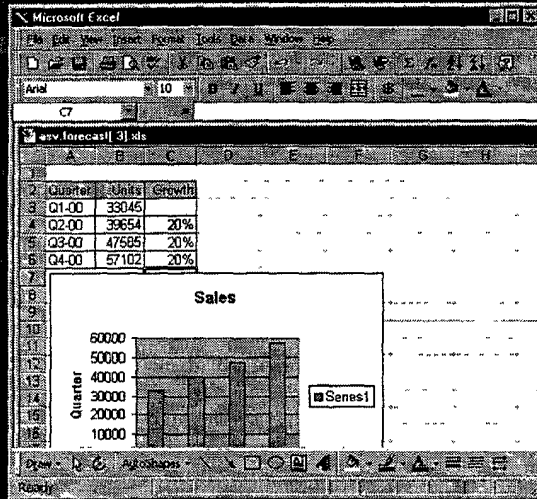


The user selects another revision to view...

Note: Most backup applications don't have such a preview capability, which significantly enhances ease-of-use.

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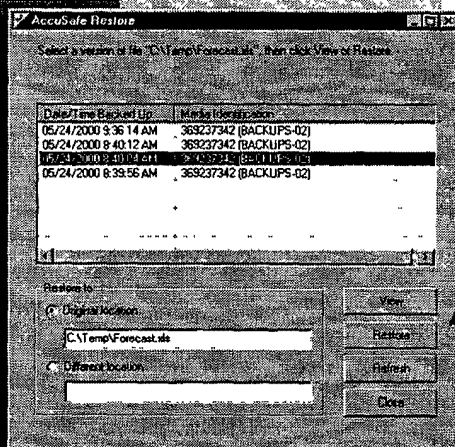
32



This is the version he wanted to restore, so...

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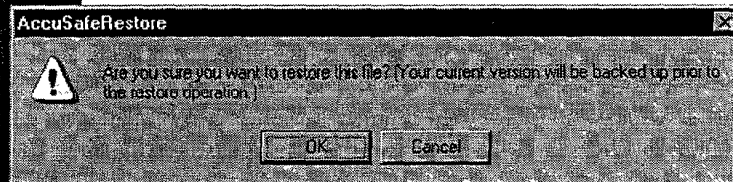
33



The user has verified this to be the proper revision to restore, so the user clicks Restore to retrieve his file.

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Safe will save the existing file (if it needs to!) before writing it with the copy the user is about to restore.

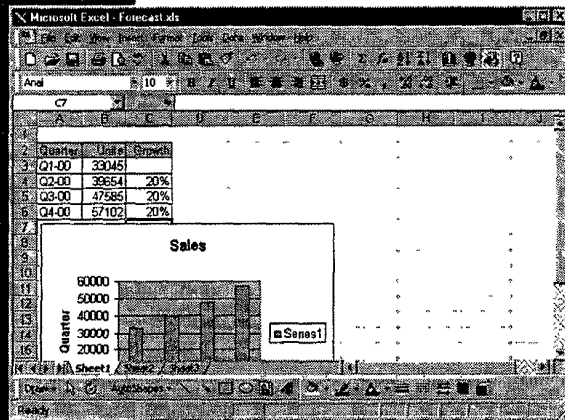
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35



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36



The correct revision is restored...

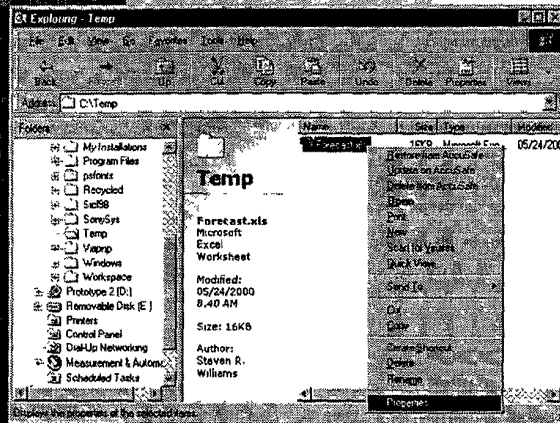
AccuSafe -- IPCI Confidential

37

to AccuSafe's IntelliQueuing technology, this entire scenario is available to the user whether or not he is physically connected to an AccuSafe storage device/media. The user still wants and needs protection of his files while he's on an airplane, or otherwise away from his office.

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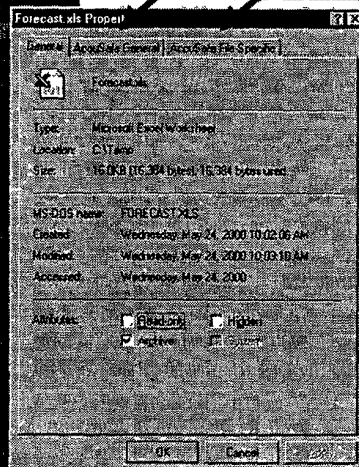
38



AccuSafe
operation can
be controlled
via a convenient
user interface...

AccuSafe – IPCI Confidential

39



AccuSafe augments the standard operating system dialogs and controls in many areas. AccuSafe is fused to the operating system the user is already familiar with, for maximum ease of use and functionality.

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40

nsive control options are available if the user
es to use them...otherwise, AccuSafe makes
e decisions for the user.

base name, extension, directory, etc.

Revision stack depth

Include / exclude

Compression on/off and technique (not Ver. 1)

Encryption on/off, passwords and technique (not Ver. 1)

Target AccuSafe device and media ID

Backup Strategy

– Automatic, Interval or Scheduled

Etc.

*gives you
no option*

Carl Tel

↑ ↑
base system

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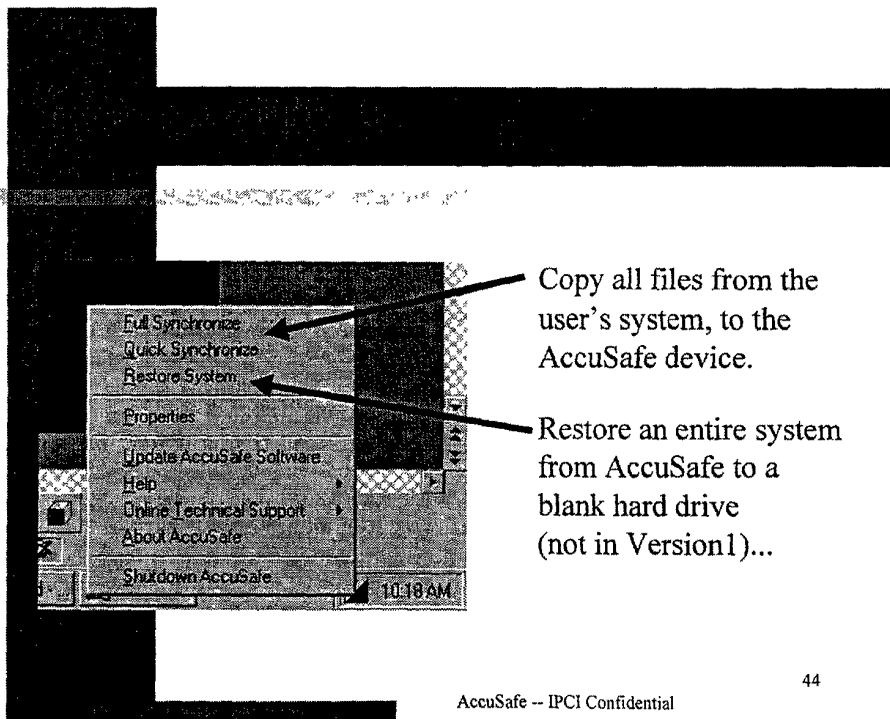
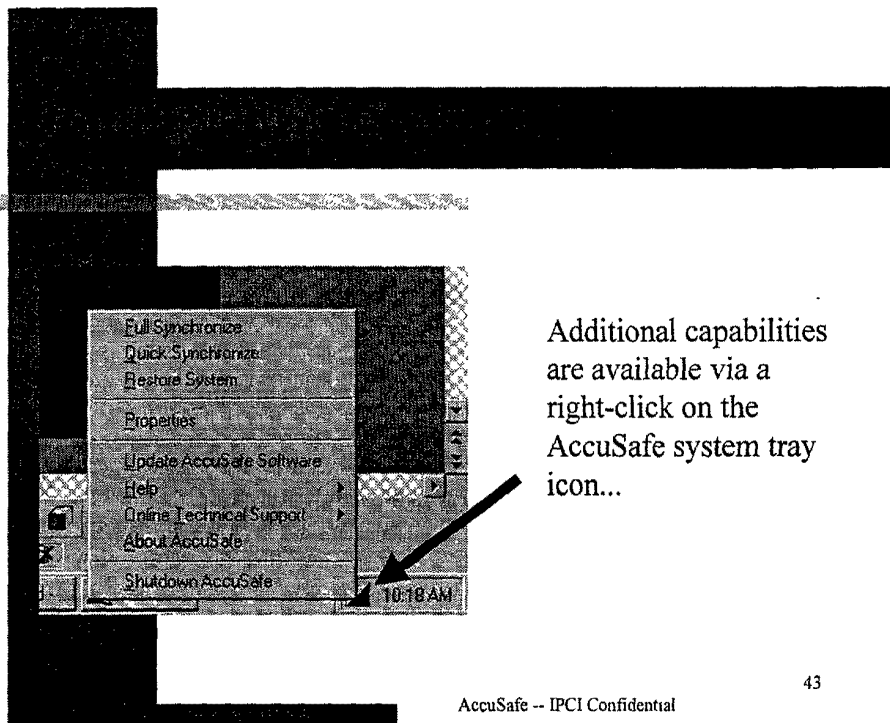
41

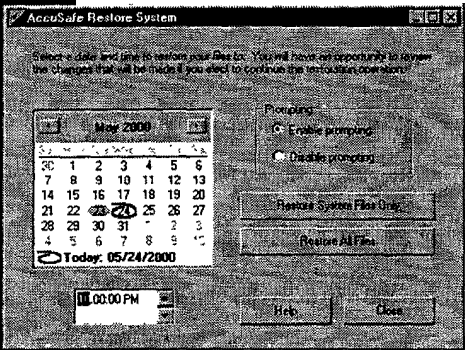
Automatic fine tuning

AccuSafe monitors its own operation, as well as the
operation of the computer to automatically fine-tune it's
operation for maximum data integrity with minimal disk
space use and minimal PC performance degradation.

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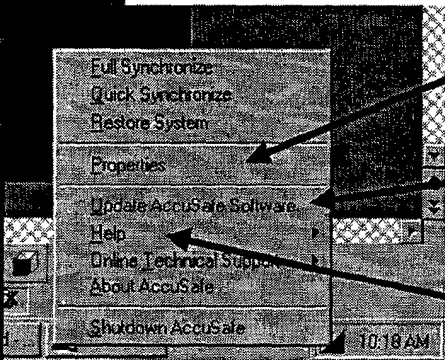
42





Users will be able to perform disaster recovery or clone disks using AccuSafe.

These features are planned as AccuSafe plug-ins after the initial introduction.

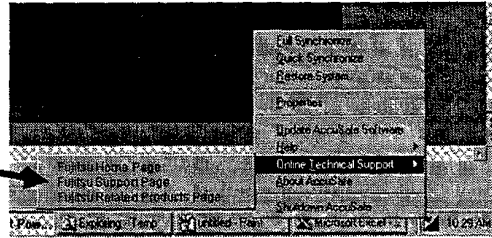


General AccuSafe operational controls.

One-button software updates via the web.

Localized help and user interface. Languages TBD.

connected
t and cross-
poses...



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operation

AccuSafe
Intervention:

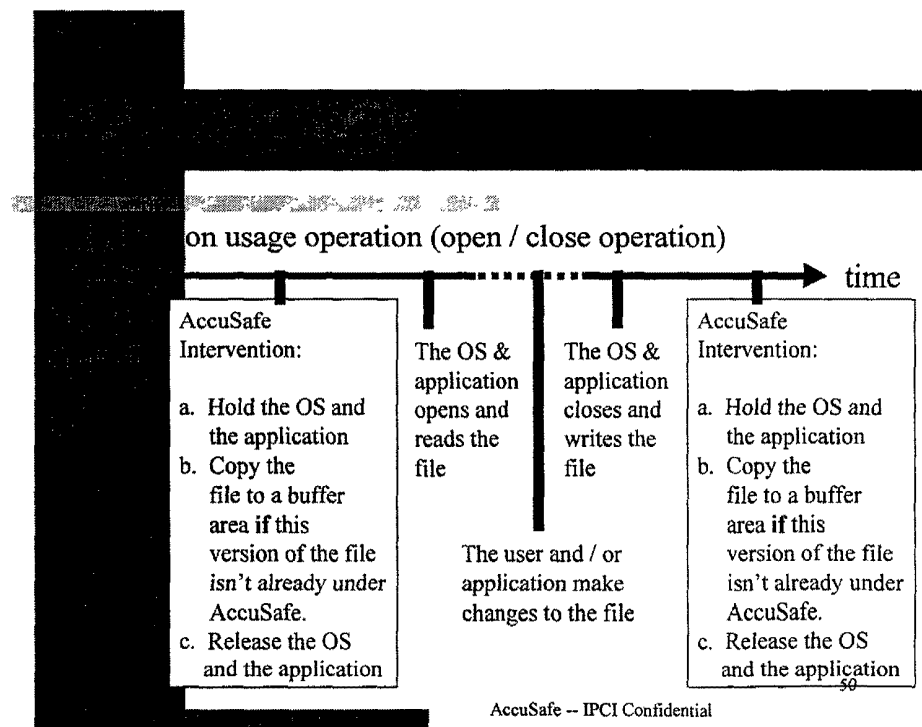
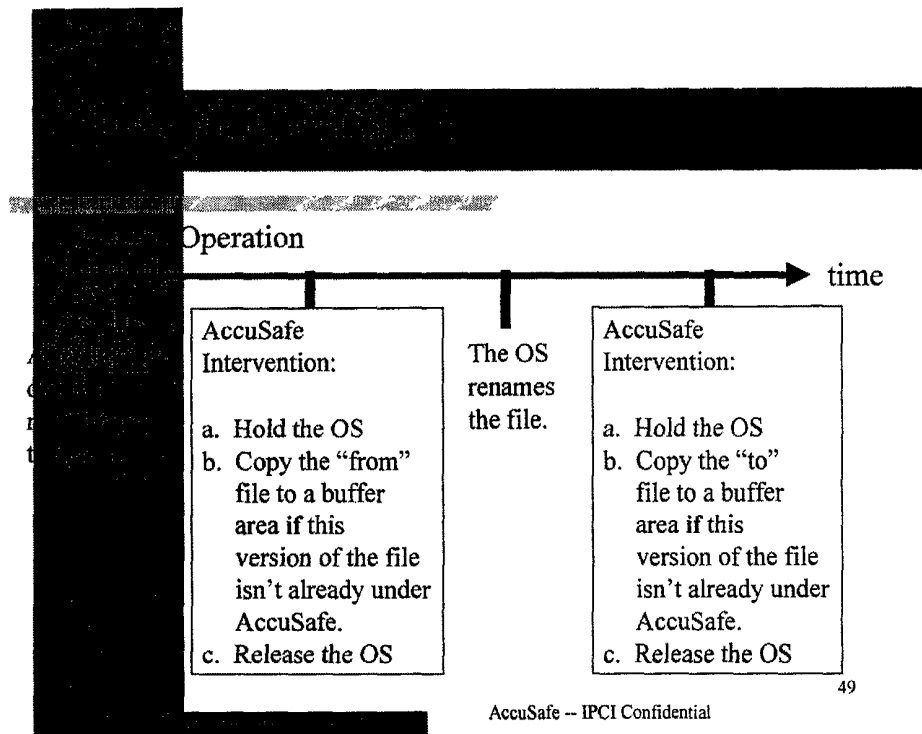
- a. Hold the OS
- b. Copy the file to a buffer area if this version of the file isn't already under AccuSafe.
- c. Release the OS

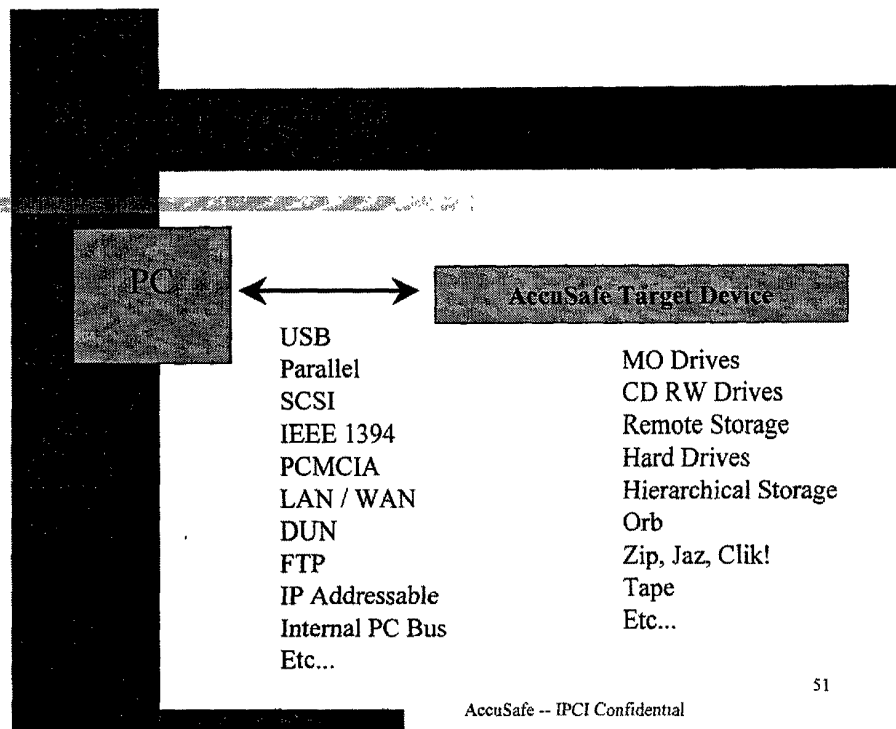
The OS
deletes
the file.

time

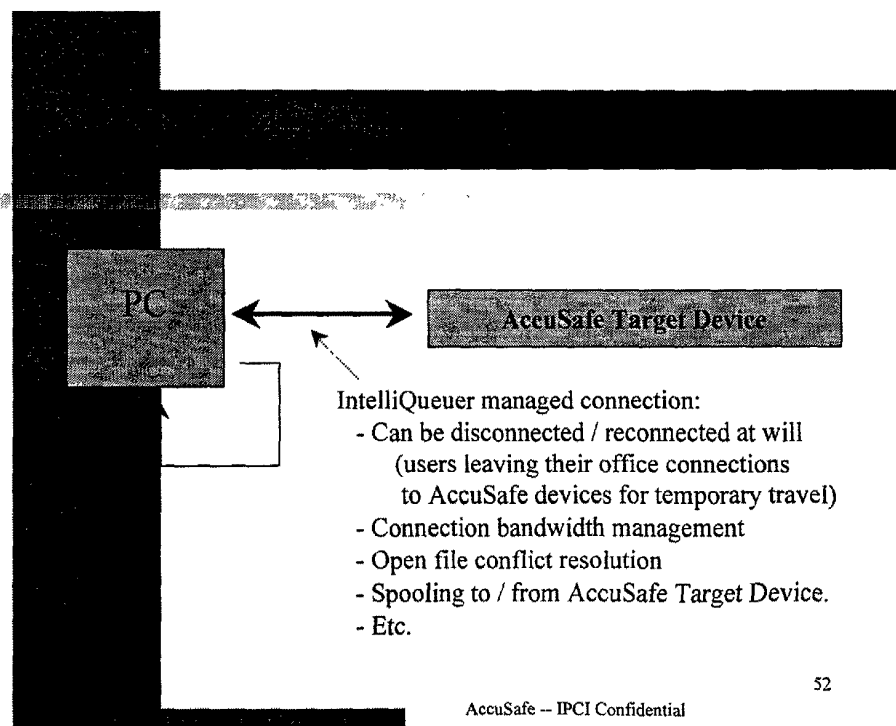
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48

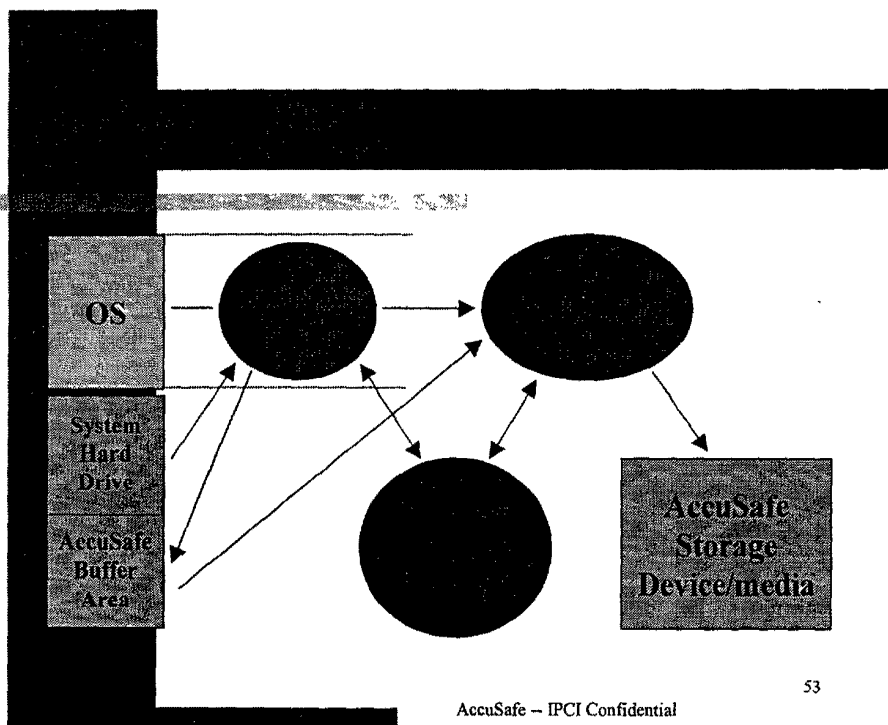




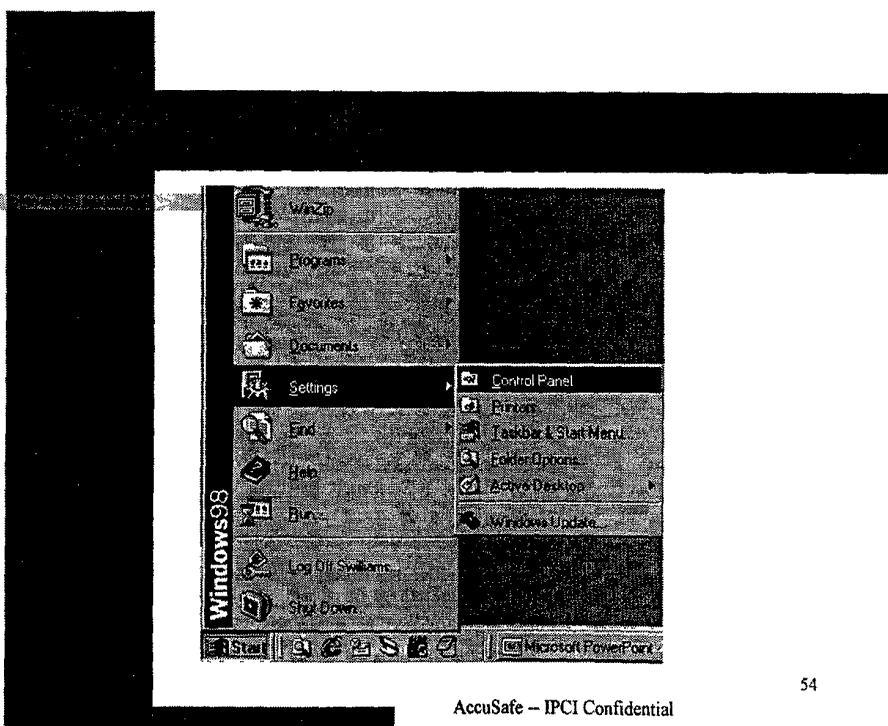
51



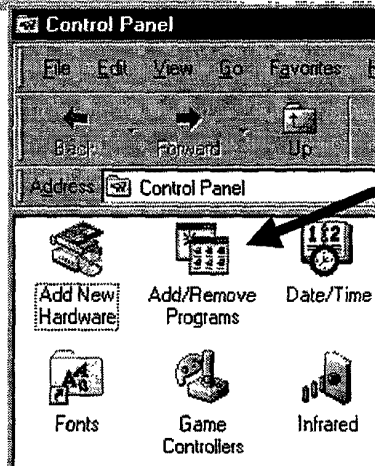
52



53



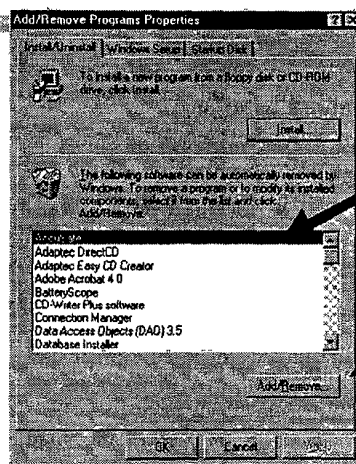
54



Double-click

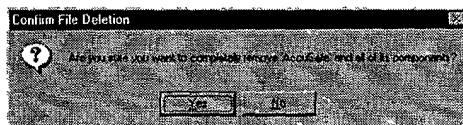
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55



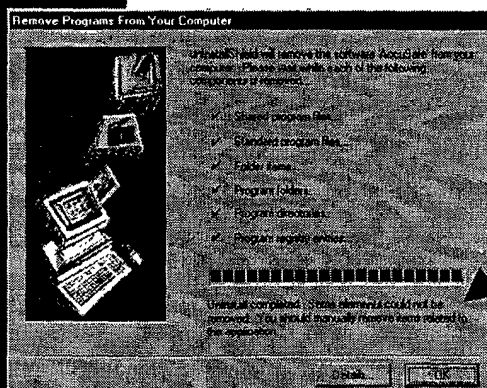
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56



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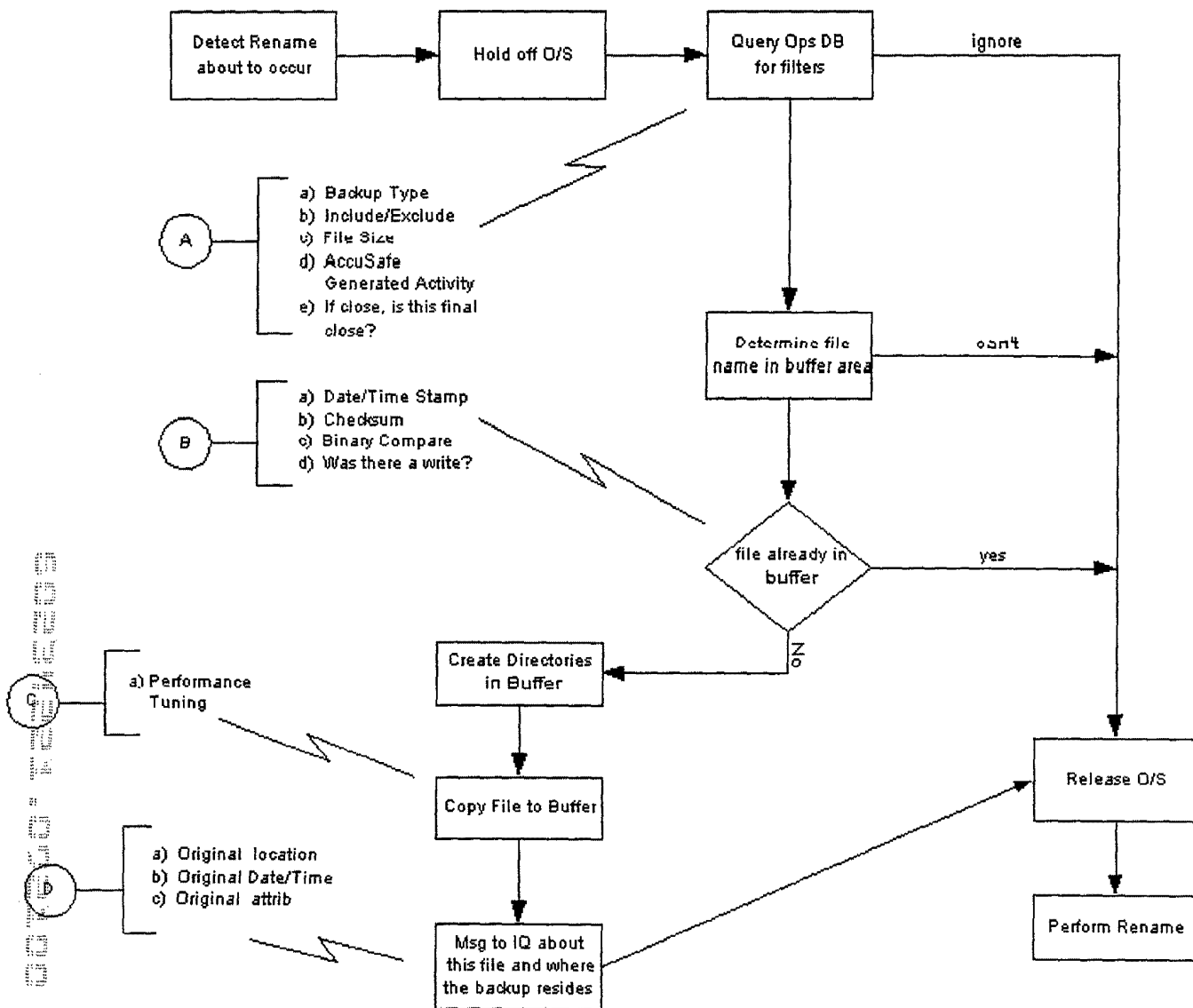
57



Of course, backed up files and other related information are never removed by this process.

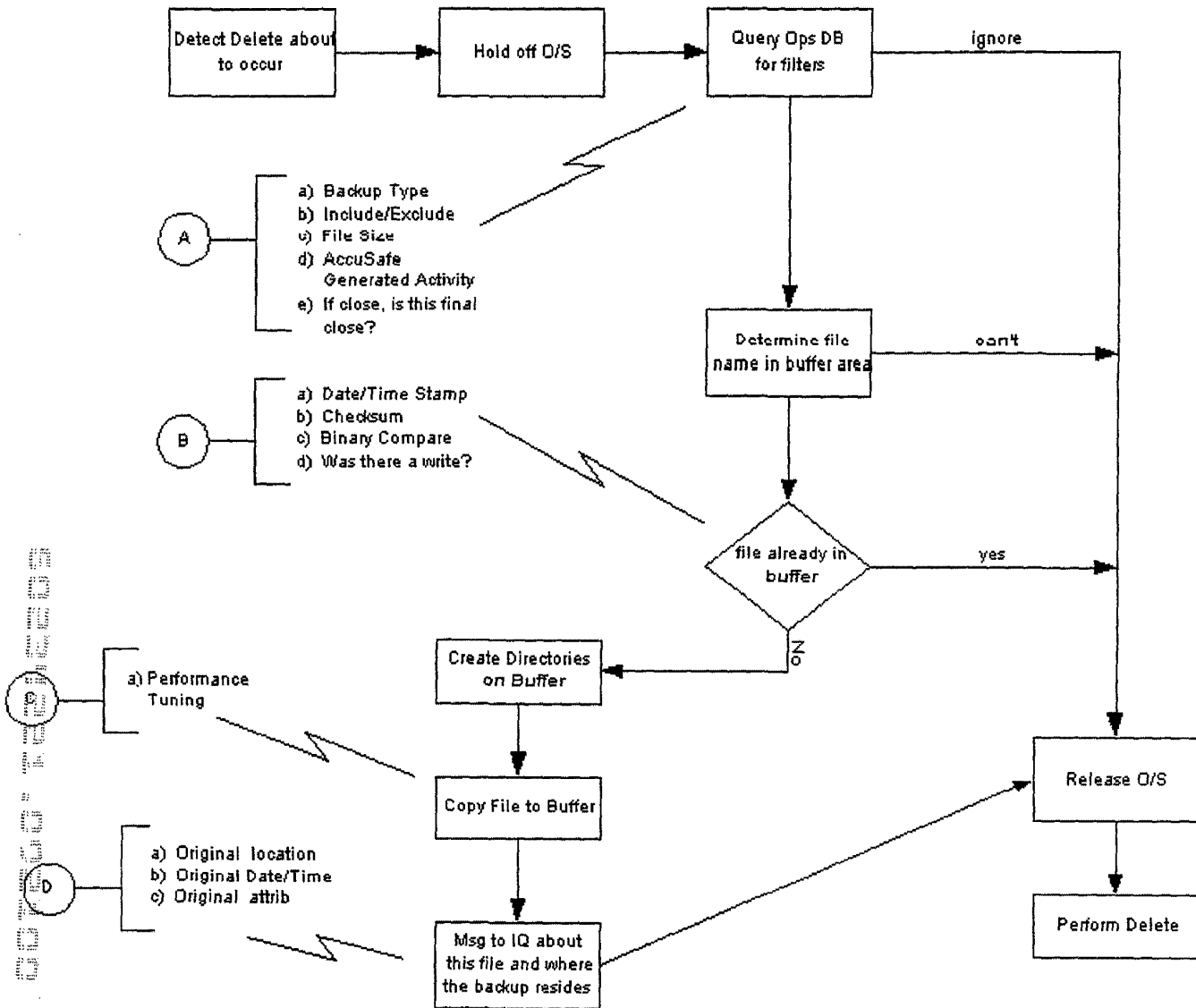
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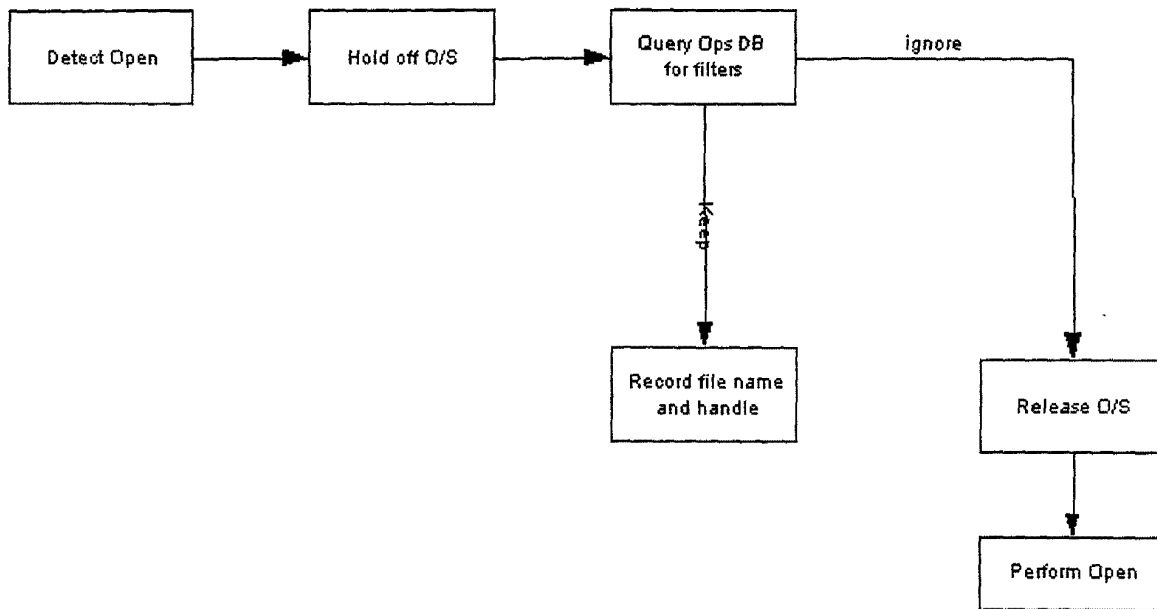
DELETE

Pre-IFS (all ops will be performed before the file system I/O is accomplished).



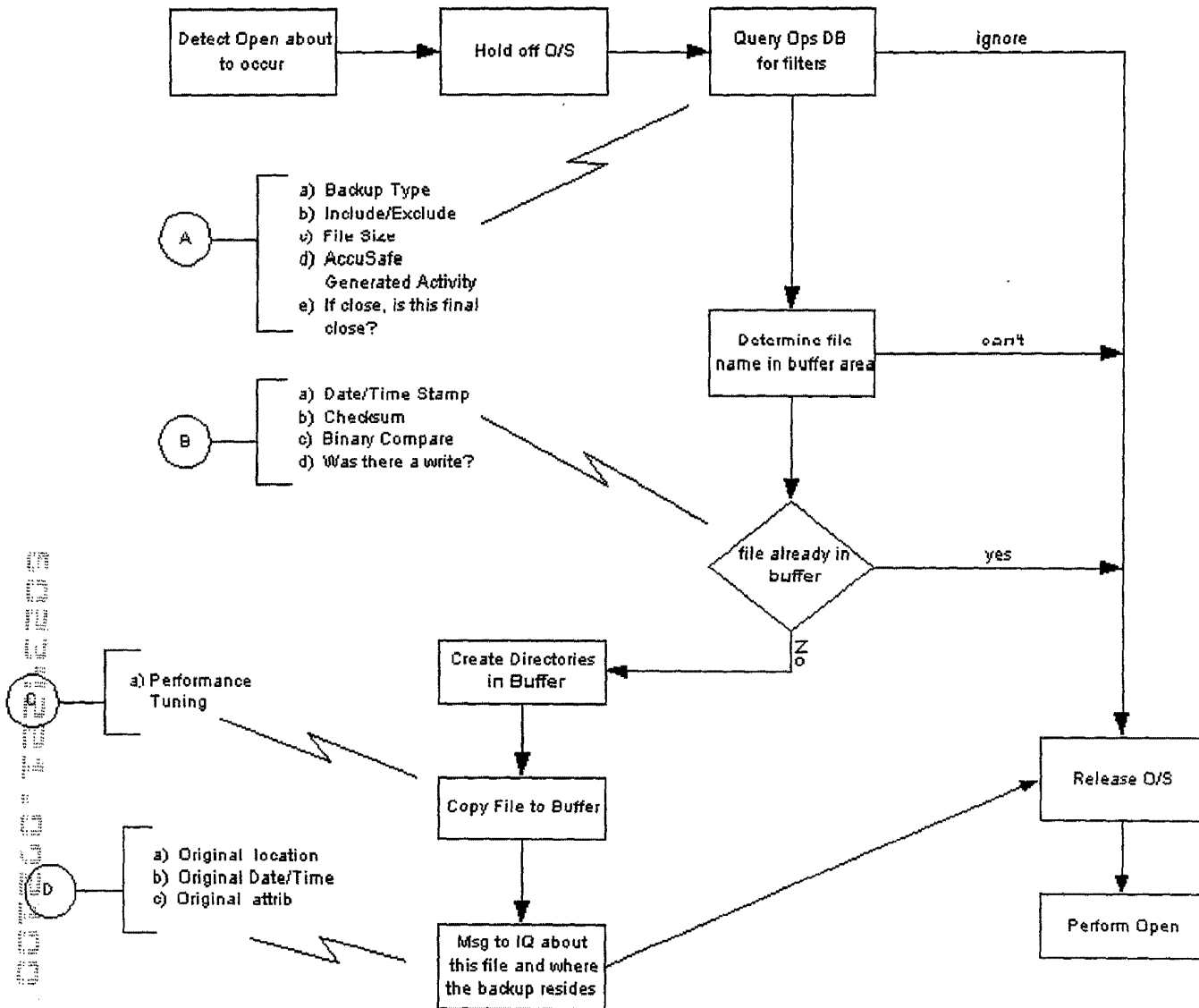
OPEN

IFS Hook (all ops will be performed before the file system I/O is accomplished).



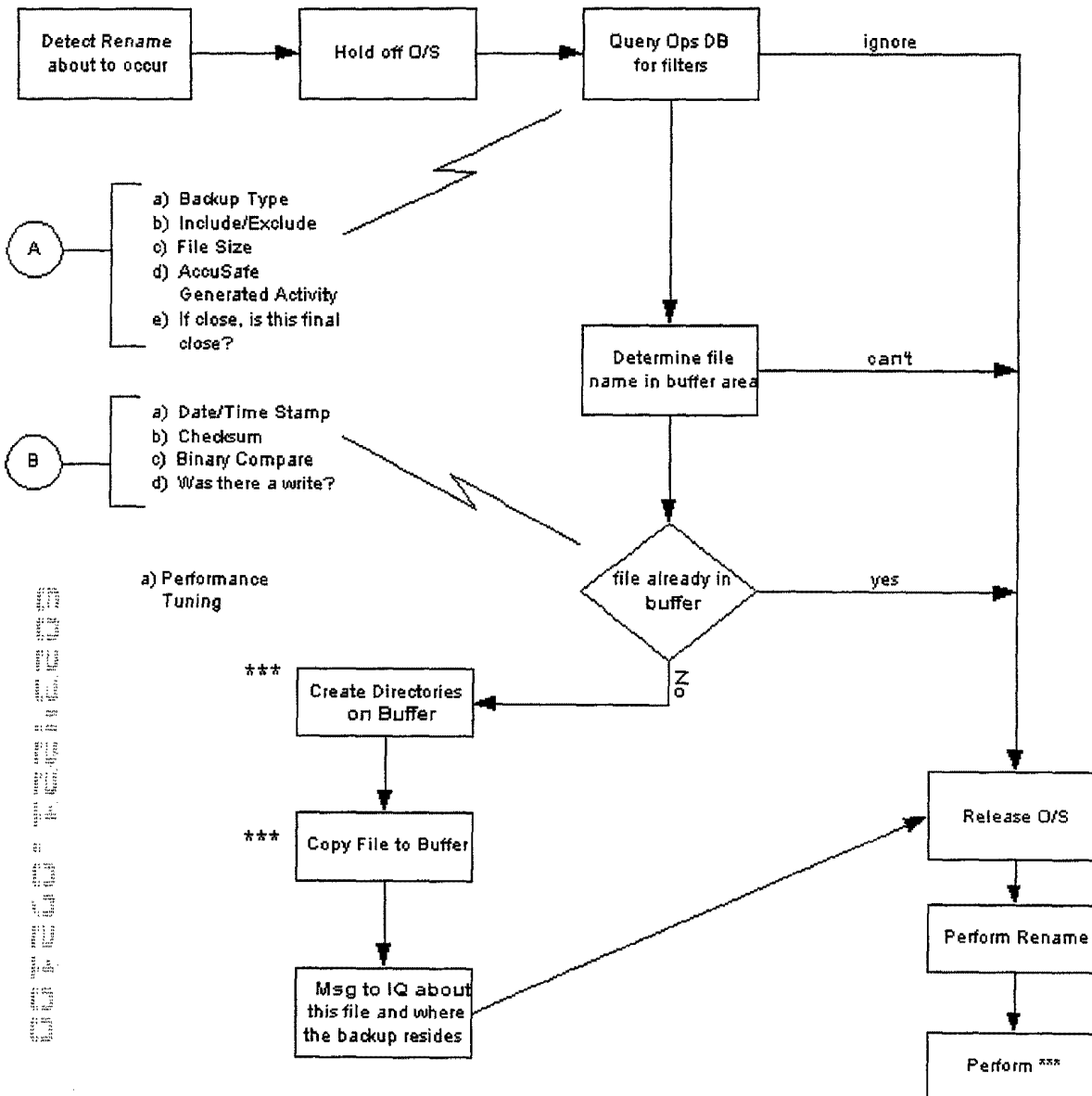
OPEN

Pre-IFS (all ops will be performed before the file system I/O is accomplished).



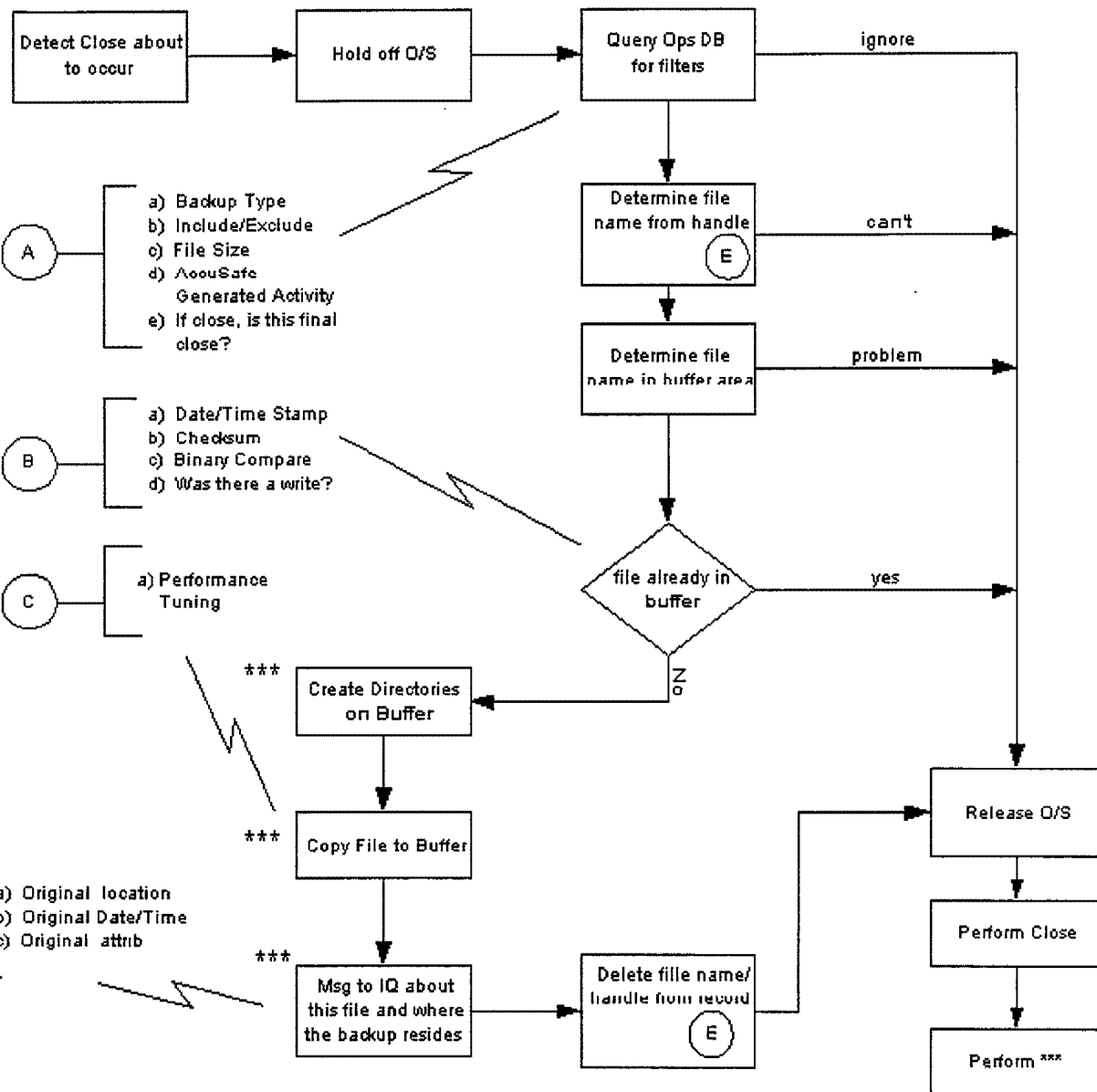
RENAME

IFS Hook (all operations will be performed after the file system I/O is accomplished.)



CLOSE

IFS Hook (all operations will be performed after the file system I/O is accomplished.)





US005259390A

United States Patent [19][11] **Patent Number:** **5,259,390****MacLean**[45] **Date of Patent:** **Nov. 9, 1993**[54] **METHOD AND APPARATUS TO MONITOR
SLEEP BEHAVIOUR**

[56]

References Cited**U.S. PATENT DOCUMENTS**

3,363,242 1/1968 Currey et al. 128/782
4,617,525 10/1986 Lloyd 128/716
4,836,219 6/1989 Hobson et al. 128/782

FOREIGN PATENT DOCUMENTS

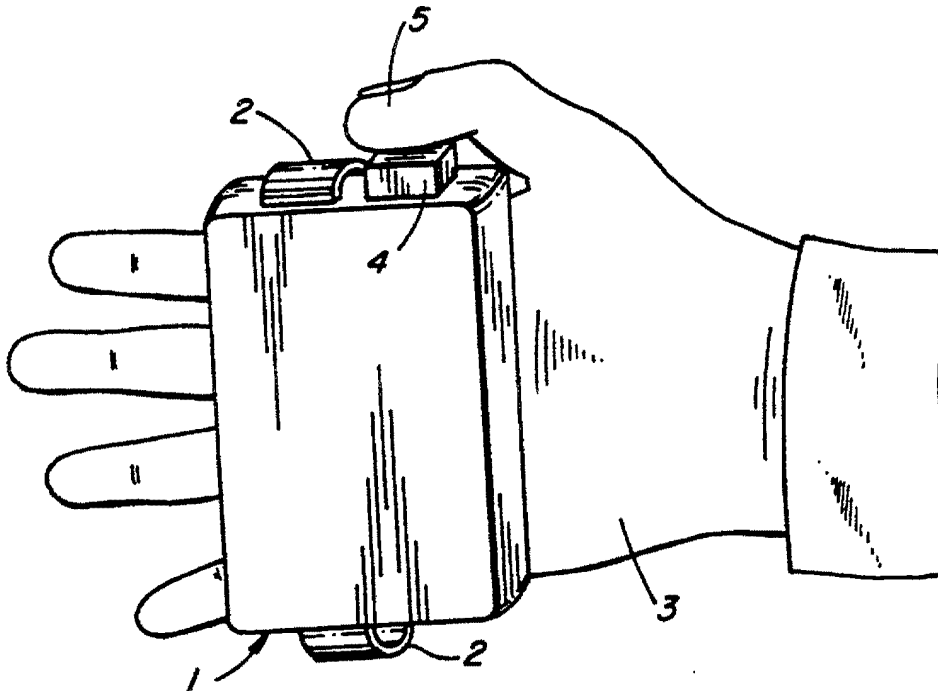
1503745 8/1989 U.S.S.R. 128/739
1553055 3/1990 U.S.S.R. 128/739

[75] **Inventor:** **Alistair W. MacLean**, Kingston,
Canada[73] **Assignee:** **Queen's University**, Kingston,
Canada[21] **Appl. No.:** **829,203**[22] **Filed:** **Feb. 3, 1992**[51] **Int. Cl.⁵** **A61B 5/00**[52] **U.S. Cl.** **128/739**[58] **Field of Search** 128/739, 774, 782;
600/26, 27; 340/573, 575**Primary Examiner—Max Hindenburg****Attorney, Agent, or Firm—Richard J. Hicks**

[57]

ABSTRACT

A vibrating stimulus-response device and method to monitor sleep behaviour is described. The self-contained portable device can be used in a home environment as a preliminary screen before a more extensive polysomnographic examination.

12 Claims, 2 Drawing Sheets

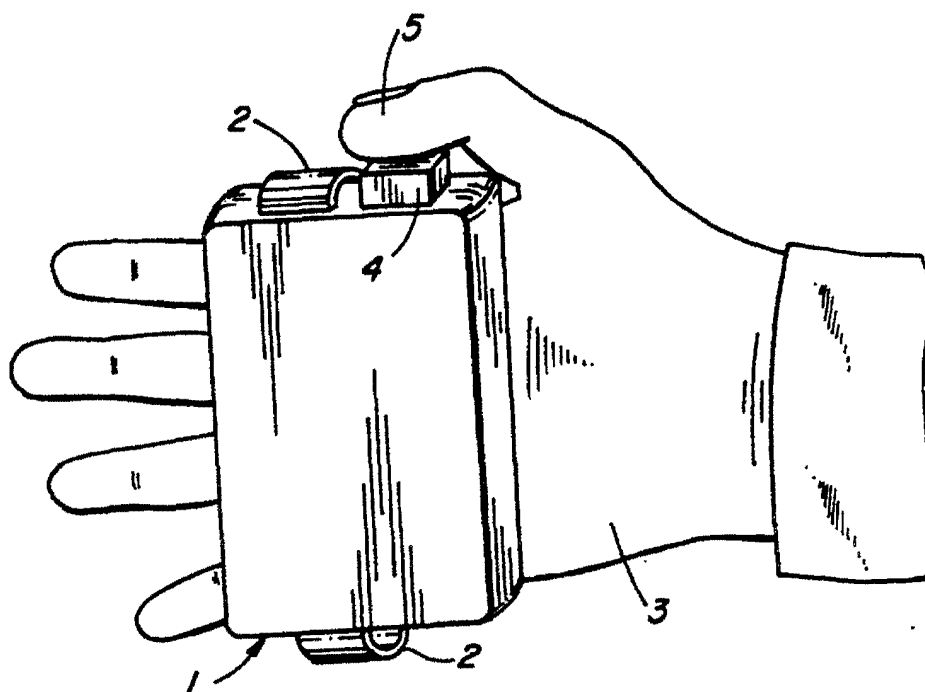


FIG. 1

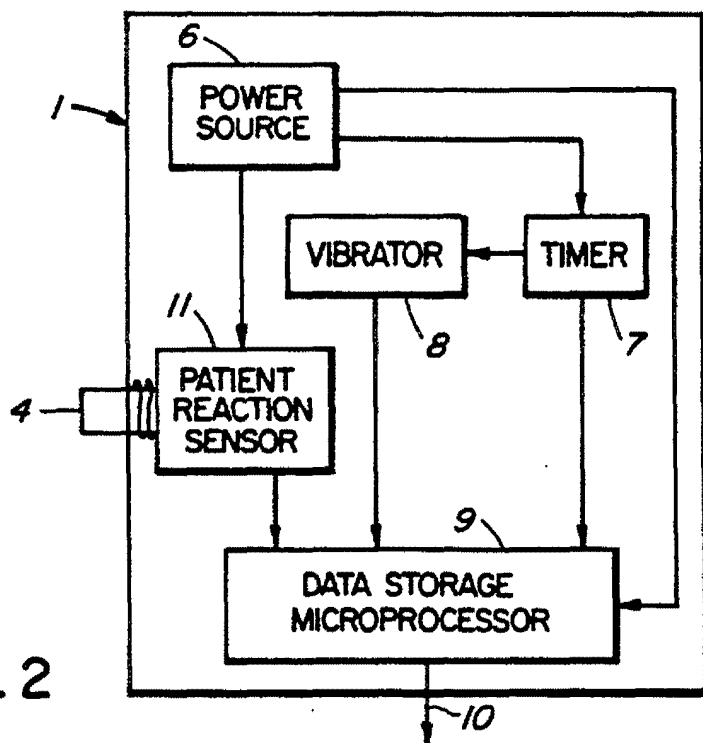
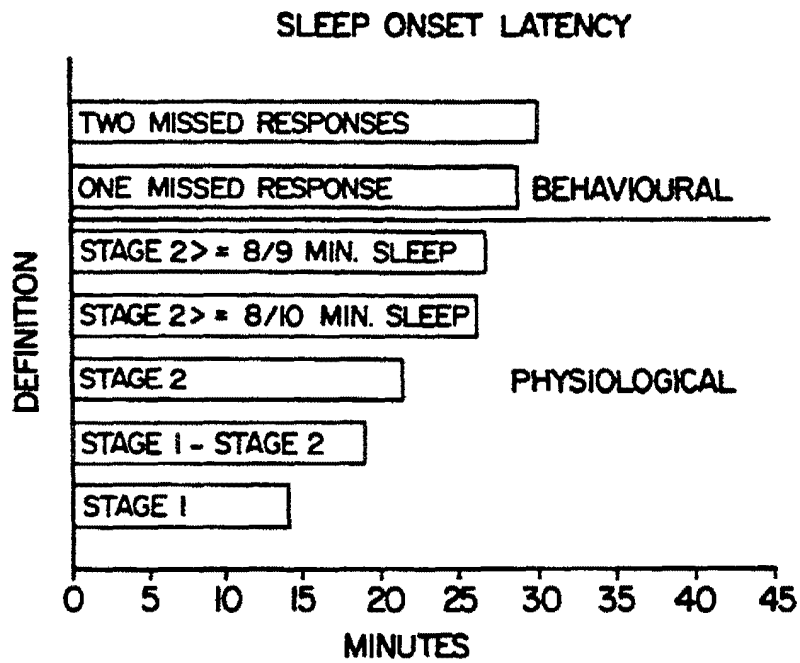
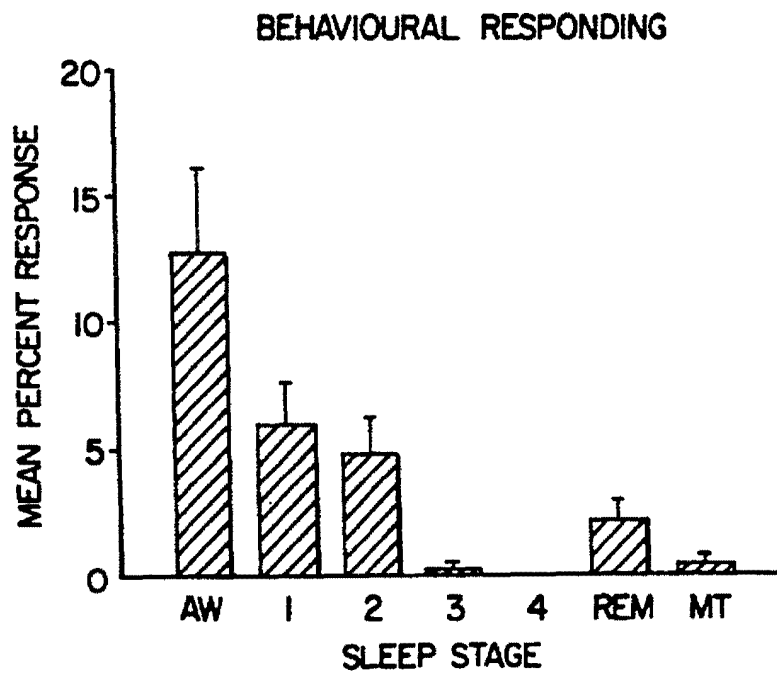


FIG. 2

**FIG. 3****FIG. 4**

METHOD AND APPARATUS TO MONITOR SLEEP BEHAVIOUR

FIELD OF INVENTION

This invention relates to a method and apparatus to monitor sleep and wakefulness in a human subject. More particularly this invention relates to a vibratory stimulus-response device to monitor sleep behaviour.

BACKGROUND OF INVENTION

Sleep can be assessed subjectively, behaviourally or physiologically. Of these three approaches, electrophysiological recordings have over the last thirty-five years become the standard approach. This approach-polysomnography-requires that electrodes be attached to the subject, using standard positions, for the continuous monitoring of electroencephalographic (EEG), electroculographic (EOG) and electromyographic (EMG) activity. The resulting record is scored into various sleep stages according to internationally accepted criteria (Rechtschaffen & Kales, 1968, "A manual of standardized terminology, techniques and scoring system for sleep stages of human subjects." Brain Information Service/Brain Research Institute, Los Angeles, Calif.)

While electrophysiological techniques have the advantage of being non-invasive, relatively unobtrusive, and being well tolerated, they have a number of practical disadvantages. Their application usually requires the subject or patient to come to a sleep clinic or laboratory for an overnight stay under the constant supervision of a trained technician, who will spend up to an hour and a half connecting and disconnecting the patient to the polygraph, and several hours monitoring the sleeping patient. Such a study will generate an enormous paper record—of the order of one third of a mile long, which must be scored and evaluated by trained personnel. The mathematical reduction of the data is not trivial. Thus the electrophysiological testing methods are cumbersome, expensive and not readily adaptable to ambulatory or home based monitoring.

In addition, there are a number of substantive issues which bear on the efficacy of the physiological assessment of sleep. While electrophysiological techniques assess certain important aspects of sleep, they ignore others. Specifically, they do not assess behaviour directly. The presence of a particular type of brain activity is not an infallible guarantee that an individual will be able to make a specific response such as identifying a warning signal on a nuclear reactor or navigating a vehicle on a motorway. This issue is also pertinent to the assessment of individuals complaining of sleep disorder. At any given time about one third of the general population over the age of eighteen is likely to complain of having insomnia while a small proportion complain of being excessively sleepy. The number of individuals being referred for sleep-related complaints has increased markedly over the last two decades and continues to increase as do the number of specialist centres devoted to their assessment and treatment. While polysomnography has an important role in this, its application is limited by its availability and by its appropriateness. Even a large sleep disorders centre can only see about twelve patients nightly or about 4000 patients a year while most facilities can only handle 300-1000 patients per year. Also, polysomnography does not address all relevant aspects of a disorder. Many insom-

nia patients complain of excessive sensitivity to environmental stimulation while many excessively sleepy patients complain of failing to respond adequately to environmental stimulation.

There is, therefore, a considerable need for a simple method and apparatus for sleep monitoring which would measure relevant aspects of behaviour, would be suitable for home use, could be used to provide a preliminary screen to quickly and efficiently identify patients in need of a more intensive evaluation. A wider spectrum of relevant behaviour could be assessed, the costs of the polysomnographic examination may be avoided and the frustration of long patient waiting lists may be reduced.

OBJECT OF INVENTION

Thus, it is one object of the present invention to provide a simple vibratory stimulus response device to monitor sleep and wakefulness in a human subject.

Another object is to provide a method for assessing sleep behaviour in a human subject.

BRIEF STATEMENT OF INVENTION

Thus by one aspect of this invention there is provided an apparatus for monitoring sleep behaviour in a human subject comprising:

a housing; vibratory means and subject response means contained within said housing; timing means to activate said vibratory means at selected time intervals; means to record and store each activation event of said vibratory means, and subject positive and negative response thereto; and means to retrieve and analyze said records.

By another aspect of this invention there is provided a method for assessing sleep behaviour in a human subject, comprising:

(a) subjecting the subject to a vibratory stimulus at selected spaced intervals of time;
(b) recording the time of each said stimulus and the subject's response or lack thereof to each said stimulus;
(c) recovering stored information; and
(d) assessing the subject by comparison of said recovered stored information with known standards of sleep behaviour.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a sketch of a hand-held unit incorporating the invention;

FIG. 2 is a schematic block diagram of one embodiment of the invention;

FIG. 3 is a graph illustrating mean sleep onset latencies corresponding to five physiological and two behavioural definitions; and

FIG. 4 is a diagram illustrating behavioural response in each stage of sleep.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

As shown in FIG. 1, a preferred embodiment of the invention comprises a self-contained vibrator and data storage unit 1 which is about 4 inches long, 3.5 inches wide, and 0.5 inches thick, which may be hand-held. For convenience, and to prevent loss during sleep, the unit 1 is provided with a strap loop 2 through which the hand 3 is slipped so as to hold the unit firmly in the palm of the hand. A response button 4, such as a spring loaded micro switch, is conveniently located at one end

of the unit so that it can be readily activated by the thumb 5. It will, of course, be appreciated that the location and design of the response button is merely a matter of design choice and numerous alternatives will be readily apparent to those skilled in the art.

As shown in FIG. 2, the housing 1 contains a power source for a patient response sensor 11, a timing circuit 7, an electro tactile vibrating unit 8 (such as a Tactile Vibrator, supplied by Audiological Engineering Corp., Summerville, Mass.) and a microprocessor 9, which is provided with a signal output 10 which should be compatible with a computer interface. The power source 6 is conveniently, but not essentially, a conventional long-life dry cell which provides sufficient power to operate the timing circuit, the vibrator and the microprocessor. It will be appreciated that while preferred, it is by no means essential that power source 6 be internal to unit 1. An external power source with appropriate lead in wires is also within the scope of this invention.

The vibrator 8 is preferably an electro tactile vibrator which provides a 20-40 Hz bandwidth at the selected frequency of 160-200 Hz and preferably 180 Hz. The timer may be set to trigger the vibrator on either a random basis or, more usually, on a timed basis of the order of a 0.5 second pulse every 5-10 minutes. The vibrations are of sufficiently low amplitude that they are unlikely to provoke any sleep disturbance in a sleeping patient. The time of each vibratory event whether or not the patient makes a response to that event and the time taken to make that response may be recorded in the microprocessor data storage device. The stored data may be recovered for later analysis using a conventional computer interface.

Experimental Procedures

Twelve healthy, volunteer, young, female subjects who were medication free were recruited to compare the vibratory stimulus unit to standard polysomnographic monitoring during a single night of sleep monitoring. Before going to sleep the subjects had electrodes attached as described above for electrophysiological monitoring: the resulting sleep records were scored according to standard criteria. They then had the vibratory stimulus device 1 described above fitted to their preferred hand. The subjects were instructed to sleep normally and press switch 4 whenever they felt a vibratory stimulus. The stimulus was a 180 Hz vibration administered with a maximum peak-to-peak output of 1150 mV for 0.5 seconds at an average inter-stimulus interval of 7.5 minutes.

A polysomnographic recording classifies sleep in several stages systematized by an international committee (Rechtschaffen & Kales, 1968. "A manual of standardized terminology, techniques and scoring system for sleep stages in human sleep subjects. Brain Information Service/Brain Research Institute, Los Angeles). The major characteristics are summarized in Table 1.

TABLE 1

Table of the Major Characteristics of the Stage of Sleep	
Stage	Major Characteristics
Awake	Alpha activity and/or low voltage, mixed frequency EEG.
Stage 1	Relatively low voltage, mixed frequency EEG. Highest voltage is about 50-75 μ V and tends to occur in bursts mostly towards the latter position of the stage.
Stage 2	Defined by the presence of sleep spindles and/or K complexes and the absence of sufficient high

TABLE 1-continued

Table of the Major Characteristics of the Stage of Sleep	
Stage	Major Characteristics
5	voltage, slow activity to define Slow Wave Sleep.
Stage 3 ^b	A record in which at least 20% of the epoch consists of waves of 2 cps ^a or slower and amplitudes greater than 75 μ V peak-to-peak.
Stage 4 ^b	An EEG record in which more than 50% of an epoch consists of waves of 2 cps ^a or slower and with amplitudes greater than 75 μ V peak-to-peak.
10	REM The appearance of low voltage, mixed frequency EEG activity, and episodic rapid eye movements (REMs).
MT	A record in which at least 50% of a page (corresponding to 30 seconds) is characterized by an increase in EMG activity.
15	^a cycles per second ^b Stages 3 and 4 are commonly referred to as Slow Wave Sleep (SWS)

SLEEP ONSET

Behavioural versus Physiological Definitions of Sleep Onset

The correspondence between behavioural and polysomnographic definitions of sleep onset was assessed by comparing mean differences among a number of different polygraphic and behavioural definitions of sleep onset. Both the behavioural and physiological definitions of sleep onset are presented in Table 2.

TABLE 2

Table of Physiological and Behavioural Definitions	
Definition	Definition of Sleep Onset
<u>Physiological</u>	
1	First epoch of Stage 1
2	First epoch of Stage 1 leading to Stage 2
3	First epoch of Stage 2
4	First epoch of Stage 2 followed by ≥ 8 min. sleep in next 10 min.
5	First minute of Stage 2 followed by ≥ 8 min. sleep in next 9 min.
<u>Behavioural</u>	
6	First missed response
7	Two consecutive missed responses

The criterion of the first missed response to the vibratory stimulus was chosen as an intuitively plausible measure of behaviourally defined sleep onset. Similarly, two consecutive missed responses was chosen to identify the onset of a consolidated sleep period.

The polysomnographic criteria were selected to include a variety of definitions employed in the existing literature. Briefly, these definitions range from the least stringent criterion of the appearance of the first epoch of Stage 1 to a more stringent consolidated criterion requiring the subject to have entered the first minute of Stage 2 sleep that is followed by nine consecutive minutes of sleep (Stage 2, 3, or 4) interrupted by no more than one minute of awake. Lying somewhere in the middle is the most widely used definition of sleep onset, that is the appearance of the first epoch of Stage 2 sleep. These definitions may be roughly grouped into those requiring little or no consolidation (1-3) and those requiring a definite degree of consolidation (4 and 5). Mean sleep onset latencies corresponding to each of the behavioural and physiological definitions are presented in FIG. 3.

Sleep onset latencies defined by the seven criteria were compared in an analysis of variance in which the definition of sleep onset was extracted as a within sub-

jects factor. A significant effect of definition was found ($F(6,66)=8.62$; $p<0.0013$). As can be seen in FIG. 3, this was due mainly to differences between the mean latency defined by the physiological criterion of the first appearance of Stage 1 and the two consolidated sleep onset latency definitions and both of the behavioural definitions of sleep onset latency.

Statistical analysis indicates that the estimates of sleep onset latency provided by the vibratory stimulus device do not differ significantly from those provided by the consolidated physiological definitions of sleep onset.

This suggests that the behavioural criteria define consolidated sleep and can serve as accurate indicators of the onset of polygraphically defined consolidated sleep.

Relationship of Behavioural Response to Polysomnographically Defined Sleep Stages

The mean percent of stimuli responded to in each sleep stage is illustrated in FIG. 4. As anticipated, the highest level of responding was seen in wakefulness (AW). During sleep a higher level of responding occurred in the 'lighter' stages of sleep (Stage 1 and Stage 2), while little or no responding was seen in the 'deeper' stages (Stages 3 and 4). An intermediate level of responding was found during REM sleep.

Effects of Stimulation on Sleep Architecture

The relationship between the behavioural measure and polysomnographic recording was also examined by correlating the total percent responding of the subjects with various polygraphic measures of sleep. These correlations are presented in Table 3.

Over the whole night, a significant correlation was found between behavioural responding and both total sleep time ($r(10)=-0.777$; $p<0.003$) and sleep efficiency ($r(10)=-0.819$; $p<0.001$). Thus, those subjects who responded more frequently during the night slept significantly less than subjects who responded less frequently, and their sleep efficiency (calculated by dividing the total sleep time by the total recording time and multiplying by 100) was also significantly reduced.

TABLE 3

Table of Pearson Product Moment Correlation between Mean Percent Responding and Sleep Variables		
Sleep Variable	r	p
Total Time Recorded (TTR)	0.298	n.s.
Total Sleep Time (TST)	-0.777	<0.003
Sleep Efficiency (SE)	-0.819	<0.002
Sleep Onset Latency (SOL)	0.568	n.s.
% Awake (PERAW)	0.838	<0.001
% Stage 1 (PER1)	0.727	<0.01
% Stage 2 (PER2)	-0.747	<0.006
% Stage 3 (PER3)	-0.371	n.s.
% Stage 4 (PER4)	-0.250	n.s.
% REM (PERREM)	-0.682	<0.05
% MT (PERMT)	0.117	n.s.
REM Latency (REML)	0.614	<0.05
No of REM Periods (NREMP)	-0.463	n.s.
Shifts to Awake (SHAW)	-0.672	<0.02
Shifts to Stage 1 (SH1)	0.501	n.s.
Shifts to MT (SHMT)	0.146	n.s.
% SWS (PERSWS)	-0.593	<0.05
Shifts to Aw + 1 + MT (SHAW1MT)	0.664	<0.02

Mean percent responding over the night was also correlated with the different stages of sleep. It was found that, in general, wakefulness ($r(10)=0.838$; $p<0.0007$) and Stage I ($r(10)=0.727$; $p<0.008$) correlated positively with behavioural responding, while 'deeper' stages of sleep (Stages 3 and 4) correlated nega-

tively. This suggests that the more frequently subjects responded, the more time they spent awake and in Stage 1, and the less time they tended to spend in SWS ($r(10)=0.592$; $p<0.05$). The amount of time spent in Stage 2 sleep was also found to be significantly correlated with percent responding ($r(10)=-0.746$; $p<0.005$). Subjects who responded with greater frequency to the stimulus spent significantly less time in Stage 2 sleep. A significant correlation was also found between mean percent responding and shifts to awake ($r(10)=0.672$; $p<0.02$), indicating that more frequent responding was associated with more shifts to awake.

A significant negative correlation was also found between mean percent responding and percentage of REM sleep ($r(10)=-0.682$; $p<0.01$). Subjects who responded more often to the vibratory stimulus had significantly less REM sleep than those subjects who responded less frequently. Finally, percent responding was found to be significantly correlated with REM latency ($r(10)=0.614$; $p<0.03$), which is defined as the interval of time between sleep onset and the beginning of the first REM period. Thus, REM latency was significantly longer for those subjects who responded more frequently to the vibratory stimulus.

It is evident that a substantial relationship exists between sleep assessed behaviourally and polygraphically.

Sleep Disturbance Produced by the Vibratory Stimulus

Although the parameters of the stimulus presentation were chosen so as to minimize the possibility of disturbing the subjects' sleep, the extent to which sleep might differ from that usually experienced was assessed in two ways: by examining the subjects' subjective appraisal of their experience and their polysomnographically defined sleep. It is generally known that sleeping in a new environment produces a 'first night effect', that is sleep may be more disturbed than that which occurs in an environment which is familiar.

In the morning subjects were asked a number of questions to obtain information on their own experience during the study. On average subjects estimated that they experienced 8 vibrations a night while, in fact, they received an average of about 50 per night. Half the subjects indicated that their sleep was the same as a 'normal' night's sleep at home and half indicated that it was worse, a finding that it is typically obtained after the first night in a sleep laboratory.

A number of polygraphic parameters were compared with a sample of approximately the same age who were also spending their first night in the laboratory but who were allowed to sleep undisturbed. The results indicated differences in Stage 1, Stage 2, Slow Wave Sleep (Stages 3 and 4) and Movement Time. Overall the degree of disturbance averaged slightly over 4 percent of the total night's sleep.

Overall, by both subjective and polygraphic criteria, the sleep of the subjects was disturbed to some degree by the vibratory units. However, the amount of disturbance appears to be quite small and insufficient to invalidate the general conclusions regarding the efficacy of this device.

We claim:

1. An apparatus for monitoring sleep behaviour in a human subject, comprising:
a housing;

vibratory means and subject response means contained within said housing;

timing means to activate said vibratory means at selected time intervals for selected periods of time; means to record and store each activation event of said vibratory means, and subject positive and negative response thereto; and means to retrieve and analyze said records.

2. An apparatus as claimed in claim 1 wherein said housing is a handheld housing and includes means to releasably secure said housing to a subject's hand.

3. An apparatus as claimed in claim 2 wherein said timing means and said means to record are contained within said housing.

4. An apparatus as claimed in claim 3 including a power source, within said housing, to activate said vibratory means, said timing means and said record means.

5. An apparatus as claimed in claim 2 wherein said means to releasably secure said housing comprises strap means secured at each end in spaced relationship to each other to said housing so as to provide a loop through which a hand may be inserted.

6. An apparatus as claimed in claim 5 wherein said subject response means comprises a microswitch.

7. An apparatus as claimed in claim 5 wherein said vibratory means comprises an electro tactile vibrator

operable at a frequency of between 160 and 200 Hz with a 20-40 Hz band width.

8. A method for assessing sleep behaviour in a human subject, comprising:

(a) subjecting the subject to a vibratory stimulus for a selected period of time at selected spaced intervals of time,

(b) recording the time of each said stimulus and the subject's response or lack thereof to each said stimulus,

(c) recovering stored information; and assessing the subject by comparison of said recovered stored information with known standards of sleep behaviour.

9. A method as claimed in claim 8 wherein said vibratory stimulus is administered at intervals of between 5 and 10 minutes over a period of at least 5 hours.

10. A method as claimed in claim 9 wherein each said stimulus is administered for about 0.5 seconds.

11. A method as claimed in claim 10 wherein said stimulus has a frequency of between 160 and 200 Hz with a band width of about 20-40 Hz.

12. A method as claimed in claim 11 wherein said vibratory stimulus is provided by a hand held vibratory means which also contains a timer means and means to record and store information relating to each said stimulus and each response thereto.

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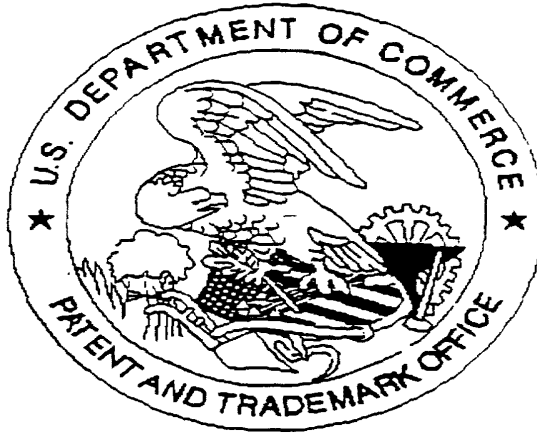
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