MEMORANDUM FOR FILE

INTRODUCTION

Some of the numerical computing requirements of Bell Labs, particularly with regard to the CRAY-1 and the PORT Mathematical Subroutine Library, are sketched below. Division 37 has a steadily increasing need to develop numerical software, acquire software packages from outside sources, and counsel users in problem formulation, software usage and efficient Fortran programming. In my opinion the workload requires two additional EMTS, one at the specialist level.

The first section below discusses numerical counseling. The next section sums up some of the benefits achieved by the PORT Mathematical Subroutine Library, and leads into the following section which sketches additions to be made to the PORT Library. The final section covers other projects to be done to assist our users.

NUMERICAL COUNSELING

At the moment, numerical analysts in research are carrying a heavy burden of user counseling. Not enough assistance has been available in Division 37 to develop, for general use, many of the numerical packages written by or known to the people in Area 10. From a survey questionnaire I recently sent to PORT users, and from a file of inquiries I maintain, I can see particular needs in minimization, least-squares fitting, partial differential equation solution, special function evaluation, and more. Division 37 should have enough people not only to develop programs from Area 10, but also to investigate and adapt packages (for example ANSYS, the finite element program) from outside sources.

Also, with the advent of the CRAY-1, we will have additional numerical counseling problems having to do with writing Fortran for vectorization, running timing profiles on applications programs, and so on.

SAVINGS FROM PORT

There are 110 users of the PORT Library on the Honeywell computer at Murray Hill. There is no way, currently, to count the users of PORT on other computers and at other sites, but I do get frequent questions from Holmdel. TM 79-3731-9 (December 19, 1979) reports results of a study of PORT Library usage on the Honeywell computer.

Without PORT, these users would have to find one or more subroutines for the problem at hand, try out the routines (perhaps debugging them) and then use them, generally without an expert to go to in case of trouble. In particular, users of medium sized computers would spend a great deal of time with these troubles — and then when the program outgrew the small computer and had to be moved to the larger computer the trouble would start all over again. Using the PORT Library these difficulties do not occur.

Further, if each user had to maintain libraries and keep files and worry about single and double precision versions of each program (as was true until recently), perhaps half of each user's time would be spent in these activities. So, for the 110 Honeywell users alone, PORT may have saved half of their program debugging time.

PORT documentation usually includes an example program which can easily be edited for many user applications — again a saving of time. And, most important of all, the hidden inefficiencies, and indeed errors, that inhabit unproven programs (especially those which users have traditionally copied from ancient numerical-methods textbooks) have been excised by PORT use.

ADDITIONS TO PORT

Below are listed, for the record, the most pressing additions needed for the PORT Library, together with their statuses.

Linear Algebra

Linda Kaufman of Department 1274 has written 190 programs covering broad areas of linear equation solution: general systems, symmetric systems, banded systems, sparse systems, etc. The programming phase is nearing completion, and some 200 pages of documentation have been phototypeset in draft form, but a great many corrections are needed. The current plan is to put the programs and documentation out as a total replacement chapter for PORT. This will require two to three months of work.

Optimization

PORT has no programs in this area, and it is the most needed. Lynn Detwiler (no longer at Bell Labs) and Linda Kaufman have adapted various programs for minimization and least-squares optimization, which should be adjusted for PORT, put in the library and documented. Again a couple of months work.

Partial Differential Equations

As is pointed out in TM 79-3731-9, the people at Bell Labs who were supporting their research with numerical computation of ordinary differential equations a few years ago are now requesting partial differential equation packages. One important way for Division 37 to help here is for us to obtain programs available from outside, particularly from other CRAY-1 sites, and get them installed for use. We have sent for some of these, and work is being carried out in Area 10 in this direction, but to use the CRAY-1 effectively a great deal of effort must be put in this direction.

Partial differential equations probably represent the area of greatest numerical interest at the Labs at present, so that it seems reasonable for the proposed new specialist MTS to be an expert in this area.

Ordinary Differential Equations

The greatest need in ordinary differential equation solution is for a stiff equation solver. Dan Warner (no longer at Bell Labs) wrote such a program, which is being revised by Linda Kaufman. There should be a way for the Computing Technology Division to take over some of the work.

Quadrature

PORT has very good quadrature routines, but lacks one for Fourier integrals, or in general for highly oscillatory functions. There are programs available, and Jim Blue (no longer at Bell Labs) has left a Fourier program that should be studied, tested and installed.

Statistics and Probability

Given a reasonable amount of time, programs for the mean, median, and standard deviation, and programs for generating random variables from various distributions could be put up. The correct and robust methods to use have been investigated and are known. There are requests for these items. Fortunately the random-deviate routines can be based on PORT's portable uniform random-deviate generator, and hence be portable. Usually portability is not possible for random number generators.

Fast Fourier Transforms

Richard Singleton (of SRI International, Menlo Park, California) who wrote the FFT used in PORT (available from the open literature), became intrigued with PORT's dynamic stack capabilities, and adjusted his programs to use the capability. (I had made a try at it and given up, and indeed it took him some time.) He encouraged me to put these in PORT, and we should do so. Larry Rabiner of Department 1227 has a number of useful special purpose FFT routines which could be adapted to call on Singleton's routines, and then be put into PORT. I get many calls on FFTs.

OTHER NUMERICALLY RELATED PROJECTS

HEMP (High Efficiency Matrix Package)

Many people still use HEMP on the Honeywell computer; the first 18 days of October show about 90 file accesses per day to CC/HEMPMAT. Clearly it is worthwhile to move HEMP to the CRAY-1. Since HEMP was written in assembly language, the reasonable approach is to rewrite the top level programs in Fortran, incorporating calls to the linear algebra subroutines in the PORT Library or in the eigenvalue-eigenvector library EISPACK. This project was started by a summer student and has been continued. No error-handling was put in the early version, so the 15 HEMP routines have been rewritten by me. I also wrote testers for them. With the exception of two of the eigenvalue routines, all have been checked out on the CRAY-1 at Kansas City.

Since the top level HEMP Fortran routines now call either on programs in the PORT Library or on routines in the EISPACK package (which is in the public domain), HEMP could be put up easily on any computer having these two libraries.

A new document must now be written to explain how to use HEMP on the CRAY-1 and on the Honeywell computer. (The previous HEMP document is in the Green Books, Vol. IV, and therefore essentially out-of-print.) At least two EMTS months will be required to do the document.

AUGMENT

The AUGMENT preprocessor permits a user to define new data types in a Fortran program, for example multiple-precision. Then, given a library of support programs to perform arithmetic on these data types, AUGMENT will preprocess a user program, analyzing expressions and putting in appropriate calls to the support library. AUGMENT is written in Fortran and is remarkably portable. It is widely used. I have put it up on the Honeywell computer, together with the multiple precision package written by Richard Brent at Australian National Univerisity. This work needs to be documented and announced, and convenient program files must be created. Again a month or so should suffice.

For the CRAY-1 it will be possible to use AUGMENT to change double-precision Fortran programs into single precision. The need is obvious: members of technical staff are already spending time trying to edit programs to single precision. Various people have written programs in QED and other languages for the purpose, but with AUGMENT the function calls to double-precision programs, for example in PORT, can be preprocessed to call the single-precision equivalents. AUGMENT is ideally suited to the purpose and should be easy to use. The "definition deck" for AUGMENT must be written and debugged, and the system must be installed, announced and documented. Three EMTS months might do it.

Special Functions

I have collected information, references and programs for many of the special functions of mathematical and engineering physics. Wayne Fullerton of Los Alamos, who has joined Department 1274, has written several programs in this area. In almost all cases the functional approximations he uses, mainly polynomial or rational approximations, are not portable, but for local use all these programs should be collected on a special library, and documentation should be made available. For some special functions, other types of approximation, such as recurrence relations, which are portable, can be made, and these should be added to the PORT Library. I have started to do some of this work, but estimate two to three EMTS months more are required.

On-line Documentation

Users often request an on-line KWIC-type index. This should include programs in PORT, EISPACK, IMSL, etc., together with information on where fuller documentation can be found, (and which computers have the program installed). Access to the index should be possible, perhaps through the EXPLAIN mechanism, at all Bell Labs sites. Three EMTS months plus a clerk-typist might suffice.

The User Reference Sheets from the PORT manual are based on a few Troff macros. It would be fairly simple to have these available on-line together with a selection mechanism for subsections. Two or three EMTS months are estimated.

Software Announcements

At the moment we are not able to put out the Murray Hill Computer Center Newsletter often enough to help our users learn about new mathematical software. Instead of a separate software bulletin, it would probably be best to obtain enough EMTS help to issue the Newsletter monthly. (A separate memorandum will discuss editorial, clerical and clerk/typist needs.)

Outside Software Acquisition

A great deal of good tested numerical software is now available from various sources: algorithms in the ACM Transactions on Mathematical Software, colleages at universities and research laboratories, and other CRAY-1 locations. Promising software items should be sent for, installed, tested and evaluated, and then, if acceptable, announced with documentation provided. We do not have time to develop it all ourselves.

SUMMARY

The EMTS time required for the projects outlined above sums to:

Project	EMTS Months
Linear Algebra	2 to 3
Optimization	2
HEMP	2
AUGMENT	4
Special Functions	3
KWIC Index	3
On-line Documentation	2 to 3
	18 to 20

Many of the additions to PORT listed on pages 2 and 3 are not included in the above accounting, because they represent ongoing work in improving the PORT Library.

Also not accounted for are numerical counseling which takes one or two hours a day and often much more, and the work involved in evaluating and installing numerical packages from outside sources. Even so, at least a year and a half of work is represented in the above table, totally aside from the time that will be required to learn about and counsel people on the most effective use of the CRAY-1 computer.

Part of the work with the CRAY should be taken up by the specialist MTS whose major work will be in the field of partial differential equations.

CONCLUSION

The incremental amount of person power required to achieve the aims outlined above appears small in comparison with the saving in hours of user and computer time which it could effect.

Phyllis A. Fox

MH-3731-PAF

Copy to:

T. H. Crowley
G. W. Baldwin
W. C. Johnson
Department 3731 Technical Supervisors:
    L. Rosler
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    P. E. Rosenfeld

Proposal for the

MHCC

Murray Hill Consulting Consortium

or

Murray Hill Computer Consultants

AREAS OF EXPERTISE

TROUBLE WITH THE STATUS QUO

COMMON ENVIRONMENT

FINANCIAL SUPPORT

RECOMMENDATION

Suggestions

"Support anachronistically
tied to computer revenue"

points - read recommendation
- area , exp - ask fill in NP Art etc
- increasingly burdened + increasingly unsupported
- not in hw but an valuable "Janus"
  role ✓ research + more

Phyllis Fox

July 6, 1981

AREAS OF EXPERTISE

To list only a few of the areas of expertise we have now and
are developing:

Current

Numerical Analysis including
  PORT and
  other numerical libraries
USL
The CRAY-1
  C
  vectorization

Troff - nroff - sroff - APS-5

Languages: C, Fortran, Ratfor, EFL

UNIX

Common environment ⟨ Fortran Library
                   ⟨ Design of commands

Hardware and networking
  benchmarking | archiving
  monitoring | mass storage
→prism and graphical devices |
  phototypesetting hardware
  hardware configuring

Inchoate
Inchoate and growing

Simulation and modeling

Data bases and querying systems

On-line (i.e. on network) documentation - e.g. news

Expertise we should have

Graphics
  - especially movies on the CRAY-1 - an absolute
    necessity for developing three-dimensional p.d.e.'s
    FR 80 problem
Screen editors

Programming Tools , PFORT, STRUCT, YACC

Electronic mail   p. V

TROUBLE WITH THE STATUS QUO

As the VAX's and other mini's proliferate, we experience more and more "fully separated sites" pulling away from the central computer center.

These sites are often inexperienced and need guidance; often they even ask us questions. Unfortunately there are too many questions and we have to tell them that if they do not have a Honeywell userid, we cannot help them.

But this response is unsatisfactory - it is alienating, and of course they can get a nominal Honeywell id. What happens is that we answer the calls anyhow if possible, and, in some cases, where there is no one else, e.g. the PORT library, we have to field the question.

So we are increasingly burdened and increasingly unsupported.

COMMON ENVIRONMENT

A good start has been made on meeting this need for a centralized source of knowledge, by the Common Environment. And Numerical libraries such as PORT and several others also move easily among the separate sites, presenting problems only in that they inspire users at those sites to call on the computer center for all help.

But this is just a start.

p. 3

FINANCIAL SUPPORT

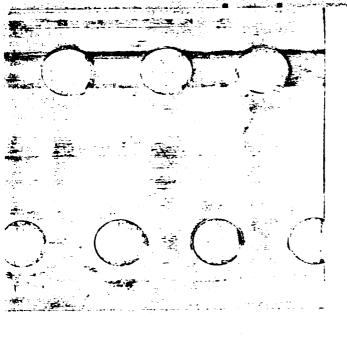Some of the ways to support a central computing consultant group are the following:

1. The current method - which doesn't even support the hardware, much less sufficient staff. (Even poorer places, like universities and England, understand that personnel costs are now running two or three times hardware costs; not the factor of 60% hardware, 40% software-and-support which we now endure.)

2. The idea of charging out consultant's hours, as law firms, etc do, is used various places, but is probably counterproductive and difficult to implement. How does one charge out five different phone calls in one half hour?

3. One could put a "tax" or an installation fee on each new separated site.
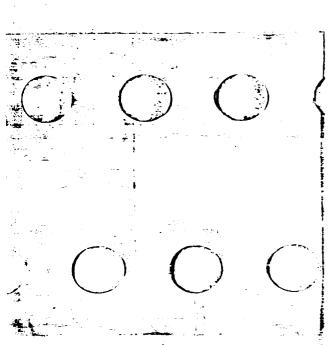
None of these work.

The reasonable, and often-proposed solution, is to make the consulting service a general loading factor like the library. Certain difficulties occur here too: It has been pointed out that if the computing center is put into a corporate budget as a general loading item, it is so large that it automatically gets chopped. However, if a consulting group as such were charged out as a separate item, its salience might be less. Another objection to general loading, is that there is no accountability - the service gets abused. But our consulting group should be strong enough to cope with that.

RECOMMENDATION

The expertise now available in the MHCC should be cherished and encouraged. We have the opportunity to expand and consolidate, for the common good, the considerable knowledge we now have at a central site. From a corporate point of view the alternative is a dilution and ultimate demise of this central source of experience and knowledge as computing spreads out over increasingly naive sites.

p. 4

12/9/81

George,

Many thanks for your encouraging words on my proposal for a Common Computing Department.

Dick McLaughlin and I have discussed the matter a few times, and we have developed a tentative 4-group structure for the department. It is shown on the next page.

In all this I am strongly motivated by the need to get PORT 3 out. I get asked about it often, and in order to document the need I asked the last inquirer, Astfalk of Western, to put his needs in writing. A copy of his letter is attached.

I've also attached the original proposal on the Common Computing Dept.

How about Friday PM or sometime next week to discuss this with you and Walt?

PAF

subject: Proposal for a Common Software Department

MEMORANDUM FOR FILE

1. INTRODUCTION

We propose the formation of a Common Software Department. You may have noticed in a recent issue of Business Week an article on the proliferation of "software stores." (Business Week, December 28, 1981, page 52.) The new department we have in mind would be such a store, furnishing quality software to users within Bell Labs, and perhaps eventually outside.

This proposal is a response to basic changes in the general purpose computing needs of the Bell Labs community. Over the past several years there has been a steady decentralization of general purpose computing. As the costs of minicomputers have gone down and their capabilities have increased, more and more technical organizations have seen advantages in having their own computer system. The economies of scale for general purpose computing that inhibited this in the past are gone. In fact, for many jobs the local minicomputer really is cheaper. The centralized hardware needs of our users have changed dramatically. Economies of scale tend to be restricted to more specialized functions: large number crunchers like the CRAY-1; specialized output devices like the Xerox 9700 or the various graphical and phototypesetting devices; very large, quick access data storage like that provided by the IBM Mass Storage System.

The decline in demand for centralized general purpose hardware parallels a rapid growth in demand for general purpose software to run on the locally owned systems. Much of the effort going into such software support is on UNIX*, and therein lies a problem. The "other half" of the computing world is not keeping pace. The UNIX tools are either not available on the larger systems or are becoming available too slowly to provide significant common capabilities. To be an effective purveyor of the centralized services our

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* UNIX is a trademark of Bell Laboratories.

Bell Laboratories

subject: Proposal for a Common Software Department

date: February 8, 1982

from: P. A. Fox
MH 45231
x4747

C. D. McLaughlin
WH 45225
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MEMORANDUM FOR FILE

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users need, we have to assure substantial commonality between our centralized systems and the locally owned systems through software that runs both on our systems and theirs. Division 451 will sell UNIX systems whether our systems are compatible or not. If they are not, we will be the loser.

Of course, the benefits of common software go beyond simply keeping our users tied in with us. All of the benefits of increased technical interchange, personnel portability, reduced training needs, and others identified by the Task Force on a Common Environment for Computer Users back in 1979 apply as well. Furthermore, there is every reason to think that a rich set of common software which provides the same functional capabilities in a variety of hardware and operating system settings would be a highly marketable package.

The proposed Common Software Department addresses the problems associated with the implementation, maintenance and development of software for use on more than one type of system. The current scattering of responsibilities for such common software throughout the division causes us to use our staff inefficiently. Moreover, the staff we have assigned now is barely enough to maintain existing software. There is little or no capacity for new software development.

The proposed department would permit more effective coordination of common software work by concentrating it into four supervisory groups. Initial staffing would be primarily from the Common Environment and Languages Group at Whippany, along with selected individuals from the Whippany and Murray Hill Computer Centers. The department could start small and build gradually through new hires over several years.

Given a charter and resources, the new Common Software Department will create, develop and maintain portable software products for internal use and possible external sale.

The next section highlights the common software problems addressed by this new department and the progress towards resolving them to date. Section 3 then describes the new department, first in terms of the groups, then in terms of the products and services to be provided. Estimates of staffing needs are included as well. Section 4 discusses possible methods for funding. Finally, for ease of reference, the appendix summarizes projects and staffing needs.

2. ACHIEVEMENTS TO DATE - AND THE PROBLEMS

Some work has already been done by individuals or isolated groups to move towards software commonality, but much remains to be done. Close coordination and cooperation will be essential to realize the full potential of this approach.

2.1 The Common Environment

The Common Environment and Languages Group was formed in March 1980, to begin building common portable software. The efforts of the group have already resulted in a common set of tools for FORTRAN-based programmers, documented in a common user manual. A stockroom for software is being built to consolidate and control the maintenance of new software as it is added to the common environment. This effort started with a small staff, and it has not grown. As a result, the group will soon be devoted entirely to maintenance and administration of existing software.

The portable C compiler is a key element in the future of the Common Computing Environment. Today, however, the machine-independent portion of this compiler, which controls the language definition and constrains the compiler implementor, is the responsibility of Division 451. The special priorities of Division 451 do not include a robust, portable C compiler. If anything, they have tended to move in the opposite direction, towards a C compiler tailored to their specific needs.

2.2 PORT

The second edition of the PORT Mathematical Subroutine Library was produced in 1976. It is released for licensing by Western.

PORT is in use at some 120 sites outside of Bell Labs, mainly educational, and it is up on computers at various government laboratories such as the National Center for Atmospheric Research and the Magnetic Fusion Center at Livermore. Since there are only three major general-purpose numerical libraries available, and one of these is PORT, it is quite well-known as Bell Labs entry in the field. (The other two libraries, both much larger, are the IMSL library from Texas, and the NAG library headquartered in Great Britain.)

We are often asked when the new and larger version of PORT will appear; these questions come both from outside the labs and within. Unfortunately the resources to carry out such a substantial endeavor have not been available.

2.3 TROFF/NROFF/SROFF

Important developments in our text-formating software are going on. Brian Kernighan has entirely rewritten the phototypesetting program TROFF as a new portable package. Software to permit the use of typesetter simulators such as the IMAGEN printer is being developed in research and elsewhere. The simplified text processor SROFF is showing promise of great efficiencies (factors of 10 to 15 over NROFF) for use on appropriate devices such as the Xerox 9700 printer.

Despite these promising beginnings, there is no group targeted to complete the development, distribution and maintenance of this important group of homeless packages.

3. THE NEW DEPARTMENT

3.1 Supervisory Groups

We propose four groups within the new department:

    Languages Group
    Numerical and Statistical Tools Group
    TROFF/NROFF/SROFF Group
    Applied Research Group

The activities and staffing of each group are outlined below.

3.1.1 <u>Languages Group</u> This group will have responsibility for the machine-independent portion of the portable C compiler for all instances of that compiler in Bell Laboratories. Work on this portion of the C compiler, since it affects people outside Division 452, could be coordinated through a company-wide user group, possibly having representatives from other interested organizations. A common C library will be defined and implemented by the group, and both the library and the compiler will be maintained by them.

The next effort of the group will include a common interactive debugging system for C, and the support responsibility for language-related tools such as YACC, LEX, LINT, C-FLOW, etc.

This group will initially be staffed with four EMTS currently involved in C compiler maintenance, and could grow to six or more EMTS as the work expands.

3.1.2 <u>Numerical and Statistical Tools Group</u> Currently a great deal of uncoordinated work on numerical/statistical libraries is taking place within Bell Labs. The PORT library is in wide use, but users are asking for more programs and capability. The statistical interactive language S is very popular, but needs a much enlarged portable library to act as its foundation. A small group in statistical research is facing the task of creating such a large portable statistical library, and in the process is finding they are duplicating much of the work and many of the programs already available in the PORT library. Finally, in research, convenient simplified user-interface languages for computation are under development.

The solution to this diversity is obvious - especially since users often want both statistical and numerical programs in the same computation. One combined, portable, complete library containing both statistics and numerical algorithms must be developed. Such a library could be invoked by Fortran programs, Ratfor programs, EFL programs, or by the S interface language. And the library would present a solid computational basis on which the various other interface languages such as NIMBLE or GROVE or PINE could build.

Development of the library would be the primary task of the numerical group, but this group should also serve as a centralized advisory and numerical counseling group, able to help users find and acquire special purpose numerical programs or libraries.

Finally, the group should develop an expertise in the new types of hardware beginning to appear such as vector processors, array processors (such as Floating Point Systems), parallel and multi-processor environments, so that new directions of computation and algorithm selection can be tracked.

The group should be staffed initially by five MTS, one AMTS, and 1 STA or clerk, and will have to grow in parallel with demand.

3.1.3 TROFF/NROFF/SROFF Group The initial responsibility of this group will be the support of the new TROFF program, including the PIC and IDEAL processors, and EQN and TBL. This effort will be followed by a study of SROFF: developing and maintaining a portable version, working out a well-designed set of MM (and other) macro packages that can be mimicked in SROFF, and ascertaining the efficiencies of replacing NROFF with SROFF on various output devices.

Various phototypesetting simulators, such as the IMAGEN printer, should be studied by this group, both from a hardware and software feasibility point of view.

Two EMTS and one MAG should be the starting complement for the group.

3.1.4 Applied Research Group The Applied Research Group will serve as a bridge between computing research (within or outside Bell Laboratories) and users. The group should have a broad charter to investigate new languages and tools that might be candidates for department support. An advisory committee made up of representatives from major user groups might be set up to determine best directions for study.

Initially, the group will focus on the FORTRAN language community. The EFL compiler development could continue here on a provisional basis. At the same time, this group would assess the FORTRAN 77 compilers and come up with a recommendation for the best common adaptation.

There are a number of other areas where this kind of applied research effort might benefit our users. A common virtual file system, a flexible and powerful access system for using other computers on the BLN, or a common "shell" program are among the research-like projects where effort within this group might have a high payoff. The work in this group should be sufficiently forward-looking to appeal to new PhDs in computer science.

The group should start out with four EMTS from our current organization. As the work progresses, the majority of the staff should come from new hires, allowing us to bring in fresh ideas and set the direction of the work according to the abilities of the staff. The level of long range effort should be allowed to grow gradually in order to maintain a reasonable balance with the development effort.

3.2 Products and Services

3.2.1 Software Distribution, Documentation, and User Counseling As software products are developed by the four groups, they must be distributed to the increasingly scattered user community. A good start on procedures for distribution has been made by members of the common environment, but the job is a large one. At present users often do not know where to obtain software that they know exists. One approach might be a coordinated effort with the Computing Information Libraries - especially if we envision our products eventually being sent outside the labs.

All of our products must be clearly and completely documented and backed up by counseling. The present organizational structure seems to lead to random incomplete information dissemination. The new department will present a central knowledgeable source from which users can obtain advice on the best computer to use for a given computational need and on the best program languages and packages.

We presently have considerable duplication of documentation effort: many sites are producing machine-dependent documentation at considerable cost in dollars and EMTS time. Further, the outpouring of documents burdens both the users and the Computing Information Libraries. The ability of the new Common Software Department to select the best portable software and then document it cleanly and economically should improve efficiency - and save a lot of money.

4. COMMON SOFTWARE FUNDING

The current method of funding software development no longer works. The financial base in the large computer centers which made software development possible is anachronistically tied to computer revenues and has left with the very users who are now demanding software help.

Software stores sell software packages. We could consider some internal accounting analog of this procedure to support the new department, but aside from the immense bookkeeping task, this method has a fundamental contradiction as a startup procedure because it will not pay for the heavy maintenance job we already have, and certainly will not give us funds for software yet to be developed - one cannot sell such stuff on spec.

Moreover, software charges, if they represented the sole support of the new department would have to be loaded to cover maintenance, documentation, counseling, etc. (Some computing sites charge separately for counseling on an hourly basis, like law firms, but that approach surely adds an unnecessary burden.)

Another possibility is to charge for software on a per-use basis, assuming the userid, and hence charging case, of the user can be captured. However, with the pervasiveness of the network that is expected, many problems would occur with this approach.

Realistically, the kinds of products and services to be offered by the new department are the software analog of the services offered by the Technical Libraries - indeed it seems likely that the two types of services will converge as technology advances. For this reason we propose that the most appropriate way to fund the department is on a general service case, spreading costs across all of Bell Laboratories. If the evolution of the new department and its products later suggests that other forms of financing are more valid, the matter could be restudied.

5.   SUMMARY AND RECOMMENDATION

Bell Labs needs a "software store" in the form of a new <u>Common Software Department</u>. The new department would provide solid central support for quality, portable software. It would be a central place for users to go for help and advice. The department could do effective planning for user needs across the labs, and prevent the duplication of effort that is seen today. Moreover, software products developed by the department should prove attractive to outside markets.

                                        P. A. Fox

                                        C. D. McLaughlin

Copy to
R. E. Archer, Jr.
G. L. Baldwin
W. C. Johnson
W. C. Ridgway, III

APPENDIX

COMMON SOFTWARE DEPARTMENT

Summary of proposed products and staffing needs

For each of the supervisory groups in the new Common Software Department, we include here an account of the current products needing support within the group, a projection of proposed projects, both short range and longer view, and finally an estimate of staffing needs. The staff estimates shown in parentheses after the group title consider only people who are currently in Division 452 at Whippany or Murray Hill and who might reasonably be expected to move into this new department.

Language Group (3 EMTS)

   1. Upgrade the IBM versions of the Portable C Compiler to remove base register limitations

   2. Revise the machine-independent part of the Portable C Compiler to

           - permit global optimization

           - extend portability

           - improve user diagnostics

   3. Implement a Common C Library

   4. Implement a Portable C Debugger

   5. Maintain and enhance the package of C-related software design tools

           - yacc

           - lint

           - lex

No supervisor could be identified in Division 452 for this group, but should the shift in responsibility for the Portable C Compiler from Division 451 take place, a lateral supervisory shift from that division might be appropriate. The staff of this group should grow over two years to 6 EMTS.

Numerical and Statistical Tools Group (1 EMTS + supervisor)

1. Combine PORT and a statistical library into a single portable statistical/numerical program library

    - incorporate new error handling

    - incorporate new stack mechanism

    - select and make portable an appropriate set of statistical programs

    - install new linear algebra programs (about 200)

    - develop and adapt further numerical programs (especially optimization, stiff de's, pde's)

    - develop test programs for entire library

    - write a new introductory chapter for each section

    - user documentation for the entire library (building on PORT 2 and other extant documentation)

2. Other numerical work

    - numerical and statistical counseling

    - acquiring, testing, studying and maintaining new special-purpose program packages and libraries

    - particular study of pde codes

3. Relationship of new hardware to numerical algorithms

    - vectorization

    - array processors

    - parallel and multi-processor environments

4. Numerical aspects (especially pde's) of integrated circuit design

Initial staff could be augmented by up to 2 EMTS from outside Division 452 if people doing related work at Murray Hill could be transfered into this group. Staff should further grow over two years to 6 to 7 EMTS.

TROFF/NROFF/SROFF Group (3 EMTS + 1 MAG + supervisor)

1. Distribute and support new TROFF (including EQN, TBL, PIC, IDEAL) and provide counseling

2. Final development and support for SROFF (including new MM macro package) and provide counseling

3. Coordinate documentation for new Common Software Department

4. Take over from research new TROFF simulator programs

5. Track future text processing research - especially increased capability in melding text and graphical output.

The staff of this group should grow over two years by 1 MTS and 1 MAG. and 2 clerks.

Applied Research Group (3 EMTS + supervisor)

1. Complete the EFL version of the EFL compiler.

2. Develop and implement a transition plan to FORTRAN77 for all general purpose machines.

3. Investigate tools for EFL programming support

    - interprogram reference checker

    - portable debugger

    - structurer for converting from FORTRAN to EFL

4. Examine possible common environment extensions

    - common "shell" program

    - virtual file system

    - language driven editors

    - new high-level languages

The staff of this group should grow by 1 to 2 EMTS over two years.

Common Computing Department - Groups

Phyllis Fox   December 9, 1981

McLaughlin and I propose a four-group department:

1. C language group charged with a portable, supportable and supported C
    compiler, along with related tools (c library, debuggers, etc.)

2. PORT 3 and Numerical Group.   (I won't put all the details here, but to
    get anywhere this group will need at least 2-3 MTS + 1 AMTS + 1 STA or
    clerk.)

3. Planning group.
       EFL and Tools (EFL is put here, rather than with C above, for
          political reasons.)
       Other languages
       Software tools in general
       Design of commands
       (Screen editors)
       (Graphics planning - see below)

4. Troff, Nroff, Sroff group charged with the new portable troff,
    including tbl, eqn, pic, ideal, and with developing a portable
    sroff.
    Planned development of macro packages applicable to both
    troff and sroff is important here.
    Counseling.

Graphics needs, somewhere, a strong effort to blend and rationalize EID,
(DISSPLA), interactive graphics, color, movies, incorporation of graphs in-
to troff, etc. But, ambitious as we are, this seems too much at the moment
so we dumped it in the planning group above.

subject: Ten-Year Computing Plan

date: March 22, 1982

from: P. A. Fox
MH 45231
2D-235 4747

R. E. Archer:

Looking ahead (ten years is a *long* time!) to the future of Division 452's Computing Departments, I'll mention a couple of aspects of the software side of things.

At the present time, to help our users, we either write software or develop software originating in Computing Research. In the latter role we are an essential conduit, one hesitates to say `pipe`, bringing new ideas from research to our users at large. But, for some time it has worried me that our ties to research and the work going on there have become increasingly tenuous. We have to try, now and in the future, to strengthen those ties and maintain a close relationship to the work in research, not only to channel it to our users, but also to present challenging development work that will attract and keep people of high caliber.

The second problem affecting the future of the Division's software effort is that our software products are needed by an expanding technical environment moving out to all levels of computers (and taking away our support dollars with them). To help this distributed set of Bell Labs computer users with their software needs, Dick McLaughlin and I have proposed, as you know, the establishment of a Common Software Department. We are convinced that a consolidation of effort would accelerate our efforts at creating a common computing environment, and would result in substantial savings – of people, computing cycles, and indeed dollars.

MH-45231-PAF-   P. A. Fox

subject: MHCC Software Acquisitions

date: February 7, 1983

from: Phyllis Fox
MH 45266
2D-235 x4747

The Murray Hill Computer Center has a problem with software acquisition that I'd like to illustrate with a one-paragraph case study:

I've been getting more and more inquiries about programs for symbolic calculation. Users want to find a derivative symbolically, or expand series, or do symbolic integrations. They are becoming aware of the very powerful tools now available to help them with their calculations. Of the several packages available for this purpose, such as REDUCE, SMP, or VAXIMA, probably VAXIMA, which was developed at MIT as MAXSYMA in connection with the ARPA net, is best for our environment. It has a license fee of $15,000. (The fee for SMP is $40,000.) We cannot make a case to install VAXIMA on the computer center computers because we cannot prove "cost effectiveness." Therefore the people in research, specifically Depts. 1121 and 1127, needing such tools, have no option but to acquire VAXIMA for their own computer. Since these departments have limited computing capacity, they cannot let everyone use VAXIMA on their system, so others, such as physicists, will have to get their own license (perhaps at a 25% reduction for a second license).

The people in 1121 and 1127 aren't eager to do this; they would really prefer to have us acquire, install and maintain a generally available copy of VAXIMA. And they don't like refusing access to users, but will have to.

Now when users call me to ask about such tools, shall I lie and say Bell doesn't have them, or tell them we do but they can't use them?

Consider, as an analogue, the library. Suppose the library was allowed only to stock books on simple arithmetic, because more advanced texts and journals weren't "cost effective" – (can one prove they are?). Surely the company would have to provide funds to individual departments for necessary sources and references. Imagine the redundancy and the cumulative cost!

No matter if we do research or development or marketing, in this era we must have the best computer tools generally available.

Phyllis Fox

Phyllis Fox

MH-45266-PAF-paf