The Focus PADT

A Publication for ANSYS Users

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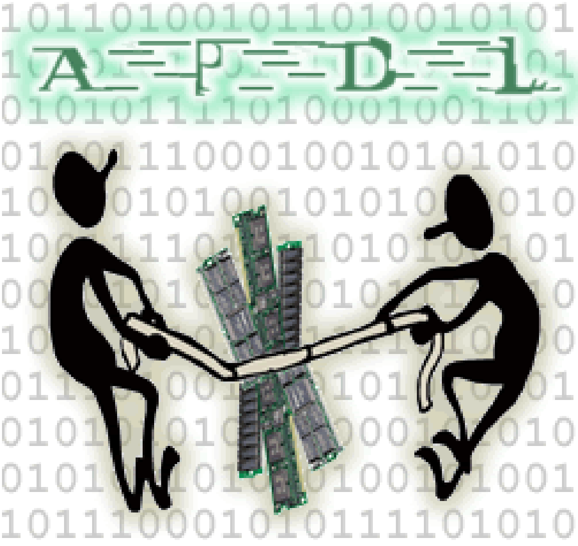

On the Web

Resources

ANSYS Support Distributor

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Reading and Writing ANSYS Binary Files

by Eric Miller, PADT

Many people who conduct more advanced analysis, or who have a need to integrate other software with ANSYS, want to be able to access the large binary files created by ANSYS. Although it may appear daunting at first, this is a pretty simple task as long as you know FORTRAN and you take the time to understand the rather clever file structure used by the ANSYS developers. The most common examples of this are creating your own substructure matrices and reading the ANSYS results file directly from your own program.

When ANSYS writes a data file to disk, it writes it in an IEEE standard binary file format that is compact and very fast to read and write. Almost every binary file written by ANSYS uses the same basic internal structure:

- Main Header. Information about what is in the file.
- Main Index. Pointers to where data is stored in the file
- Section Index. Pointers and content information for a chunk of data.
- Data Blocks. Chunks of data.

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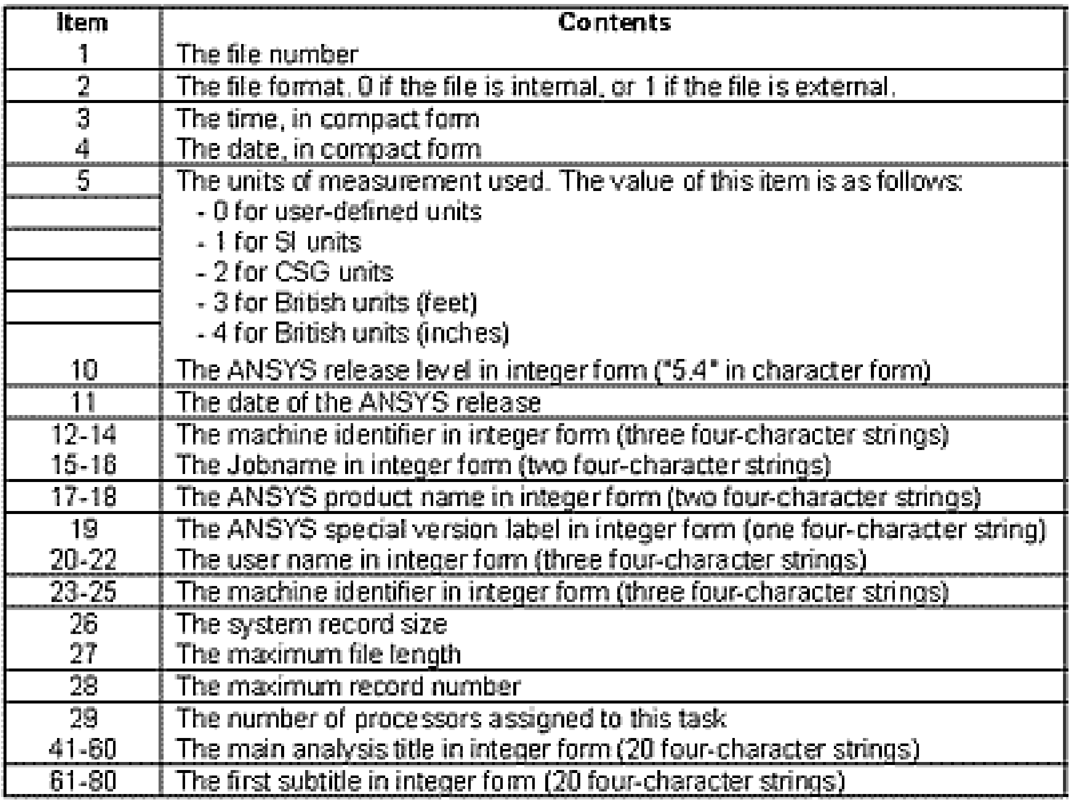

Item	Contents
1	The file number
2	The file format, 0 if the file is internal, or 1 if the file is external.
3	The time, in compact form
4	The date, in compact form
5	The units of measurement used. The value of this item is as follows:
	- 0 for user-defined units
	- 1 for SI units
	- 2 for CSG units
	- 3 for British units (feet)
	- 4 for British units (inches)
10	The ANSYS release level in integer form ("5.4" in character form)
11	The date of the ANSYS release
12-14	The machine identifier in integer form (three four-character strings)
15-16	The Jobname in integer form (two four-character strings)
17-18	The ANSYS product name in integer form (two four-character strings)
19	The ANSYS special version label in integer form (one four-character string)
20-22	The user name in integer form (three four-character strings)
23-25	The machine identifier in integer form (three four-character strings)
26	The system record size
27	The maximum file length
28	The maximum record number
29	The number of processors assigned to this task
41-60	The main analysis title in integer form (20 four-character strings)
61-80	The first subtitle in integer form (20 four-character strings)

Figure 1. Standard file header.

There are, however, two exceptions to this standard format; the result (.RST/.RFL/.RTH) files use a special type of blocking that is more efficient for result data, and the .DB file is not documented at all.

Since the structure is the same, there are FORTRAN subroutines provided by ANSYS to read headers, indices, and the data blocks. The routines do not need to be linked with ANSYS. Instead, you create standalone programs to read and write these files. Users can find the routines and a couple of complete sample programs in the custom/misc directory of the ANSYS install. We recommend:

- **bintrd.f** reads and dumps any file (except .db and .rst)
- **reswr.f** shows how to write your own .rst file
- **rdsubs.f** shows how to read a substructure file

This is also where you can find the BINLIB library file that you link into your program to gain access to the prewritten functions you will need. There is also an example of how to link these routines called rdwrt.bat and rdwrt.lnk.

If the files are not there, make sure that you choose “Custom” when you install ANSYS.

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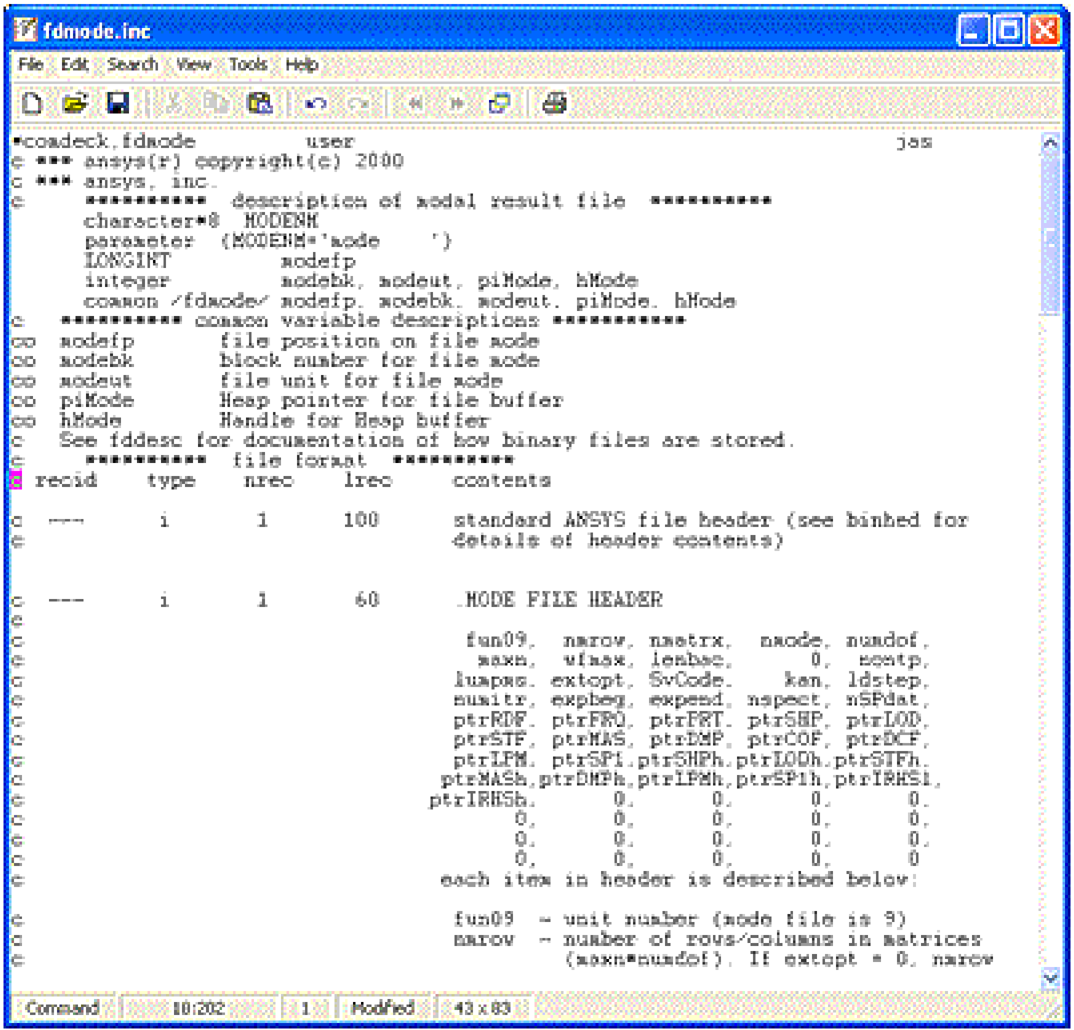

```
*comdeck,fdmode         user                                            jas
c *** ansys(r) copyright(c) 2000
c *** ansys, inc.
c     **********  description of modal result file  **********
      character*8  MODENM
      parameter  (MODENM='mode    ')
      LONGINT          modefp
      integer          modebk, modeut, piMode, hMode
      common /fdmode/ modefp, modebk, modeut, piMode, hMode
c   ********** common variable descriptions ***********
co  modefp       file position on file mode
co  modebk       block number for file mode
co  modeut       file unit for file mode
co  piMode       Heap pointer for file buffer
co  hMode        Handle for Heap buffer
c   See fddesc for documentation of how binary files are stored.
c     **********  file format  **********
c recid    type    nrec    lrec     contents

c  ---      i       1      100      standard ANSYS file header (see binhed for
c                                   details of header contents)


c  ---      i       1       60      .MODE FILE HEADER
c
c                                    fun09,  nmrow, nmatrx,  nmode, numdof,
c                                     maxn,  wfmax, lenbac,      0,  mcntp,
c                                   lumpms, extopt, SvCode,    kan, ldstep,
c                                   numitr, expbeg, expend, nspect, nSPdat,
c                                   ptrRDF, ptrFRQ, ptrPRT, ptrSHP, ptrLOD,
c                                   ptrSTF, ptrMAS, ptrDMP, ptrCOF, ptrDCF,
c                                   ptrLPM, ptrSP1,ptrSHPh,ptrLODh,ptrSTFh,
c                                  ptrMASh,ptrDMPh,ptrLPMh,ptrSP1h,ptrIRHSl,
c                                 ptrIRHSh,      0,      0,      0,      0,
c                                        0,      0,      0,      0,      0,
c                                        0,      0,      0,      0,      0,
c                                        0,      0,      0,      0,      0
c                                  each item in header is described below:

c                                   fun09  - unit number (mode file is 9)
c                                   nmrow  - number of rows/columns in matrices
c                                            (maxn*numdof). If extopt = 0, nmrow
```

Figure 2. File header for mode file.

Once you become familiar with these routines, you need to understand the layout of each particular file. ANSYS, Inc. documents these by giving users access to the same #INCLUDE header files they use to compile ANSYS. These files all have the same fd*.inc naming convention and are located in the custom/include directory. Once you have explored the example programs and understand the standard format, you can use these files to locate the information you need for the file you want to read or write.

As we have supported our customers and our own internal projects that use this capability, we have learned a couple of important lessons:

1. 90% of the time you don’t need to read or write these files. A combination of *vget and *vwrite or /inp and *vput will usually do what you need to do.
2. If you want matrices from ANSYS, use the new HBWRITE command in

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ANSYS 8.0 to create a file in Harwell-Boeing format.

3. Build yourself a very simple 1 or 2 element test model to help debug your code.
4. Beware of models that have elements with more than 3 DOF’s. Things can get tricky.
5. Use /AUX2 to dump out binary files in a readable format to better understand the file structure.

If you are ready to take the plunge, there are a few resources that you can use to make your task easier. The most important is the “ANSYS Programming Guide, Interfacing with ANSYS” manual. It repeats the information you can find in the custom/misc and custom/inc directory with a little bit of explanation. Your next best resource is the XANSYS mailing list at www.xansys.org. The academic community seems to like reading and writing these files, so there is probably something in the archive that can help you. And last, but not least, is your technical support provider. If you are lucky enough to have a Channel Partner supporting you, they usually have experience in this area.

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THE MATRIX®

Trinity: I know what you’ve been doing... why you hardly sleep, why you live alone, and why night after night, you sit by your computer. It’s the question that drives us. It’s the question that brought you here. You know the question, just as I did.

Neo: What languange is the Matrix written in?

Trinity: The answer is out there, Neo, and it’s looking for you, and it will find you if you want it to.

Morpheus: Unfortunately, no one can be … told what language the Matrix is written in … you have to see it for yourself.

Neo: Whoah.…

Morpheus: APDL is everywhere. It is all around us. Even now in this very room. You can see it when you look out your window. Or when you turn on your PC. You can feel it when you go to work. When you go to lunch. When you pay your taxes. It is the wool that has been pulled over your eyes to blind you from the truth.

Neo: What truth?

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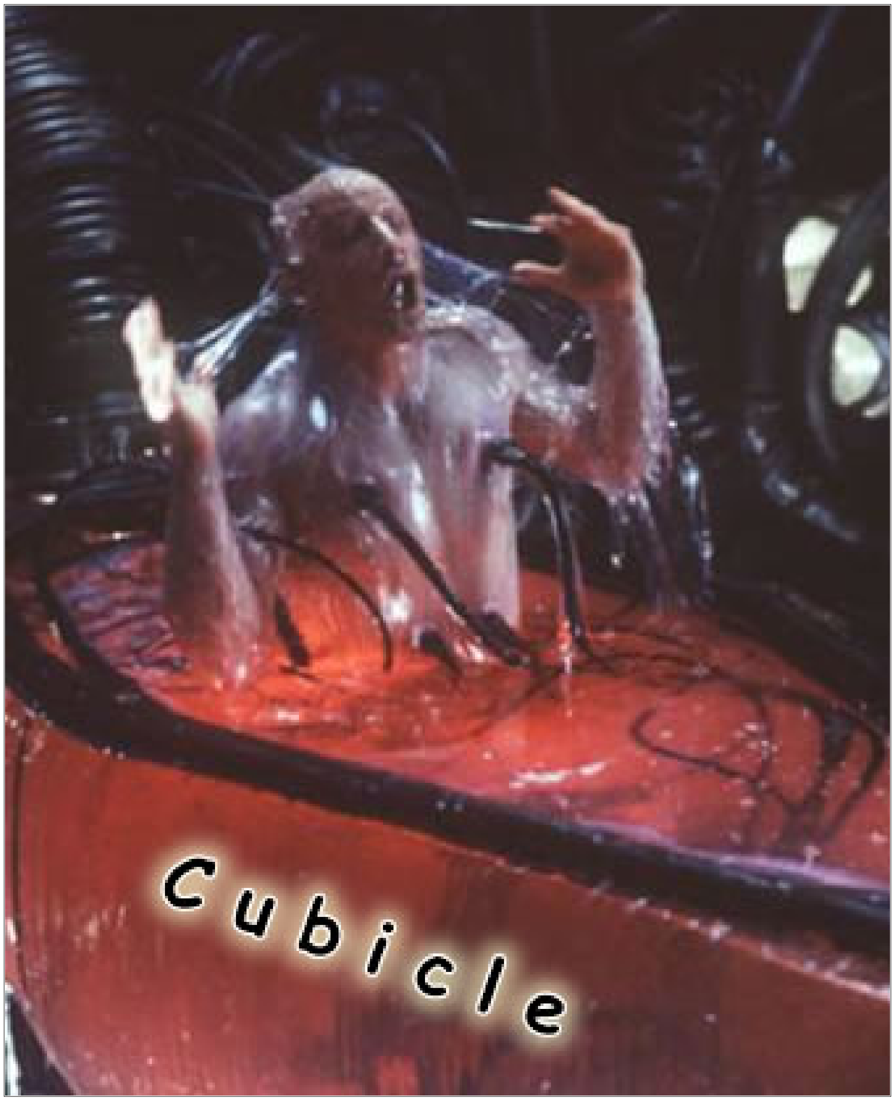
Morpheus: Everything is scripted. Even the commands you use through the GUI.

Cypher: But there’s way too much information to decode all the Matrix. You get used to it. I-I don’t even see the GUI anymore. When I open the log file, all I see is plate-with-hole, bracket, turbine….

Neo:So what is it like when I start using APDL rather than the GUI?

Morpheus: It is like waking up.

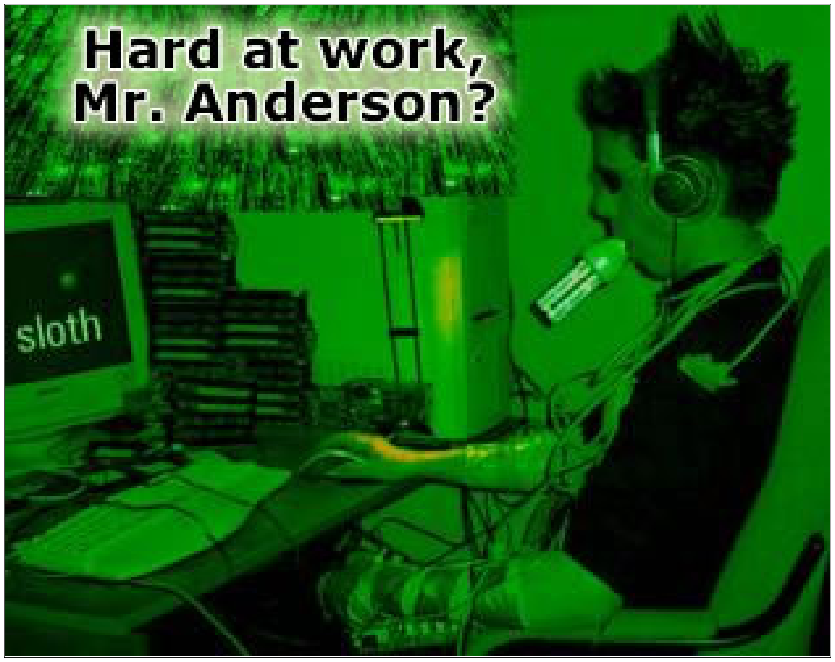


Neo: And my increased productivity will look like what to others?

Morpheus: To those who are also awake you will look like a master.

Neo: What about to those who aren't using APDL. Who don't understand? Like my boss?

Morpheus: Oh. Well to them, you'll look a little different….



Neo: Oh. And to women?

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Morpheus: Well … let’s just say you’ll look really smart.

Neo: Perfect.

PADT encourages you to Enter the Matrix with one of our APDL classes:

- 801. Introduction to APDL
- 802. Advanced APDL and Customization

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I MSAVE’ing Some Memory

by Rod Scholl, PADT

Even as computers grow faster, mesh refinement reuirements also grow. We occasionaly find ourselved butting up against RAM requirements.

The MSAVE command can sometimes help out. In fact, it never hurts to throw in an MSAVE,ON. If ANSYS can use the memory saving feature, it will!

Save 70% of your memory requirement!

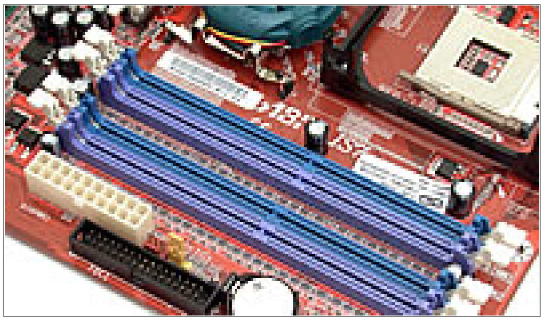
On a test of a square block of 95’s, you need only 30% as much RAM for an analysis!

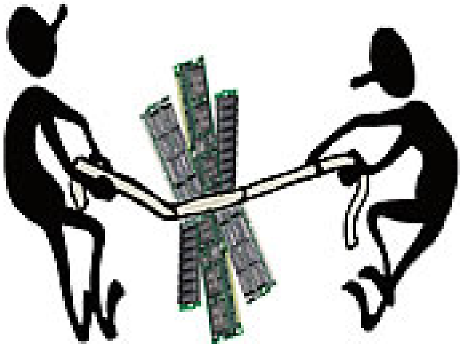
You must meet the following criteria in a static anlaysis:

- NLGEOM,OFF
- Using high-order elements (92, 95, 186, 187)
- No PRSTRS or SSTIF
- PCG solver
- No temperature gradient across each element
- A few rare others (check the manual for details)

For a modal analysis, you must be using the PowerDynamics method. It has its pros and cons which you should look into before using it.

Start adding MSAVE,ON to your analyses!





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Upcoming Training at PADT

A complete schedule of the training courses for the next three months is shown below. Learn more about how the **Training Services** offered by PADT can save you time and money. Or, feel free to drop an e-mail to our training coordinator, Ted Harris!

Month	Start	End	Course	Description	Location
Mar '04	3/8	3/9	203	Dynamics	Tempe, AZ
	3/11	3/12	501	ANSYS/LS-DYNA	Irvine, CA
	3/17	3/19	101	Introduction to ANSYS, Part I	Albuquerque, NM
	3/29	3/30	301	Heat Transfer	Tempe, AZ
Apr '04	4/5	4/7	101	Introduction to ANSYS, Part I	Irvine, CA
	4/19	4/21	101	Introduction to ANSYS, Part I	Albuquerque, NM
	4/21	4/23	201	Basic Structural Nonlinearities	Tempe, AZ
May '04	5/3	5/5	101	Introduction to ANSYS, Part I	Tempe, AZ
	5/6	5/7	102	Introduction to ANSYS, Part II	Tempe, AZ
	5/10	5/11	100	Engineering with Finite Element Analysis	Tempe, AZ
	5/13	5/14	803	Tcl/Tk for ANSYS	Tempe, AZ
	5/19	5/20	203	Dynamics	Tempe, AZ

Whether it s one of our regularly-scheduled classes at our training facility, or a customized class tailored to your specifications and location, you can be assured that the training you receive will have immediate, positive results on your capabilities in design, analysis, and product and process improvement.

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About *The Focus*

The Focus is a periodic electronic publication published by PADT, aimed at the general ANSYS user. The goal of the feature articles is to inform users of the capabilities ANSYS offers and to provide useful tips and hints on using these products more effectively. *The Focus* may be freely redistributed in its entirety. For administrative questions, please contact Rod Scholl at PADT.

The Focus Library

All past issues of *The Focus* are maintained in an online library, which can be searched in a variety of different ways.

Contributor Information

Please don t hesitate to send in a contribution! Articles and information helpful to ANSYS users are very much welcomed and appreciated. We encourage you to send your contributions via e-mail to Rod Scholl.

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