Proposal for Research No. ISU 73-128

Proposal for Research No. ISU 73-128

Proposal for Research No. ISU 73-128

NETWORK INFORMATION CENTER AND AUGMENTED KNOWLEDGE WORKSHOP DEVELOPMENT

PART ONE--TECHNICAL PROPOSAL

Organization of this Proposal 1

This proposal is divided into two parts, each of which is broken down into several sections. 1a

Part One is the Technical Proposal covering the proposed work --its background, context, and estimate of level of support for each proposed area of effort. 1a1

Section I is the introduction. 1a1a

Section II is an overview of proposed project activity. 1a1b

Section III is a summary outline of proposed project activity and funding allocation with references to appropriate appendices. 1a1c

Section IV lists references and selected publications. 1a1d

Section V contains supporting documents as appendices. 1a1e

Part Two contains the Contractual Provisions, with sections covering such topics as estimated time and charges, reports, contract form, acceptance period, and a cost estimate with supporting schedules. 1a2

I INTRODUCTION 2

General 2a

This proposal outlines at a number of levels the research, development, application, and technology transfer program that the Augmentation Research Center (ARC) of Stanford Research Institute plans to continue pursuing. 2a1

This proposal is a consistent extension of the work being carried out as described in the Institute's 1971 proposal (7404,), under current Contract No F30602-72-C-0313. ARC has established the framework, as planned, for developing and delivering prototype evolutionary information services to ARPANET clientele, is organizing an operational Utility

Service, and has begun to enlist paying subscribers to that Service. 2a2

ARC's research and development strategy is based on a number of propositions, two important ones being: 2a3

1) Advanced information systems are for users and their evolution must include concurrent involvement of users based on serious application effort. 2a3a

2) Research and development in the area of Knowledge Workshop systems is a long-term effort that will require the collaboration of many groups with a variety of disciplines and backgrounds. 2a3b

Within a framework based on these propositions, described further in Appendices A, B, C, ARC proposes to organize its work under three main headings, 2a4

Application Systems, 2a4a

Workshop Subsystems, 2a4b

and Basic Workshop System Structure. 2a4c

Background 2b

There is a growing need to enhance the effectiveness of the increasing numbers of people at all levels: clerical, engineering, scientific, executive, whose prime economic function is to work with information in one form or another. The need is both to provide new approaches to help people better deal with the growing interconnectedness and complexity of the problems facing them and to help increase their productivity. In Appendix A, "The Augmented Knowledge Workshop," the term Knowledgeworker and the concept of the Knowledge Workshop (workshop) are developed as an approach to meet this need which ARC is committing itself to pursue over the years ahead. 2b1

As mentioned above, it is a basic premise of ARC's development strategy that the Knowledge Workshop System can be developed only in an environment of usage by people doing their real everyday work and feeding back their experience into the evolutionary development process through formal analysis and informal comments and suggestion. Until recently the users were the system developers themselves. This approach proved very useful but limits the types of function and working environment for recognizing needs and gaining usage experience. Therefore, the next step was to provide a capability to market and deliver Knowledge Workshop services to a wider range of groups who want to participate as users and developers of a workshop system. We are meeting this need by setting up a "Workshop Utility Service," as described in Appendix B. 2b2

There are two general classes of user groups toward which support is being oriented: single coherent organizations (called Offices for short), and mission- or discipline-oriented groups (called Communities for short) whose members' prime affiliations are with different organizations. Examples of the first category would be government, industry, research institute or university organizations. Examples of the latter would be a distributed group of researchers and developers working on the same problem domain, such as cancer, or representatives of many organizations working on a particular problem in the energy or environmental areas. 2b3

Although many of the workshop support functions needed by each of these two classes are shared in common, their profile of needs, their organizational and financing problems, and their methodology for use of functions are sufficiently different that it is useful to maintain the distinction. 2b4

The workshop system envisioned must be designed in a coherent

way at many levels with consideration given to tools and technology, methodology of use, training, and organization. Such an effort is expected to require many hundreds, possibly thousands, of man-years of coordinated effort by people from many disciplines and backgrounds, e.g. hardware, software, operations research, psychology, management science, etc. 2b5

There is no way that a single organization such as ARC is likely to have the wisdom, range of capabilities, and financial backing necessary to achieve the goal by itself. 2b6

Although, as pointed out in Appendix A, developments in the area of computer application systems show a trend toward the evolution of workshop systems, this evolution is more implicit than explicit. ARC's goal is to make workshop system evolution explicit. 2b7

A strategy that ARC believes has the greatest probability of creating a truly coherent, coordinated workshop system in the most economic and explicit fashion is the formation of an interdisciplinary community made up of user representatives and developers who want to create and experiment with the usage of such a workshop. Because of the usage, analysis-feedback, and development nature of such a community, ARC has been calling it a "bootstrap community" (BC) in its planning and writing. 2b8

An attempt to create and sustain a healthy BC is a significant experiment that will yield much useful experience for other large interdisciplinary efforts that are required to meet many important social needs. To get to a place where there was an early prototype workshop that could 2b9

1) be demonstrated and used by others, 2b9a

2) serve to create further interest in the concept of the Knowledge Workshop, and 2b9b

3) provide a beginning focus for the formation of a BC, 2b9c

has been a central motivating factor for the work at ARC during the past ten years. The sections to follow in this proposal describe areas of support that we feel are necessary to meet the needs of ARPA applications and contribute to capabilities essential for the early creation of a BC. 2b10

The Augmentation Research Center 2c

ARC is an organization of researchers, supported by several different contracts, in which the research activity is aimed at exploring the possibilities for enhancing the performance of intellectual work of individuals and groups with the help of real-time computer aids and for actual experimental development of computer-based "augmentation" systems. 2c1

Several coordinated research activities have been developed, sponsored by different contracts, to pursue the various aspects of this augmentation research. Important aspects include the following: 2c2

1) Development and operational use of software features and methodology for a computer-supported augmentation system, as further described in Appendix A, 2c2a

2) Development, operation, and maintenance of a real-time computer-display facility, 2c2b

3) Development and operation of the ARPA Network Information Center (NIC). 2c2c

The researchers within ARC do as much of their work as possible at display and typewriter consoles (depending on console availability and whether or not a specific task can appropriately be done at a console). Thus they serve not only as researchers but also as the subjects for the analysis and evaluation of the augmentation systems they are developing. 2c3

Consequently, an important aspect of the augmentation work done within ARC is that the techniques being explored are implemented, studied, and evaluated with the advantage of intensive everyday usage within a coordinated working environment compatible with the particular techniques being studied. 2c4

ARC is organized into three main groupings: Development, Analysis, and Operations. ARC visualizes the system evolution process as a closed-loop feedback process in which needs are analyzed; tools, methodology, training etc. are developed to meet these needs; operational services are provided; and finally the fit between the services provided and needs to be met is evaluated in actual operation, thus starting a new cycle. The resulting whole yields a healthy research and development framework. 2c5

Development and Analysis are presently carried on principally

within ARC, but a shift is planned toward other groups collaboratively contributing in these areas, some from the information-system R&D community (when it can be established that mutual collaboration within a common, applications-oriented system-evolution environment provides higher payoff than otherwise). 2c6

Operations supplies all of the Knowledge Workshop services, both to internal ARC users, and via the Workshop Utility to external-application clientele. If an application client itself is serving users, our Operations could, with appropriate funding, supply all with computer services, but would encourage the client to build its own staff to provide any people support services needed, and this staff would be supported by Operation's people services (training, analysis/development consultation, etc). 2c7

Knowledge Workshop Operation, Development, and Analysis Funding Framework 2d

We expect, as mentioned above, that workshops will evolve by the collaboration of a number of groups, several of which might be funded by ARPA under an Office Automation program or other programs, and that some groups will be funded in different aspects by more than one organization or agency. The ARC funding plan consists of a number of key pieces. 2d1

The central piece, represented by this proposal, is for "Base-Project" support. 2d2

Another key piece is the associated proposal ISU-73-5 (14946,) (previously submitted) for support of operational prototype services from a Workshop Utility to "end" application users; a copy of this proposal is included as Appendix B. 2d3

ARC hopes to have a range of subscribers of the Utility services who: 2d3a

1) Accept the fact that they are participating in a large system development experiment, i.e., understand that the system will not be static, but will change and grow in value. (Much care will be taken, however, to assure reliability and stable change.) 2d3b

2) Pursue activiites that either a) add to the techniques and capabilities that will subsequently be available to other participants or that b) help other people learn about and obtain this kind of service and to participate in the bootstrapping process. 2d3c

This strategy seems useful from ARPA's point of view in that participants, among others, will be DoD organizations thus aiding in the transfer of ARPA sponsored technology. 2d3d

ARC also plans to obtain other funding pieces to add to the Base-Project support, thus enabling both additional developments and provision of special assistance to sponsoring user organizations. This approach is also advantageous to ARPA as it gives additional leverage and acknowledgement of ARPA support. 2d4

II OVERVIEW OF PROPOSED PROJECT ACTIVITY 3

Introduction 3a

The effort covered by this proposal for a Base-Project contract will go toward: 3a1

1) A restructuring of what is now the Network Information Center into two parts: 3a1a

One part to keep the name Network Information Center (NIC) to provide a limited core set of general network-wide services necessary for a basic healthy resource sharing network. The NIC would obtain funding from this Base-Project and subscription arrangements with the non-ARPA supported sites; 3a1a1

A second part to be renamed ARPA-IPT Community Information Service (ACIS) to move toward emphasis on providing advanced information support services to designated ARPA-IPT sponsored special interest groups and research program communities. 3a1a2

2) A balanced program of development and analysis of Knowledge Workshop Systems at three main levels: applications, workshop subsystems, and basic workshop system structure. 3a1b

3) Operational support of the ARC R&D effort. 3a1c

Analysis

3b

A few explicit words about the Analysis function are useful at this point. A more detailed discussion is contained in Appendix E. Analysis is a relatively new formally organized function at ARC, although its need has been recognized for many years. The function of Analysis has been performed during the lifetime of ARC, but it has been less formal and more implicit. The goal now is to make analysis explicit and more formal. The Analysis function needs to operate at all levels of system evolution from applications down to basic system architecture. Analysis provides capabilities in application needs determination, system evaluation, economics (cost benefit studies), and other areas.

3b1

The development of analytic tools and methodology for workshop systems and many of the results of studies performed in areas of the workshop usage environment and system performance are very important research results in and of themselves as well as being useful support for the evolution of workshop tools and methodology.

3b2

If large scale system evolution and the smooth incorporation of these systems into society are to increase in effectiveness and move more toward the "science" end of the "art-science" spectrum, increasing attention must be given to healthy support of the Analytic function. A two-person group is below critcal mass. It is for these reasons that ARC is proposing increasing the size of its present Analysis group during the coming contract period.

3b3

Applications 3c

Introduction 3c1

The needs of applications will help set priorities and goals within the constraint of analysis and development of a coherent Knowledge Workshop. Within the Base-Project being proposed here, the following applications will be supported as described. 3c1a

Community Applications 3c2

ARC plans to encourage communities that can benefit from the use of workshop technology to become users of the Workshop Utility and associated information services. Appendix C contains a background discussion of the types of services that can and could be offered to help increase the effectiveness of geographically distributed collaborating groups. 3c2a

ARC visualizes the following scheme by which the types of information services described in Appendix C will be delivered to a community. Associated with each community there will be an information Center or service (possibly one Center serving several communities, but for simplification consider a one-to-one relationship). 3c2b

A governing body made up of community members will oversee the development, operation, and financing of the Center. This Center could be specially set up by the community or the community's sponsor(s) as an independent corporate entity or contracts could be let to establish the Center within some other appropriate organization. 3c2c

Associated with each Community/Information Center pair would be a person playing the role of information service (workshop) architect whose role is to understand and match the community's needs with the possible services that could be offered by the Center. There would be a computer-based support system (Workshop Utility) for each Center, supplying services directly to its community members and the Center staff. Community members would also receive support from people in their Center. 3c2d

Behind a group [community) of community information centers would be another Center performing R&D into new and improved types of community information services. These prototype services would be available to the staffs of the information centers for trial usage from a Prototype Workshop Utility.

Technical support for the architects and community of architects would also be available. Direct or indirect transfer of these services to end community users would be offered by the individual information centers if deemed appropriate. 3c2e

In other words, there are several key roles, community information center, community architect, community computer (Workshop Utility) support, and ongoing workshop R&D. 3c2f

The Base-Project covered by this proposal will support all the above roles in a designated (by ARPA) set of ARPA-IPT contractor special interest groups. In the future it might be appropriate for one or more of the above roles to move outside of ARC. 3c2g

Evolution of the Present Network Information Center 3c2h

The Network Information Center (NIC) was originally created to develop and provide information services in support of a small number of research sites involved in network development and use. The NIC has performed that function and has struggled to provide its services to a rapidly expanding network community consisting of new sites as well as people interested in ARPANET technology but not actually connected to the network. This NIC clientele is in the United States and some foreign countries. 3c2h1

The size of the network and its projected growth have probably exceeded the resources which ARPA should invest in operational NIC support for the entire ARPANET community. There is, however, a continuing and growing need for certain aspects of the services provided by the present NIC to the general network community. There is also a need to make more explicit support of mission- or discipline-oriented special interest groups (communities) involved in ARPA-IPT-sponsored research. It is becoming increasingly common for large problems (both DoD and non DoD) to be worked on by geographically distributed groups that need community-coordinated information services. 3c2h2

The work proposed here is important both for the actual service performed and as a prototypical R&D effort in the development of advanced information services within the community information center scheme above. 3c2h3

ARC therefore proposes a restructuring of present NIC

services and resources along the following lines, described in more detail in Appendix D: 3c2h4

Network Information Center 3c2h4a

ARC will continue work recently begun to determine through careful analysis what set of core services are needed network-wide for the ongoing support of ARPANET resource sharing development. This set of services would be provided under this Base-Project to ARPA research contractor sites on the ARPANET. 3c2h4a1

The incremental cost, or other pricing basis determined after negotiation with ARPA, of providing these services would be charged to those other users on the ARPANET who would like to subscribe. Or these services might be considered as part of the basic communication service cost of the ARPANET. 3c2h4a2

Pricing of information services is a difficult area and will require further study. 3c2h4a3

It is expected that about 25% of the Base-Project funds (including computer support) would be required for this function. 3c2h4a4

ARPA-IPT Community Information Service 3c2h4b

Information services as funded under this Base-Project proposal will shift toward more support of the ARPA-IPT contractor community's special interest groups that have a common mission or discipline. This shift will take place at the funding levels proposed and under the assumptions described in Appendix D. 3c2h4b1

Accurate costing and determination of needs for advanced information service support of communities are difficult areas and ones where more analysis effort is planned. Which groups to support should be designated after discussion with ARPA. ARC expects to have more data that would lead to proposals for incrementally funded support of additional groups if so desired by ARPA. 3c2h4b1a

It is expected that initially three such groups can

be supported with the services described at a cost of about 10% of base project funds. 3c2h4b2

Funding Sources for ARPA-IPT Community Applications Summarized 3c2h4c

Actual computer support for the NIC and ACIS services to ARPANET clientele covered above would come from the Utility Service negotiated under a related proposal included as Appendix B. It is estimated, based on experience to date, that 10% of the ARPA subscription would go toward this support. 3c2h4c1

Manpower for support of the NIC and ACIS needs would be covered under this Base-Project proposal as would computer support of NIC and ACIS personnel developing and operating services under this proposal. This latter computer support would be provided by the computer facility operated by ARC at SRI. 3c2h4c2

ARC will also provide community support service to non-ARPA-IPT communities under seperate contracts and funding. 3c2h4c2a

In order to avoid a serious discontinuity, NIC support of non-ARPA network users would continue until mechanisms and prices for charging for NIC services have been worked out and negotiated with ARPA. This process is expected to take at least six months from the start of the new contract. At that point a plan agreed upon with ARPA for making the changeover for non-ARPA-IPT NIC clientele would be put into operation. 3c2h4c2b

Office Applications 3c3

A basic aspect of ARPA's research strategy in the development of Office Automation systems is that ARPA offices, particularly the IPT office, should involve themselves in early use of the systems under development in order to feedback needs and experience into the ongoing evolution. Operational support for this ARPA office use of ARC workshop services is provided under the related Workshop Utility proposal included as Appendix B. The development of new and improved services is to be provided under this Base-Project proposal. 3c3a

The exact detail of the work to be performed can only be specified as ARPA's usage and experience increase when service becomes available in the fall. 3c3b

An estimate at this time would indicate that about 2% of Base-Project support will be required for Items 2 and 3 below. Item 1 is discussed later. The types of service and work expected to be important are the following: 3c3c

1) The evolution of the general application subsystem capabilities described below, 3c3c1

2) Adaptation and tailoring of these subsystems as necessary to the ARPA office environment, 3c3c2

3) Other special support (i. e. extra training, analysis, etc.) beyond that proposed in the Utility proposal, Appendix B.

3c3c3

Workshop Subsystems 3d

In ARC's thinking about application subfunctions that should be provided within a Knowledge Workshop System a number of areas have been identified that are candidates for further development under this proposal. They are described further in the notes of Appendix F. ARC would expect to allocate about 12 to 15% of the Base-Project support to subsystem development and analysis. The subsystem areas are ordered roughly as ARC perceives their importance, given present workshop capabilities, to the ARPA applications above. 3d1

1) Dialog Support 3d1a

Those tools and associated methodology that aid the collaboration of geographically distributed and other groups. 3d1a1

2) Information Management 3d1b

Those tools and associated methodology that aid the organization, storage, and retrieval of various classes of information. The primary emphasis here will be on: 3d1b1

Support of the needs for easy, fast manipulation of working sets of information (personal information), possibly derived from large data bases stored in systems such as the Data Computer, 3d1b1a

Support of NIC and ACIS services, and 3d1b1b

Support of the "filing" needs of the ARPA offices. 3d1b1c

3) Documentation Production and Control 3d1c

Those tools and associated methodology that aid the composition, study, modification, and control of online documents (including mixed text and graphics) of individuals, collaborators (multiple authors, editors, reviewers, etc.); and those tools that aid the production of quality hard copy documents. 3d1c1

4) Software Engineering 3d1d

Those tools and associated methodology that aid the design, implementation, checkout, and installation of computer-based systems. 3d1d1

5) Project Management 3d1e

Those tools and associated methodology that aid in the management and coordination of groups (particularly geographically distributed groups) working toward a common goal. A prime emphasis here would be on integration with management support systems that already exist on the ARPANET. 3d1e1

As ARPA is expected to fund other groups to work on problems associated with Office Automation, ARC would offer cooperation; for example, we would integrate their developments in a coherent fashion within the workshop, help them perform such a function themselves, or help them build directly within the workshop framework if so desired. 3d2

The present ARC workshop contains explicit tools in subsystem areas 1 through 4. Except where tools of categories 1 through 3 can be used, no explicit tools for project management exist in the present workshop. 3d3

ARC plans to allocate the resources alloted to subsystems development across subsystem areas primarily as indicated by needs determined at the application level or specifically negotiated with ARPA. ARC would expect strong continuing effort in Dialog Support, a more explicit effort than at present in Information Management because of its basic nature to many functions, and less but continuing effort in the Documentation Production and Control area. 3d4

In the area of Software Engineering, ARC proposes to pursue just that effort necessary to provide adequate tools to its software engineers and stay involved in this vital area. ARC will otherwise try to obtain additional non-ARPA support for this important area which is so basic to the bootstrapping process. 3d5

If ARPA decides to go ahead with the development and prototype operation of a Software Production Facility, then ARC would urge ARPA to consider the Workshop Utility as a starting point for further evolution. 3d6

There would probably be little explicit effort in the project management area unless so indicated by ARPA. Additional support may be sought for work in this area. 3d7

Basic Workshop System Structure 3e

Just as there is a recognized set of technology and system building know-how for domains such as programming languages and their translators, or operating systems, the domain of workshop systems also has challenging problems unique to it, which must be solved, and the technology and system building know-how must be codified and disseminated. The approach ARC plans to take in these areas is described further in Appendix G. 3e1

Work within the basic architectural level is to assure a system framework and set of capabilities to allow: 3e2

1) Delivery of the system at the lowest cost commensurate with a research and development framework, as opposed to a commercial exploitation framework; 3e2a

2) Flexibility to enable other collaborating groups to easily build and integrate tools into the evolving workshop in a well defined manner; 3e2b

3) Methods of easy adaptation of tool systems developed outside the workshop architecture for use within the workshop; 3e2c

4) Integration into the ARPANET environment (pieces of the workshop running on different computers or easily accessible from other computers); 3e2d

5) Consistent user interface principles (command language, user help, relationships between subsystems, etc.); 3e2e

6) A more user-oriented programming capability to allow users who are not programmers to create new tools or combinations of existing tools tailored to their applications (a powerful user programming facility exists presently in the L-10 language); 3e2f

7) A range of workstations to be supported in terms of their cost-performance; 3e2g

8) A range of symbol and concept representations; a variety of file organizations with data types such as text, graphics, numeric, voice, microfilm, video, etc. 3e2h

Operations 3f

The Workshop Operations function at ARC is made up of the following areas: 3f1

Facility and computer service 3f1a

ARC presently leases a DEC PDP-10 computer system and other equipment. Additional equipment is either owned by SRI or has been purchased under various past and current government contracts. 3f1a1

The facility supplies service to both the ARC and NIC (via the ARPANET) user communities. 3f1a2

ARC is pursuing a plan of facility development to position itself so that it can obtain its computer support from an ARPANET-connected vendor. This requires studying the problem of obtaining a high-speed display facility supporting a range of terminals that can be connected to the ARPANET. 3f1a3

The display facility should contain as its major components, commercially available, low-cost systems so that it can serve as a model for those Offices that need this type of terminal support. 3f1a3a

ARC will also have the option during the contract period of buying its PDP-10 system. 3f1a4

To support the present hardware facility, TENEX operating system, and NLS requires hardware people, software maintenance people, and computer operators. 3f1a5

Documentation 3f1b

Because ARC provides unique operational services to its own staff and ARPANET clientele, documentation is a vital (presently understaffed) function. Documentation is needed for beginners and experts at basic system user levels (command, subsystems, etc.) and also as methodology scenarios on how to accomplish various information-handling tasks. 3f1b1

The important point here is that documentation performs services valuable not only to ARC, but also to ARPANET clientele. 3f1b1a

3f1b2

People support services 3f1c

These cover the usual secretarial support and also additional specialized services needed in our Workshop environment -- transcription to online files, editing, filing, and cataloging tasks as examples. 3f1c1

Training 3f1d

When new employees come into ARC, they must be trained in the use of the workshop system--details of online system use and methodologies in use in ARC at many levels. 3f1d1

Administration 3f1e

This area covers the usual contract administration tasks, purchasing, personnel support, etc. 3f1e1

III SUMMARY OF PROPOSED PROJECT ACTIVITY 4

Summary Picture from ARC Viewpoint 4a

Contract Year 1974	1975		The Base-Project work will focus on:	
				4b
17%	17%	1)	Development and delivery of operational services (not including computer support) for Core Network Information (NIC) Center reference and dialog support functions. (discussed further in Appendix D)	4b1
8	8	2)	Development and delivery of operational services (not including computer support) for ARPA-IPT Community Information Services (ACIS) (discussed further in Appendix D)	4b2
17	17	3)	Development of Knowledge Workshop Capabilities at the levels of: (labor only)	4b3
2	2	a)	Applications (other than NIC and ACIS)	4b3a
10	10	b)	Workshop Subsystems (discussed further in Appendix F)	4b3b
5	5	c)	Basic Workshop System Structure (discussed further in Appendix G)	
17%	17%		Subtotal	4b3c
8	8	4)	Analysis (discussed further in Appendix E)	4b4
17	17	5)	Labor for Operations support services to the ARC Development and Analysis (non NIC and ACIS) efforts.	4b5
33	33	6)	Non-labor for Operations Support to ARC Development, Analysis, NIC, and ACIS efforts.	
100%	100%			4b6

Proposal for Research No. ISU 73-128

NETWORK INFORMATION CENTER AND
AUGMENTED KNOWLEDGE WORKSHOP DEVELOPMENT

PART TWO--CONTRACTUAL PROVISIONS 7

I ESTIMATED TIME AND CHARGES 8

It is proposed that the research work outlined herein by Stanford Research Institute be performed during a period of 24 months, starting 9 February 1974. 8a

Pursuant to the provisions of ASPR 16-206.2, attached is a cost estimate and support schedule in lieu of the DD Form 633-4. Also enclosed is a signed form complete except as to the "Detail Description of Cost Elements." 8b

II GOVERNMENT-FURNISHED EQUIPMENT 9

The performance of the proposed work will involve the use of government-furnished equipment covered by Air Force (RADC) Contract No. F30602-72-C-0313. 9a

III REPORTS 10

The Institute will submit an Interim Technical Report which documents and summarizes the work performed during the first 12 months under the proposed modification. This report will be submitted in draft form 12 months and 30 days after commencement of the proposed work. 10a

A Final Technical Report will be submitted 30 days after the second 12 months. 10b

The Institute will submit management reports on a quarterly basis as under the present contract. 10c

IV CONTRACT FORM 11

It is requested that any contract resulting from this proposal be awarded on a cost-plus-fixed-fee basis as a supplemental agreement to Contract No. F30602-72-C-0313. 11a

V ACCEPTANCE PERIOD 12

This proposal will remain in effect until 8 February 1974. If consideration of the proposal requires a longer period, the Institute will be glad to consider a request for an extension of time. 12a

Proposal for Research No. ISU 73-128

Cost Estimate:

COST ESTIMATE

(for the two year period starting 2/8/74)

Personnel Costs		
Proj Supv	2,500 hrs.	
Senior Prof	4,800 hrs.	
Prof	86,854 hrs.	
Technical	7,200 hrs.	
Clerical	9,600 hrs.	
Total Direct Labor		812,696
Payroll Burden @ 26.0% *		211,301
Total Labor and Burden		1,023,997
Overhead @ 105% *		1,075,197
Total Personnel Costs		$ 2,099,194
Direct Costs		
Travel		$ 21,414
48 trips East @ 318 =	15,264	
150 Days Subsistence @ 31=	4,650	
Auto Rental 100 days @ 15	1,500	
Facility *		928,797
Report Costs		2,133
Total Direct Costs		$ 952,344
Total Estimated Cost		$ 3,051,538
Fixed Fee		183,092
TOTAL ESTIMATED COST PLUS FIXED FEE		$ 3,234,630

* See following Schedules

Cost Schedules:

SCHEDULE A

DIRECT LABOR

Direct labor charges are based on the actual salaries for the staff members contemplated for the project work plus a judgmental factor applied to base salary for merit increases during the contract period of performance. Frequency of salary reviews and level of merit increases are in accordance with the Institute's Salary and Wage Payment Policy as published in Topic No. 505 of the SRI Administration Manual and as approved by the Defense Contract Administration Services Region.

SCHEDULE B

OVERHEAD AND PAYROLL BURDEN

Based on projected 1973 budget data, higher overhead and payroll burden rates were formerly negotiated. However, these have been adjusted downward (with the concurrence of the Resident Government Auditor) to reflect more favorable cost experience through the first six accounting periods.

Rather than setting forth these specific rates, it is requested that contracts provide for reimbursement at billing rates acceptable to the Contracting Officer subject to retroactive adjustment to fixed rates negotiated on the basis of historical cost data. Included in payroll burden are such costs as vacation, holiday, and sick leave pay, social security taxes, and contributions to employee benefit plans.

SCHEDULE C

TRAVEL COSTS

Air fare is based on prices for travel to Washington D.C. at $318 round trip tourist established in the Official Airline Guide dated August 1, 1973.

Domestic subsistence rates and travel by private auto are established standards based on cost data submitted to and approved by DCAA.

SCHEDULE E

REPORT COSTS

Report costs are estimated on the basis of the number of pages of text and illustrations and the number of copies of reports to be produced, in accordance with the following rates per page which have been reviewed by DCAA:

Editing	$ 2.29
Composition	$ 2.22
Report coordination	.63
Proofreading	.92
Press/Bindery/Photography	.021 per impression

The following is a breakdown of the estimated cost of report production:

Printing, 300 pages at $ 6.06 per page = (including editing, composition, report coordination, proofreading)	$ 1,818
Press and bindery at $ .021 per printed page = (for 300 printed pages - 50 copies)	315
Total Estimated Report Costs	2,133

SCHEDULE F
FACILITY COSTS

SUMMARY:

$ 733,872	Equipment Cost
67,125	Maintenance and Operation
800,997	Total Base Facility Support
127,800	Display Facility Upgrading
$ 928,797	Total Facility Costs

DETAILS:

Base Facility Support Details		$ 800,997
Total Equipment Costs		$ 733,872
Computer Facility		$ 651,840
PDP-10 lease costs:		
Monthly: 24 Mo. @ $ 27,160		
(P.O. B13477) consisting of:		
Basic Facility (*)	$ 13,986	
DEC Disk Pack Equipment (**)	6,514	
DEC ME10 Memory (16k) Addition	1,250	
DEC Maintenance	5,410	
TOTAL	$ 27,160	

(*) Includes leased from DEC:
KA10 Arithmetic Processor
KM10 Fast Register
KT10A Dual Mem Protect Relocate
TM10A Mag Tape Control
TD10 DECTape Control
DC10A Data Line Scanner Control
TU30-B 7-Channel Mag Tape (two)
TU55 DECTape Transport (two)
DC10B 8-Line Group Unit
MA10 Core Memory (eight)
MC10 Memory Ports (24)

(**) Includes:
DF10 Data Channel (two)
RP02 Disk Controller (two)
RP02 Disk (six)

Other leased equipment 24 months			$ 48,072
Dataphones (7)	$ 257	(329-8220-6)	
Couplers (8)	120	(B94707)	
Cassette Recorders (6)	687	(B55739)	
T-I Terminals (9)	939	(B94691)	
Total monthly rate	$ 2,003		
Telephone expenses			$ 33,960
Lines to remote sites	$ 12,792		
Voiceline 24 months @ 365 /mo = 8,760 (PR 1KP1179)			
Voiceline 24 months @ 168 /mo = 4,032 (PR 1KP1861)			
NIC service	$ 21,168		
Fixed cost 24 months @ 132 /mo = 3,168 including			
PA Answering Service @ $40 /mo (B77425)			
Enterprise Service @ $92 /mo (SRI 23-70)			
Toll calls 24 month at 750 /mo = 18,000 (based on operating experience with NIC costs)			
Maintenance and Operation			$ 67,125
Maintenance Materials		$ 21,125	
Such as:			
Picture tubes 15 @ 75=		1,125	
(P.O.64901)			
CRTs 30 @ 300=		9,000	
(P.O.62654)			
Vidicons 40 @ 150=		6,000	
(P.O.66508)			
Other		5,000	
(Actual components and costs will depend upon the results of further design work. This estimate is based upon previous experience in the field.)			
Other Operating Costs		$ 46,000	
Mag tape 200 @ $15	$ 3,000		
(SRI Comp Center)			
NIC mailing costs =	15,000		
Paper tape, printer paper, etc.=	4,000		
Xerox for NIC dist	24,000		
(These estimates are based upon initial and anticipated experience in NIC.)			

Display Facility Upgrading Details $ 127,800

Basic information concerning display facility upgrading estimates:

Inexpensive Alphanumeric Displays:	
purchase	
range	$2-5k
for our needs	$3-3.5k
lease	
range	$100-250 per month
for our needs	$150 per month
Line Processors:	
purchase	
(cost to build)	$1.5-2k
lease	
(projected figure)	$80 per month
Graphic Display:	
purchase	
range	$30-100k
for our needs	$50k
lease	
range	$.75-2.5k
for our needs	$1.25k per month
Mini-Computer controller:	
purchase	
range	$30-100k
for our needs	$50k
lease	
range	$.75-2.5k
for our needs	$1.25k per month
examples	
BBN mini-host peripheral processor	
pdp-11/40 plus extras	
purchase	$29.5k
lease	$750 per month
ANTS basic system	
pdp-11/40 plus extras	
purchase	$65k
lease	$1,375 per month
ANTS super system	
pdp-11/40 plus extras	
purchase	$100k
lease	$2.5k per month

Sample configuration

	purchase	monthly lease
20 Alphanumeric Displays	60,000	3,000
20 Line Processors	40,000	1,600
1 Graphics Display	50,000	1,250
1 Minicomputer Controller	$ 50,000	1,250
	$200,000	$7,100

Monthly lease x 18 months = 127,800
(assumes display facility upgrading six months after start of 24-month contract period)

28 AUG 73
SRI-ARC 18368

Proposal For Research
SRI No. ISU 73-128

NETWORK INFORMATION CENTER AND AUGMENTED KNOWLEDGE WORKSHOP DEVELOPMENT

Part One--Technical Proposal

Prepared for:

Information Processing Techniques Office
Advanced Research Projects Agency
1400 Wilson Blvd.
Arlington, Virginia

Attn: Lawrence G. Roberts

Submitted by:

J. C. Norton, Assistant Director
Augmentation Research Center

R. W. Watson, Assistant Director
Augmentation Research Center

Approved:

D. C. Engelbart, Director
Augmentation Research Center

Bonnar Cox, Executive Director
Information Science and Engineering Division
Stanford Research Institute

28 AUG 73
SRI-ARC 18368

Proposal For Research
SRI No. ISU 73-128

NETWORK INFORMATION CENTER AND AUGMENTED KNOWLEDGE WORKSHOP DEVELOPMENT

Part Two--Contractual Provisions

Prepared for:

Information Processing Techniques Office
Advanced Research Projects Agency
1400 Wilson Blvd.
Arlington, Virginia

Attn: Lawrence G. Roberts

Proposal for Research No. ISU 73-128

[APPENDIX A, (journal,14946)]

Proposal for Research No. ISU 73-128

[APPENDIX B, (journal,14724)]

Proposal for Research No. ISU 73-128

[APPENDIX C, (journal,12380)]

Proposal for Research No. ISU 73-128

(J18368) 6-OCT-73 19:59; Title: Author(s): Stanford Research Institute /&SRI-ARC ; Distribution: /JSP DLS (for info) ;
Sub-Collections: SRI-ARC; Clerk: JCN ;
Origin: <DOCUMENTATION>IPIPROP.NLS;7, 8-SEP-73 09:53 JCN ;

Part One--Technical Proposal

Proposal for Research No. ISU 73-128

Proposal for Research No. ISU 73-128

APPENDIX D

NETWORK AND COMMUNITY INFORMATION CENTERS

This appendix supplements the information in the main body of this Base-Project proposal and is organized as follows: 1

INTRODUCTION

2

Why Have a Network Information Center ?

2a

The Network Information Center (NIC) was originally created to develop and provide reference and dialog support services for a small number of research sites involved in network development and use.

2a1

The NIC has performed these functions and has struggled to provide its services to a rapidly expanding network community. The NIC community has consisted of ARPANET sites and of people interested in ARPANET Technology but not actually connected to the network. From the NIC's viewpoint, the main characteristics of this community have been rapid growth and changing needs.

2a2

We recognize that the size of the network and its projected growth have exceeded the research resources which ARPA has to invest for NIC support of the general network community. There is, however, a strong and growing need for the type of services provided by the present NIC.

2a3

There is a need for a reference service that provides "consumer information" to potential and actual users. Without such a service, marketing and sharing of network resources is hindered, and manpower and money is wasted through the questions and redundant efforts to find answers by those who need them.

2a4

There is a need for well-structured information exchange mechanisms to facilitate coordination and collaboration among the network community.

2a5

In short there is a need for information to facilitate network resource sharing, collaboration, and dialogue.

2a6

These problems exist both in the general network community, and in special interest groups involved in ARPA-IPT sponsored research.

2a7

This Proposal describes a framework and mechanism for addressing and resolving these problems. The continued support of a service that resolves these needs would provide both a valuable R&D effort in the development and operation of advanced information services and a valuable service to the users.

2a8

The support proposed is within the context of maintaining total NIC and ACIS funding at present NIC levels. The resulting manpower levels will thus be strained to meet the basic needs which we feel should be met. 2a9

Restructuring of NIC Organization 2b

An evolution of the structure of the present NIC organization is planned. 2b1

The new organization, the "next stage of an evolutionary information center", is the result of a recent analysis at ARC of NIC operations and NIC products. It is designed to provide answers to specialized user needs at reasonable cost, with a built-in mechanism that will allow new needs to be determined, and new services to emerge that will meet those needs. 2b2

We wish to draw your special attention to this proposed new stage of an evolutionary information center, because we feel it represents a necessary step forward. The concept is briefly described elsewhere in this Appendix. 2b3

Restructuring of NIC Services into two components. 2c

1) The Network Information Center (NIC) 2c1

The NIC will continue to provide a basic set of services for the ongoing support of ARPANET resource sharing R&D. This set of services would be costed and provided under this Base-Project to ARPA research contractor sites on the ARPANET. 2c1a

Other non-ARPA sponsored users on the ARPANET who would like to subscribe to these basic services would be charged the incremental cost, or other charge after negotiation with ARPA, of these services. 2c1b

2) The ARPA-IPT Community Information Service (ACIS) 2c2

In addition to the above basic NIC services, the NIC will evolve toward providing information services for the ARPA-IPT community and those special interest groups which have a common mission or discipline. The focus for this evolution will be an ARPA-IPT Community Information Center (ACIS), an offshoot of the NIC to be funded ultimately by the communities being served. 2c2a

The ACIS services to be provided and the cost of these services are being analyzed at present. We expect to have

more data which will lead to proposals for incrementally funded support of additional special interest groups at the discretion of ARPA. It is expected that initially about three such groups will be supported with the services described below, at the funding levels requested. We would expect to discuss with ARPA-IPT the designation of the groups to be supported. 2c2b

Computer support for the end users of the NIC and ACIS services covered under (1) and (2) above would come from the Workshop Utility Service. 2c3

We intend to provide end-user support from the Utility because of the greater reliability expected there. In exchange for this, the local ARC computer system (instead of the Utility system as originally intended) will be used by those ARC personnel that support the Utility. 2c4

It is estimated that about 30 percent of the ARPA subscription for the Utility would be for this purpose (15 percent for NIC users, 15 percent for ACIS users). 2c5

Manpower support for the NIC and ACIS, computer support for the NIC and ACIS staffs, and development and operation of the NIC and ACIS services would be covered under this Base-Project proposal. The computer facility operated by ARC at SRI would be used for these purposes. 2c6

CONTEXT FOR THIS PROPOSAL: Current Status and Roles of the NIC

3

The Network Information Center has been performing four main roles, as conceived at the beginning of the current contract period: 3a

1) Stimulating the use of and interest in the ARPA Network; 3a1

2) Supporting dialog among the geographically distributed individuals and research teams that have been contributing either to the development of Network Technology, or to the support of other network-oriented research; 3a2

3) Providing reference information about Network resources and facilities; 3a3

4) Developing prototypical services for use in future, similar network-oriented information centers. 3a4

The NIC is operational, and it is prototypical. It has been serving a rapidly growing and rapidly changing community. The estimates of community needs and anticipated growth rates made two years ago at the start of this contract period have proved to be gross underestimates. The NIC framework that was designed to meet those estimated needs and growth rates is, we feel, no longer applicable to the current situation. 3b

But the needs outlined above still exist. Only the framework designed to fulfill those needs must change. 3c

A study of the services and associated costs of operating the Network Information Center was recently made, based on data collected during the period April 1973 to August 1973. The conclusions were these: 3d

1) The NIC's prototype and operational services have not evolved fast enough to meet the rapid growth and changing needs of the ARPANET community. 3d1

2) The costs of the present NIC services, and the practice of supporting these services wholly through the ARPA-IPT contract, were not justifiable within the framework of present ARPA Network research and development support plans. 3d2

The reasons for this, and our proposal for continuing the above sevices within a rather different framework, are given in the next

section. In this section, we intend to discuss briefly the roles stated above, to put our Proposal in proper perspective. 3e

NIC Roles 3f

1) Stimulating interest in and use of the Network. 3f1

This role has had two aspects: assisting in marketing the ARPA Network and assisting in the development of network protocols. 3f1a

The NIC's staff has taken an active role in introducing visitors and network users (both potential and actual) to the network's resources. This has been done through distribution of various reference materials to network associates and sites, and through discussions and demonstrations for those who visit the Network Information Center. The NIC and ARC staff also devoted many man months in helping ARPA prepare for the 1972 ICCC, in order to help stimulate interest in the network. Finally, others such as NBS and MITRE have been using NLS and the NIC online Query system to demonstrate the capabilities and potentials of the network. 3f1b

This role of the NIC in marketing ARPANET technology has not been generally recognized, but has been implicitly accepted and used as part of our services. We have continued this role because we believe it has been of strategic value to ARPA. 3f1c

The other aspect of the NIC's role in this area (with support from the Augmentation Research Center staff), has been active participation in the development of network resource sharing protocols, ensuring that the needs for information exchange were adequately addressed. For example, the NIC was one of the prime contributors in the development of the Telnet and Mail protocols, and has participated in the design of the File Transfer and Graphics protocols. 3f1d

2) Supporting dialog among geographically distributed researchers, to help stimulate network-oriented R&D. 3f2

ARC and the NIC have developed and operated the "Journal" system for the support of online and offline dialog among geographically distributed researchers. This has facilitated the development of network protocols, by providing a means to exchange technical memoranda and to record and retrieve all documentation and memoranda relating to protocol development. A key aspect of this support is that distribution is automatic once an individual or research group is named in the addressee list. 3f2a

Recent innovations have extended the dialog support to other groups of researchers working in common problem areas, such as Computer-Based Instruction, Speech Understanding Research, and Packet Radio. We have also recently implemented a mechanism that allows network users to utilize the NIC's Journal system via any site's File Transfer Protocol software, without the users having to learn or use NLS. 3f2b

3) Providing reference information, to help create a feeling of community among network developers. 3f3

The NIC's reference service is simultaneously online and offline. It is available to all users of and researchers on the network. It includes indexes to all dialog that has been transacted through the Journal, a directory of individuals and research groups using or associated with the network, and a directory ("notebook") of resources and facilities on the network. It also includes indexes and hard copy distribution of professional papers that are of interest to special interest groups of network participants. 3f3a

Use of the online reference service has been facilitated through development of a prototypical user-oriented Query language. In addition, introduction of Enterprise phone service at many locations around the network has allowed users to have toll-free conversational access to the NIC when that mode of communication was desirable. 3f3b

Use of the offline services was accomplished by distributing and maintaining a collection of NIC documents at each network site and at other locations where interest in network developments existed. 3f3c

4) Developing prototypical services. 3f4

As with virtually all other aspects of the network technological development, the combination of the context, type, and scope of NIC's services have had few precedents. We intentionally set out to develop prototypical, evolutionary services and evaluate them and evolve them, to be of use in future information centers, as well as in the present one. 3f4a

Our recent analysis of NIC services and expenditures is in keeping with this prototypical nature of the NIC. Based on this analysis, we have found that it will be beneficial to restructure our services and to restructure the framework in which we provide those services. 3f4b

For example, the concept of providing a uniform level of both online and offline services to the entire network community is, we now believe, not sufficiently responsive to rapidly changing user needs. We also believe that because of the growth of the network community, it is no longer efficient to serve all users with a uniform set of products. We therefore intend to tailor the products to meet specific user groups' needs. 3f4c

As another example, the practice of fairly widespread distribution of a uniform set of hard copy documentation was necessary at the beginning when much of the technology for online dialog was somewhat unstable and the network community was smaller than it is now. However, because of network growth and a stable technology, this practice is now felt to be inappropriate, and is being reevaluated. 3f4d

Our Proposal in the next section addresses these problems directly. It includes approaches that will enable us to continue this development/operation/analysis cycle more effectively, until network usage patterns and information needs stabilize. These approaches are (a) the "evolutionary" NIC and (b) the ARPA-IPT Community Information Service. 3f4e

PROPOSAL DETAILS: Goals and Tasks

4

Goal: An Explicit Evolutionary Structure for an Information Center 4a

Background 4a1

It has been a basic strategy of ARC to try to operate in an evolutionary cycle: analyzing needs, developing and operating services designed to meet those needs, and then analyzing and evaluating the results--thus leading to a new cycle. 4a1a

This evolutionary pattern has been carried through one cycle with the NIC, culminating in the recent analysis of the NIC by Paul Rech and Michael Kudlick. 4a1b

In that analysis the plan for a more explicit evolutionary structure for an Information Center was developed as a means to handle the basic problems of the Network Information Center. 4a1c

The result is the design of a new NIC structure that makes it easier to carry out analysis on a continuing basis and, thereby, be more responsive to changing needs. 4a1d

This concept is outlined here, as it forms the basis of this proposal. 4a1e

What is Meant By "Evolutionary"? 4a2

Because of the rapidly changing nature of the ARPA Network environment, most of the information needs of the community change rapidly. It is not feasible to try to respond to these needs with fixed levels and types of services. 4a2a

The re-structured approach entails a small, highly knowledgeable staff that will observe, analyze, and respond to users' needs. Over a period of time, the staff will steadily improve the computerized data bases and query mechanisms that deal with the needs as they become more stable. Users knowledge and skill as to when and how to use these data bases will steadily improve through their interactions with the staff. The staff's ability to perform these functions will be significantly enhanced through use of state-of-the-art computer technology such as NLS and the ARPA Network. 4a2b

The Need 4a3

The NIC's goals are to provide answers to specialized user needs, to do so at reasonable cost, and to be able to respond to rapidly changing needs with up-to-date, accurate, timely information. The ARPA Network environment of rapid growth and changing needs affects the ability of the NIC to meet these goals. 4a3a

To achieve these goals satisfactorily and at reasonable cost requires a knowledge of the user's needs as well as a high volume of NIC usage. We believe the present NIC is not structured to meet these goals satisfactorily. 4a3b

The proposed changes toward helping the NIC to meet its goals are based on two related facts: 4a3c

1) At any point in time, information is of two types. For convenience here we call these two types "historical" (published), and "recent." 4a3d

Historical information can be indexed, cataloged, and distributed, but its fixed nature means that it does not require updating. Consequently, the means of managing and disseminating historical information can be reduced to a fairly straightforward set of procedures. 4a3d1

Recent information is usually unorganized and distributed around the community, residing in such information sources as people's heads, intraorganizational memoranda, or fragmented computer data bases, rather than in published papers and books, or computerized data management systems. 4a3d2

Recent information sources cannot be dealt with in the same fashion as historical sources. They can usually only be used when one has the right personal contacts. Flexibility and adaptability are required on the part of the user in utilizing these sources. 4a3d3

2) One reason that many information centers fail to adequately serve the needs of their communities, is that they do not distinguish adequately the different approaches needed to provide both recent and historical information to their clientele: 4a3e

Recent information cannot feasibly be kept sufficiently up to date and properly organized in computerized data bases or other files. 4a3e1

Patterns of usage of recent information have to be observed before the information can be organized effectively for retrieval purposes. Attempts to build data bases and query systems before analyzing the needs of the users do not succeed. But even the attempts to analyze the needs of users often fail to lead to a useful system, unless there is some mechanism for continually upgrading this knowledge and evolving the system accordingly. 4a3e2

To discern and respond to these usage patterns requires question and answer dialogues and a flexibility that formal data bases do not provide. 4a3e3

Outline of Proposed Solution 4a4

An ideal NIC would know and provide for most of the information service needs of the user community and be able to adapt to new needs as they arose. It would be flexible enough to utilize properly both the recent and historical sources of information in its community. The concept we have developed to approximate the ideal solution is this: 4a4a

Instead of relying heavily on the distribution of hard copy documents that were designed to answer anticipated user needs, the NIC services will be provided primarily in four ways: 4a4b

1) Through a compact directory of basic ARPANET resources. This will be small enough to be produced economically and distributed to every ARPANET user known to the NIC. 4a4c

2) Through well-advertised, easy-to-use online query capabilities. This will provide access to the NIC's Resource Directories online, enabling users to obtain information supplementary to that given in the brief hard copy directory. It will also provide access to the NIC's online Journal files and indexes in support of community dialogue. 4a4d

3) Through a Reference Staff that is trained to answer user requests that come to it by phone, U.S. mail, Network Mail, or NIC Journal. This staff and its supporting analysis and development staffs constitute the hub of the evolutionary NIC. 4a4e

The Reference Staff will be connected to most of the relevant information sources in its community, by means of the ARPA Network. The staff will comprise a skilled

interface between its community's members and its information sources. 4a4e1

It will be able to evolve because it is uniquely situated to gain knowledge of the type of questions (and type of users) it is serving. Through continuing analysis of these needs, the NIC will be able to persistently evolve its computer data bases and query facilities to respond to these needs at reasonable cost. 4a4e2

It will be able to evolve more quickly than a conventional information center, because the NIC's staff will be augmented by the NLS system and by the ARPANET information exchange facilities. 4a4e3

4) Through dialog support services that include either hard copy distribution or online availability of memoranda and reports and indexes to these items. 4a4f

Network Information Center 4b

Overview of NIC Tasks 4b1

The re-structured NIC services to be provided under this Base-Project contract will be for the ongoing support of ARPA research contractor sites. The services will be primarily oriented to serving three needs: 4b1a

1) Providing reference information
(2) Developing prototypical information services
(3) Supporting dialog among geographically distributed individuals. 4b1a1

(A discussion of the problem of providing dialog support is given at the end of this section.) 4b1a2

The operational services will be 4b1b

Hard copy Directory: Maintenance and bi-annual (or perhaps quarterly) distribution of a re-formatted, compact Directory of ARPANET personnel and system resources, including scenarios on how to use the more detailed online NIC data bases and services. 4b1b1

Reference Staff: A reference staff to provide specific answers to specific user requests for information, when that information is not available to users through either the hard copy or online directories. 4b1b2

The development services required for the support and evolution of the operational services will be 4b1c

On-Line Directory: Maintenance of online data files and simple query capabilities to enable users to conduct their own online searches for more complete answers to their questions concerning ARPANET resources. 4b1c1

Development Staff: A development staff to assist in the continual analysis of NIC user needs, NIC product effectiveness, and NIC costs. The development staff will also be responsible for making improvements to the online services and hard-copy distribution material, as such needs emerge. 4b1c2

Discussion of Tasks 4b2

Hard copy Directory 4b2a

A small (50-page) hard copy Directory of ARPANET Resources will be distributed at least twice a year to every network individual known to the NIC. It is intended as a quick reference guide to satisfy the basic information needs of the network community. The hard copy directory will contain the following types of information: 4b2a1

- Individual names, with organization and phone number, network mail address and NIC Journal ident (one line per individual) 4b2a2

- Organization names and phone numbers (one line per organization) 4b2a3

- Site information: identification, primary contact, host number, TIP phone numbers or Host Network Addresses, where to obtain additional documentation 4b2a4

- Scenarios: how to use the NIC by phone and by Network Mail, how to use the NIC Journal via the Network FTP; how to access and use the NIC Directory of Resources online via the Query language 4b2a5

- Brief summary (in matrix form) of ARPANET hardware and software resources, to provide "consumer information" about the available network resources 4b2a6

- Scenarios of how to access server sites on the Network (evolving eventually into a paid-for "yellow pages"). 4b2a7

Reference Staff 4b2b

The Reference Staff will consist of a few trained persons, knowledgeable about ARPANET resources and network information sources (personnel and data bases). This staff will be augmented in its work through the use of NLS and the Network. 4b2b1

The staff's function will be to provide specific answers to specific questions not answerable by the quick-reference hard copy directory or by users unskilled in the use of the NIC's online directory. 4b2b2

The staff will know and use the NLS data bases and network information sources, thereby augmenting its ability to do its work. They will attain familiarity with network computer resources through direct use, whenever practicable. As users request information via phone, U.S. mail, Network Mail, or NIC Journal, the Reference Staff will formulate replies. Where appropriate, replies will include instructions on how to use the NIC online services. The Reference Staff may also put users in contact with sources of information they know will further help the user. They will record the requests and responses so that subsequent analyses of this correspondence may be made. 4b2b3

The analyses of the Reference Staff's correspondence will in large part dictate the evolving directions that the NIC's services will take: that is, the content of the Directory's computerized data bases, the form of the query language, and the nature of future services will all be further developed as a result of these analyses. 4b2b4

On-Line Directory 4b2c

An online Directory of ARPANET Resources will be maintained as an in-depth back-up for the brief hard copy directory. 4b2c1

The online directory will utilize the information in already existing data bases at the NIC. These data bases include the NIC ident files, which contain the basic data about persons and organizations, and the "Resource Notebook," which contains comprehensive descriptions of hardware and software resources at each ARPANET site. 4b2c2

Access to the online Directory will be through the NIC/QUERY language, which will be available to all Network users with no log-in requirements. This Query language will undergo continual enhancement, the goals being to keep it simple and easy to use, and to provide the capabilities that users demonstrate they want. 4b2c3

The evolution of the Query Language will rely heavily on the information gained from continual analysis of the NIC's Reference Service function, and will be coordinated with the needs of MITRE Corporation (Jean Iseli) and the Range Measurement Laboratory (Ed Schelonka), or whomever else ARPA-IPT designates. 4b2c4

Development Staff 4b2d

A small development staff will help build data bases and maintain the programs used by the NIC. This is necessary in order to avoid having the NIC's priorities be subordinated to the overall ARC priorities. This has been a source of difficulty in the past, keeping the NIC somewhat frozen in its efforts to make minor but needed improvements and corrections to the programs it relies on. 4b2d1

The Development Staff will maintain the integrity and usefulness of the hard copy documents produced for use by the Reference Staff. It will maintain the programs that produce the hard copy Directory that is distributed Network-wide. It will help build the data bases and implement the Query language extensions that enable user-oriented online access to them. And, where appropriate, it will convert NIC document processing to other network computer systems such as UCSB (see "Transition Plans" below). 4b2d2

Additional Support Requirements 4b2e

Computer Support 4b2e1

requested here for computer support is for support of the NIC's staff. The staff will use NLS to augment its capabilities to serve its clientele. The funds requested include the NIC staff's share of ARC's computer resources, as well as its share of overhead support for ARC's computer operations staff. It is anticipated that the NIC staff would require three terminals in use each day. 4b2e1a

NIC users will obtain their computer service from the ARC Utility Service. Based on our analysis of current NIC usage, we estimate that about 15 percent of the ARPA-IPT subscription for Utility computer resources will be used by NIC users in their communications with the NIC Reference Staff. 4b2e1b

NonLabor Expenditures 4b2e2

Non-labor expenses cover the cost of producing and distributing the hard copy documents, as well as the cost of the Enterprise telephone facilities. 4b2e2a

Transitional Plans for Past Services 4b3

Past services wil be reevaluated and if warranted they will be cut back--especially those services comprising maintenance and distribution of hard copy reference and dialog support documents to each network site and to associates. Specific funding support from interested users would be required to continue any services that would otherwise be cut back. Such support and services would be negotiated separately from this Base-Project Contract. 4b3a

In order not to cause a serious discontinuity in service, those NIC services destined to be dropped would continue until mechanisms and prices for charging for these NIC services have been worked out. This process is expected to take at least six months from the start of the new contract. 4b3b

In order to ease this transition and reduce the cost of these services, we are presently analyzing the feasibility of using computer facilities at UC Santa Barbara to produce the offline documents used for reference and dialog support. Simultaneously, we are reexamining the scope and content of these documents. We expect the result to be less documentation produced, at lower unit cost than at present. 4b3c

Transitional Plans for Future Services 4b4

Future services will depend on the evolving needs of the NIC community. Presently, we believe that one need is for some distribution of hard copy documents, for example, RFC's and other technical memoranda. We plan to evaluate, and if

**found to be useful, continue this type of service. 4b4a

We currently base our hard copy distribution services on photoreproduction of standard computer output. Within the framework of present and anticipated facilities, such hard copy distribution services could evolve to include: 4b4b

- distribution of relevant documentation about how to use network systems (hosts), using a "clearing-house" concept in which distribution services are supported partly by user subscription and partly by ARPA contract, 4b4b1

- and introduction and utilization of microform technology and/or digital facsimile transmission technology. 4b4b2

Regardless of what mechanism is used, specific funding support will be solicited from the users interested in

having these services provided. Details of these funding mechanisms are yet to be worked out. 4b4c

Dialog Support 4b5

The NIC presently provides dialog support services to the entire network community through the Journal, and through maintenance and distribution of indexes and catalogs that facilitate retrieval of the recorded dialogue. 4b5a

The future course of this service is not clear at present. We have begun analyzing users' needs and requirements and intend to modify the dialog support service if our conclusions warrant that. More work needs to be done in this area, however. We will report our results to allow wider discussion before final decisions are made. 4b5b

Our main concern is the cost and benefits of providing the same comprehensive index and catalog to all who participate in network dialogue. We currently see merit in providing separate indexes and catalogs for each user group, the content being just that which is relevant to the group's interest and the distribution generally being limited to group members. 4b5c

Despite this concern, we believe that dialog support services are crucial to any network community R&D effort because they provide a means of recording, distributing, and retrieving dialog anong geographically distributed researchers. 4b5d

We therefore expect to continue these services in some of the present forms, for example, the online Journal dialogue. And we intend to improve the forms of some of the present services, for example, the offline indexes and catalogs, and provide an extension to allow online recorded dialog to include general Network Mail. 4b5e

However, firm decisions have not been reached on all aspects of this service. The problem is discussed further in the context of ACIS at the end of the next section. 4b5f

ARPA-IPT Community Information Services (ACIS) 4c

Framework for the ACIS 4c1

Initally, the information services to be provided by the ACIS will be a continuation of the current NIC services. The ACIS community will be the ARPA-IPT contractors. 4c1a

The main objective in forming the Community Information Service, however, is not simply to provide certain operational information services to selected research teams. The main objective is to begin an R&D effort whose goal is to determine the information services that geographically distributed mission- or discipline-oriented groups need and to develop and deliver these services in an evolutionary way. This R&D effort complements that described in the main body of this Proposal on establishing a "bootstrap community." 4c1b

In keeping with the "bootstrap community" concept, we have proposed a specific role, that of "community architect," whose function will be to ensure that the ACIS services evolve to serve the needs of the community, that the community understands and knows how to use these services, and that commensurate funding mechanisms evolve to support these services. 4c1c

The most realistic way for the ACIS to succeed would be by having the groups that are being served contribute directly to the ACIS's support, both with funds and with ideas. 4c1d

Role of the Community Architect 4c2

He will be responsible for analyzing the needs of the groups in the community, and for helping to design and to evolve feasible technical and contractual solutions. 4c2a

He must therefore be someone who understands the community's information needs and understands the ways in which the ACIS can serve these needs. Two key aspects bearing on this function are: 4c2b

1) The community's members are distributed geographically, working on common problems. They may require a wide variety of information services. 4c2c

2) The coupled technology of NLS and the ARPA network makes coordination and collaboration among the members of such a community much more effective than heretofore possible.

Together, NLS and the network provide a unique mechanism through which the appropriate information services can be delivered and further developed. 4c2d

Central to this role is the problem of transferring the technical ability to use this technology. Ideally, the technology should become an integrated tool in the routine procedures of the groups. 4c2e

Although in Appendix B the "bootstrap community" architect is described as a person active in his particular community, the community of ARPA-IPT groups is too disparate to warrant that approach in this case, Consequently, we are proposing one central architect person on the ARC staff for all the groups to be served by the ACIS. With time and growth of usage, this could evolve to have separate community architects, with separate community information services or centers serving each such community. 4c2f

Potential ACIS Services 4c3

Several broad classes of coordinated information services that may evolve to benefit collaborating, distributed workers are described in the paper by D. C. Engelbart titled "Coordinated Information Services for a Discipline- or Mission-Oriented Community" (Appendix C to this Proposal). An initial subset of these services, feasible to undertake now with existing NLS and ARPANET software and hardware, are Dialog Support, Reference Support, and Document Production and Control. 4c3a

1) Dialog Support: This service utilizes online tools for preparing, storing, transmitting, receiving, and collaboratively modifying technical reports and other memoranda; and for indexing, cataloging, and permanently storing the dialog and final products. These services enable a geographically distributed community to maintain recorded, collaborative dialog with a new degree of effectiveness and flexibility. 4c3b

2) Reference Support: This service utilizes online tools to catalogue and index items that are not themselves stored in the computer, items such as professional papers, reports, notes, etc. This enables a distributed community to be kept up to date on external information important to its work. As the collection of documents and indexes grows, use of microform technology and/or digital facsimile transmission technology may become desirable as a means of storage or distribution. 4c3c

3) Document Production and Control: NLS has one of the most comprehensive sets of computer tools for composing and formatting online information, and for creating high-quality hard copy documents. The ACIS could evolve to provide experienced people to help in laying out a finished hard copy document, through use of the NLS tools for font designation, formatting, index preparation, etc. 4c3d

Short Range ACIS Objectives 4c4

The initial ACIS services will be a continuation of those dialog and reference support services currently provided by the NIC to the ARPA-IPT community, namely: 4c4a

- Maintenance and distribution of group notes and group note indexes to group members, using the online and offline facilities of NLS and its Journal system. 4c4a1

- Maintenance and distribution of group membership lists. 4c4a2

- Cataloging, indexing, and distributing professional papers of interest to the group members. 4c4a3

- Distributing special community newsletters such as the AI Newsletter. 4c4a4

The primary groups that seem to be candidates for service within the ARPA-IPT community are those that have been served by the NIC: 4c4b

ASS	ARPANET Satellite Systems Group	4c4b1
CBI	Computer Based Instruction Group	4c4b2
INWG	International Network Working Group	4c4b3
IPNWG	International Packet Network Working Group	4c4b4
USING	Network Users Interest Group	4c4b5
NAG	Network Associates	4c4b6
NLG	Network Liaisons	4c4b7
SAG	Network Station Agents	4c4b8
NGG	Network Graphics Group	4c4b9
NMG	Network Measurement Group	4c4b10
FTPIG	File Transfer Protocol Interest Group	4c4b11
PRG	Packet Radio Group	4c4b12
SUR	Speech Understanding Research Group	4c4b13
TEALWING	Tealwing Net Group	4c4b14
TIPUG	TIP Users Group	4c4b15
TUG	Tenex Users Group	4c4b16

One possible outcome of the new ACIS service is that those groups dealing with problems of network resource sharing research (protocols, etc.) would be served by the NIC, the others by the ACIS. No firm decisions have been reached yet on this. As discussed above, the problem is being analyzed at present. We intend to discuss with ARPA which groups should be designated for service. 4c4c

Funding for support of non-ARPA-IPT communities, or for extensions of the services provided, will be negotiated separately when the need arises. However, in order not to cause a serious discontinuity in service, ACIS support of non-ARPA network users would continue until mechanisms and prices for charging for ACIS services have been worked out. This process is expected to take at least six months from the start of the new contract. 4c4d

Further Discussion of This ACIS Proposal 4c5

Dialog and Reference Service 4c5a

This function has two aspects, computer service and clerical service. 4c5a1

The clerical service will produce and distribute the notes, indexes, papers, and membership lists that constitute the hard copy ACIS service to its community, and will maintain the online files that will supplement this hard copy service. Additional analysis and development will be undertaken to evolve the types and kinds of index processing, catalog making, and online services provided, and to implement these. 4c5a2

The computer service comprises the use of the Journal system and of the online files containing the dialog and indexes. These services will be provided through the Workshop Utility. 4c5a3

Computer Support 4c5b

Funding for computer support is for the ACIS staff. The ACIS staff will use NLS and the ARPANET facilities to augment its capabilities to deal with its clientele and information sources. This will require one terminal in use each day. 4c5b1

ACIS users will use the ARC Utility computer, funded separately by ARPA-IPT. It is expected that about 15

percent of ARPA's subscription of the Utility services will be used for these purposes. 4c5b2

Proposal for Research No. ISU 73-128

(J18369) 6-OCT-73 20:05; Title: Author(s): Stanford Research Institute /&SRI-ARC ; Distribution: /JSP DLS (for info) ; Sub-Collections: SRI-ARC; Clerk: JCN ;
Origin: <DOCUMENTATION>APPD.NLS;4, 5-SEP-73 10:14 JCN ;

APPENDIX E

THE ARC ANALYSIS FUNCTION

INTRODUCTION 1

Analysis is an independent function within ARC. 1a

As our system is becoming more complex and as we are moving toward more exploratory applications, we feel that it is necessary that all system evaluations and performance analyses must be conducted in as objective a fashion as possible to avoid being either too "technique-oriented" or too "goal-oriented" in our analytic approaches and in our conclusions. 1b

We feel that an independent function is needed to evaluate NLS in a systematic fashion, to study its environment, and to explore the potential application areas ARC is concerned with. 1c

It is the role of Analysis to provide such an independent support. 1d

We see Analysis as contributing in three main areas to ARC's output: 1e

1) Development and publication of the methodology for analysing Workshop systems;
2) Publication of the results of its studies of existing Workshop systems and components;
3) Feeding back the results of its analyses to Development for guidance of system evolution. 1e1

WHAT ANALYSIS HAS DONE SO FAR 2

So far, only two professionals have been involved in Analysis. They have conducted a series of studies to back Operations, Development, the NIC, and our Applications activities. 2a

The results obtained have been valuable for ARC. A few examples are the following. 2b

A new user allocation system is being implemented as the result of the cooperation between Operations and Analysis. 2b1

A joint effort between Development and Analysis led to significant improvements of the text insertion function in NLS. 2b2

In cooperation with Operations, Analysis has conducted a first comprehensive cost and usage analysis of ARC's computer operations. 2b3

Analysis is studying the economics of text editing, and comparing NLS to other text editors in this respect. 2b4

More recently, a thorough analysis of the NIC has resulted in changes in both NIC's operations and plans (See Appendix D). 2b5

OBJECTIVES OF THE ARC ANALYSIS FUNCTION 3

The ARC Analysis function has the following three objectives: 3a

1) To provide analytical support for all phases of ARC's Operations, Application activities, and Development efforts. This support falls into the following broad categories. 3b

a) Analysis of Specific ARC Activities 3b1

Some needed tasks in this category are: 3b1a

To continue the study of the performance of our time-sharing operations, our NLS environment, our Journal system, the NLS Utility, and all offline operations. 3b1a1

To design and develop a general data collection system, a set of special purpose programs for data reduction, and better analytical tools and procedures. 3b1a2

b) Analysis of User Systems 3b2

Some needed tasks in this category are: 3b2a

To analyze our Dialog Support System (DSS). 3b2a1

To analyze our documentation production and control system (DPCS)t 3b2a2

To analyze the needs for information management systems (not to be confused with management information systems) and to describe their desirable characteristics. 3b2a3

To analyze project management needs and determine what impact the utilization of NLS could have on existing project management methods and procedures. 3b2a4

c) Analysis and Evaluation of Application Areas 3b3

Some needed tasks in this category are: 3b3a

To analyze information flows and information handling requirements of offices. 3b3a1

To study the communication needs and information exchange requirements of geographically distributed communities. 3b3a2

To analyze the need for "augmented community information centers." 3b3a3

To continue the analysis of the NIC operations. 3b3a4

2) To develop the methodology and analytical tools for the experimental study of Knowledge Workshop information handling procedures. This is an extremely important aspect of ARC's overall strategy, which is to develop the capabilities needed for conducting experimental information science and make them available to the community of Knowledge Workshop developers at large. 3c

3) To build up gradually the capability for stimulating cooperation with other analysis staffs throughout the community of workshop builders. 3d

SHORT TERM PLANS FOR ANALYSIS 4

Conduct further sensitivity studies to determine operational bottlenecks in our system. 4a

Develop improved procedures and tools for operational control of all ARC and NLS Utility operations. 4b

This will cover the time-sharing operations and the NLS operations. It will include scheduling of operations, allocation of resources, and cost-benefit studies. 4b1

Launch an analysis program of information handling procedures of general interest to ARC. 4c

A few areas seem to be primary candidates for such analyses. They include, among others, the journal system, the send message system, text creation, the distribution and control of documents, and our PSO operations. 4c1

SOME PROJECTS 5

1) Development of a Generalized NLS Analysis System 5a

We need a system and procedures to conduct systematic analyses of the NLS environment. Specifically, we need a system which would allow us: 5a1

1) to study the frequencies of NLS command usage by organizations, by categories of users, and by individuals or groups of individuals. 5a1a

2) to analyze the timing of NLS commands (CPU time and excecution time, 5a1b

3) to study sequencies of commands, their interval times and their distribution (micro analysis of usage patterns) 5a1c

4) to conduct ex-post facto analyses of individual sessions, of specific jobs, and of critical events. 5a1d

5) to provide the capability to reconstruct paths leading to poor performances and to identify sources of trouble. 5a1e

6) to determine performance changes that may accompany, for instance, introduction of new features, modification of operational procedures, changes in environmental conditions, or results of training programs. 5a1f

Some tasks to be worked on: 5a2

1) Design and develop a generalized NLS data collection system. 5a2a

2) Design and develop specific data reduction programs for analysing the collected data. 5a2b

3) Develop appropriate analysis procedures for the various functional requirements. 5a2c

4) Develop appropriate reporting procedures. 5a2d

5) Develop testing procedures for operational control and training purposes. 5a2e

6) Conduct tests and measurements of existing NLS environment (ARC, Network Users and Utility). 5a2f

7) Conduct specific analysis requests for the NLS user community. 5a2g

2) Analysis of the Needs for an Information Management System 5b

The introduction of office automation technology and augmentation techniques will strongly affect information management at all levels of activities. There is a need for much improved information handling at the knowledge worker's level, at the office level, at the organizational level and, in general, at the community level. 5b1

In particular, there is a need for handling online working references, for managing online files, for handling hard copy documents in their flow through organizations, and for coordinating all these needs in a unified manner. 5b1a

There is a need to analyse from our point of view what all these requirements really are, to describe them in a unified fashion and to study what new system features of NLS should be developed to meet these requirements. 5b2

3) Analysis of Project Management Needs 5c

Project management becomes extremely difficult when a project becomes large and complex. Many methods for the management of such projects do exist and are being applied in both government and industry, and it appears that some of these currently used techniques might be adaptable for use with NLS. 5c1

The goal of this project would be to explore these possibilities, and to make recommendations about the desirability of implementing them within NLS. 5c2

STAFFING REQUIREMENTS 6

Presently, only two professionals are involved full time in the ARC Analysis function. 6a

As ARC moves along into more application areas and builds up both its development efforts and operations, the role of Analysis will become much broader and much more central in the evolution of the community of workshop builders. Additional people will have to be added to Analysis if it is to fulfill its role. 6b

The following projections summarize our expected minimal staffing requirements for these activities over the next two to three years. 6c

Functions	(man/years) 1973	1974	1975	
Development of Analytic Tools and Procedures . . .	.25	.75	.75	
Analysis of AKW Technology . .	.75	1.50	1.50	
Analysis of Application Areas .	1.00	1.75	1.75	
Total	2.00	4.00	4.00	6c1

Proposal for Research No. ISU 73-128

(J18370) 6-OCT-73 20:09; Title: Author(s): Stanford Research Institute /&SRI-ARC ; Distribution: /JSP DLS (for info) ;
Sub-Collections: SRI-ARC; Clerk: JCN ;
Origin: <DOCUMENTATION>APPE.NLS;6, 5-SEP-73 10:13 JCN ;

Proposal for Research No. ISU 73-128

Proposal for Research No. ISU 73-128

APPENDIX G

BASIC KNOWLEDGE WORKSHOP COMPUTER SYSTEM ARCHITECTURE

INTRODUCTION 1

There is much overlap in the body of technique used to design and implement a wide variety of computer systems. Each major class of system does have problems unique to it either requiring different techniques from other classes or differing in the way it applies techniques common with other classes. Areas of study have grown up to research and develop the bodies of technique in major classes such as language and compiler design, simulation, mathematical modeling, numerical analysis, operating system, and heuristic programming. Knowledge workshop systems is a new area that, we believe, has problems, the solution of which, will lead to the growth of a new discipline. 1a

In Appendix A there is a section "Basic Assumptions about Augmented Knowledge Workshops" (14724, 3) which describes general characteristics that one would like to achieve in a workshop. This appendix lists these problems from another point of view, the presently planned redesign and implementation of NLS during the coming contract period in a new programming system, "Modular Programming System," (MPS) being jointly developed by ARC and Xerox-Parc. The origin of work on this system was intially motivated to solve a number of problems associated with Knowledge Workshop design and implementation. The document incorporated below was motivated as a discussion for management on the merits of undertaking a redesign using MPS and some alternative implementation stategies. It was written by Chuck Dornbush, Charles Irby, and Jim Mitchell (Xerox-Parc). 1b

A LOOK AT THE MPS CONVERSION 2

INTRODUCTION 2a

In the next couple of years, the system developers at ARC would like to make the following kinds of changes and extensions to NLS: 2a1

Reimplement a mixed text and graphics capability. 2a1a

Combine all of our data base management facilities into one coherent and considerably more powerful (in fact, perhaps external to NLS) common data base management system. 2a1b

Redesign and reimplement the Journal and Ident systems to take advantage of the new data base management capabilities

and to greatly enhance the retrieval capabilities these systems must provide in order for there to really be a Dialog Support System. This includes making the Journal Processes considerably faster and supporting multi-site journal and Ident systems. 2a1c

Allow reasonably easy, fairly efficient access to other subsystems (perhaps on other machines in the NET) through NLS. This must be a rather powerful linkage, since we wish to be able to move data to the remote subsystem from NLS files or from the user and get data back to the user or into his files. 2a1d

We want people to be able to construct specialty functions in other programming languages which can couple with NLS in this manner. This includes the ability for these programs to access NLS capabilities and to manipulate information portrayals (such as on display screens) for the user. 2a1d1

We should also provide facilities which can be used by other programs in the NET to provide users with NLS capabilities without those users having to be aware that they are using NLS. 2a1d2

Support extended character sets (Greek alphabet, mathematical symbols, etc) in addition to a wide variety of fonts and sub- and super-scripts. 2a1e

Support multi-site NLS's: that is, a single NLS that is running on more than one computer. For example, the interactive command specification could be done "near" the user and the file manipulation could be done "farther" from him. One can imagine the use of specialty machines or systems for rapid text scanning or substitution, data base management, specialized display processing, or large-scale computation. 2a1f

Support a wide variety of terminals, adapting appropriate user interfaces for each type of terminal, without major changes to NLS. That is, to whatever extent possible, provide terminal independent command language specification. This allows us to make new subsystems and new commands without regard to the particular user feedback required for each type of terminal. 2a1g

Increase the execution efficiency of NLS. 2a1h

Provide command language programming facilities. 2a1i

Provide a file system that can accommodate a wide variety of data, not just text and/or graphics. We envision a LISP-like property list associated with each node in an NLS file, where the "property" indicates the form of its data and specifies a set of access functions for manipulating it. 2a1j

Provide "virtual" files which the user perceives (and manipulates) as a simple collection of information, but may, in fact, be parts of several physical files. We feel that a user should be able to take alternative paths through his information and have it presented to him in different ways (with access and manipulation rights dependent upon the path taken). 2a1k

Provide increased user assistance features. This can most readily be done by having the command language described in a data structure which assistance facilities can examine. 2a1l

Provide a broad range of formatting capabilities for display users. This means that one should be able to see the result of powerful formatting (such as the Output Processor now provides) and still edit the file(s). More work should be done on formatters. New ways should be sought to describe the format (or at least certain aspects of it) independent of the file. 2a1m

In addition, we must provide a solid NLS to network users through the NLS Utility Service. 2a2

The remainder of this paper discusses the problem areas which must be dealt with in order to proceed with the above objectives. We include a discussion of possible alternative development strategies and a recommendation for the approach we should follow. 2a3

THE SOFTWARE ENGINEERING CRISIS 2b

Although the goal of providing good software engineering tools sometimes conflicts with the shorter term problems of programmers and managers, the penalties in cost and reliability associated with nonmodular software are so high that decisions about modular programming systems and methodologies should reflect the best available engineering techniques. 2b1

The current economics of large computer systems suggest that software development costs exceed hardware costs, and the day is coming when software system vendors will throw in computer hardware as a free bonus for the purchase of a software system (even today, one can buy in quantity a small computer on three

chips for about ten dollars). Faced with rising software development costs and plummeting hardware costs, we must face up to the realities of large software systems: 2b2

Machine dependence 2b2a

The expected lifetime for most software systems exceeds that of any piece of computer hardware and should be independent of the supporting hardware processor. 2b2a1

Modularity 2b2b

The hundreds of pieces in a large software system are developed over a long time period. Each component must be produced and verified independently of other software components in the system. Symbols must be localizable, to avoid the plight of most systems in which only one level of external communication is supported. 2b2b1

The external interfaces for any module must be explicitly defined and documented. The implementation language should require the explicit specification of module interfaces to allow mechanical verification of module interconnections. 2b2b2

There must be reasonable facilities for keeping track of existing modules, their functions and interfaces, and the structure of systems built from them. 2b2b3

Reliability and Maintainability 2b2c

Systems which are intended to be used by people in their day-to-day work must, like the telephone and power utilities, be extremely reliable. The economic and psychological consequences of their being unreliable would be disastrous. Learning to make software more reliable and robust is, therefore, a major concern of research into human augmentation. 2b2c1

In most large software systems the costs of enhancements made subsequent to initial implementation (usually referred to as program maintenance) exceed the development costs over the lifetime of the system. This is clearly true of our environment. 2b2c2

Moreover, each change makes the following one more difficult and the system more difficult to alter; this is almost certainly not completely preventable, but the aging of a system can probably be slowed down

significantly by paying attention to its health (cleanliness of interfaces) as part of its maintenance and development. 2b2c3

THE INDICATED SOLUTIONS 2c

The challenge of producing software that satisfies the requirements of a constantly evolving system requires a set of sophisticated engineering tools. Among these are: 2c1

1) An implementation system which supports software engineering practices, including 2c1a

A) a high level (machine independent) implementation language. 2c1a1

See Attachment B. 2c1a1a

B) source language debugging facilities. 2c1a2

C) program integration tools: dynamic loading, virtual process binding, address space management, and control of system structure and module interrelationships. 2c1a3

2) Design and documentation methodologies that encourage modularity. 2c1b

Extensibility and modifiability are attributes that must be built into the system from its inception; they cannot be retrofitted. 2c1b1

3) Software production tools that allow collaborative development work. These include system documentation aids which understand programs and their interconnections, and not just text-editing or (syntactic) information retrieval techniques. 2c1c

4) Software measurement tools that provide performance analysis data based on measurement of the running system. 2c1d

2c1e

The MPS system was conceived and is being developed to meet some of these needs. 2c2

The MPS approach toward the development of large software systems: 2c3

The Modular Programming System (MPS) is a set of tools for

the development and continued evolution of large software systems in an interactive environment. All such large software systems share certain characteristics: 2c3a

(a1) they are the work of a group of people whose membership will change over time. 2c3a1

(a2) they are necessarily constructed from a number of separately developed programs. 2c3a2

(a3) they evolve and grow throughout their lifetimes (and there is evidence that they also "age" [Lehman & Belady]). 2c3a3

MPS aims to decrease the effort required to build and evolve such systems and to increase the reliability of the resultant products. 2c3b

Points a1, a2, a3 are axiomatic statements about the dynamics of all large software systems. The following discussion uses these and a few other axioms to establish desirable characteristics for MPS. Hopefully there is a minimum of hidden meaning in the following: Each axiom and consequence is intended to be taken strictly at face value. 2c3c

We first add two more axioms to the above set: 2c3d

(a4) Large software systems must be able to take advantage of available hardware for efficiency. 2c3d1

(a5) Program bugs are not known before they occur. 2c3d2

(a4a) a1-a4 imply that software components, hereafter called modules, should be separately compilable and debuggable. Therefore there must be a way of linking or binding separate components together to provide an environment (data and programs) within which a module can be debugged. 2c3e

(a6) In an interactive programming environment, users must be able to develop and use debugging tools applicable to programs in the same programming system. 2c3f

a4a, a5, and a6 together imply that 2c3g

(a6a) the environment of a program must be dynamically alterable; 2c3g1

(a6b) a program should not have to be altered when its environment changes in ways which do not affect the

semantic intent of the program--this is called programming generality. 2c3g2

(a3a) a3 suggests that a desirable characteristic for tools for building large systems should be that the energy to change part of the system should be more a function of the complexity of the change than of the size of the system. This is very hard to achieve in practice, and perhaps the best we can do is to make it a function of the interconnectedness of the system local to the change. 2c3h

(a3b) A new system always has parts that are functionally similar to previously developed systems. The new system may therefore be regarded as a change (though perhaps substantial) to an older system. (a3a) then points out the necessity for being able to reuse components that have been made reliable through usage. This increases the initial reliability of the new system, decreases its cost, and speeds up the trying of new ideas. 2c3i

(a3c) One way of constructing useful components is to build them from combinations of already existing modules (a3b). Hence there must be a way of bundling useful configurations together as seemingly atomic modules so they can be readily reused. 2c3j

THE PROBLEMS OF THE CURRENT NLS SYSTEM 2d

NLS is a large, costly, and intricate software system. It provides the user with powerful and sophisticated infomation handling tools, yet as a software system it has several problems. We have attempted to identify the general problems of the NLS software system with the premise that it is essential to address the problems of NLS in order to extend its capabilities. 2d1

The problems of NLS may be tracked to two general sources: insufficiently powerful implementation facilities and design deficiencies in portions of the system. Most of the troubles of NLS stem from the first source, and it should be noted that the NLS system is quite nicely designed and integrated (compared to many large software systems). 2d2

The general problems of the NLS system are: 2d3

1) NLS is difficult and expensive to maintain and modify. 2d3a

As already stated above, most of the cost of a software system is encountered in the maintenance and enhancement

phases of the system which follow its initial development. 2d3a1

These high costs are principally a result of shortcomings in the software development methodologies and tools. More specifically we feel NLS is difficult to change because: 2d3a2

It has diffuse functional interfaces. 2d3a2a

The information bandwidth along functional interfaces is large. Most parts of NLS make significant assumptions about facilities provided by another part of NLS. The bandwidth of assumptions spanning the functional interfaces provides some measure of the degree of interconnectedness of the system, and it is the degree of the interconnectedness that impacts the difficulty of changing any part of the system. Using global, shared variables to pass information between procedures obscures the true complexity of their mutual interface. 2d3a2a1

Its communication paths are unverified. 2d3a2b

Program modules establish communication paths to program data and function facilities. The user and provider of the data/function facilities must agree on the reference protocol and definition of the facility. L10 provides no capability for verifying the correspondence between formal and actual arguments for a function or between the definition and usage of data structures. 2d3a2b1

It is difficult to modify data representation. 2d3a2c

L10 does not provide sufficient data definition and structuring facilities. The RECORD and FIELD facilities are useful but are not general or powerful enough to describe many data structures. 2d3a2c1

The fact that the syntax for accessing some data or functional facility in the L10 system is dependent upon the type of the object (a different notation is used for functions and arrays for example) implies that a change in the implementation strategy for a particular program facility may require that all of the references be altered as well. Finding and editing all of the references in

a large software system is difficult, unreliable, and expensive. 2d3a2c2

It is difficult to control the scope of names. 2d3a2d

The scope rules are not flexible enough to support modular programming development. It is not possible to assure name uniqueness across independently developed parts of the system. 2d3a2d1

The command parsing for NLS is not centralized. 2d3a2e

Making significant changes to the NLS command language necessitates modifying many of the components of the system because command parsing is distributed too widely. 2d3a2e1

NLS has inadequate system documentation, and it is difficult to learn about the design and actual implementation of the system. 2d3a2f

2) NLS is running out of address space. 2d3b

Currently there are about 65 pages of address space remaining for NLS on the PDP10. We can not continue present cumulative development techniques much longer as the address space problem will solidly halt development work until solved. NLS was not designed to support an overlay system, and the retrofit of a segmentation or overlay system into the present NLS would be a substantial effort. 2d3b1

3) NLS is tied to processing exclusively on PDP10's. 2d3c

L10 is quite machine dependent and the machine and operating system dependencies are widely dispersed throughout the system, making it difficult to move any of the present NLS system to a non-PDP10 processor or one which does not run TENEX. 2d3c1

4) NLS is expensive. 2d3d

The execution cost of NLS is high and on a feature-by-feature basis is not competitive with other corresponding software systems. NLS encompasses more capabilities than any comparable software system, yet that seems an insufficient reason to tolerate high computer costs for NLS. One way to lower the cost of NLS would be to build the system so that part of the

processing may be distributed over more efficient special application computers. Global code optimization and better structuring can improve the efficiency of NLS. 2d3d1

EVALUATION OF ALTERNATIVE DEVELOPMENT STRATEGIES 2e

Given that the NLS system has a known set of deficiencies common to most large software systems, the question is "What development strategy is most appropriate for accomplishing the goals of 1) significantly extending the capabilities of NLS, 2) solving existing NLS problems, and 3) providing a solid software foundation for NLS which will facilitate future NLS development?" 2e1

A set of five alternative development strategies are suggested below. Each has its own merits and drawbacks. We have highlighted the implications of each strategy and have tried to assess the long range as well as shorter term implications of each method. 2e2

PLAN 1--Status Quo approach. 2e2a

The status quo approach is the continuation of present development strategies utilizing present development tools. 2e2a1

Advantages: 2e2a1a

1) System remains stable and intact. 2e2a1a1

2) No resources are "diverted" from NLS enhancements to the development of better software engineering tools. 2e2a1a2

3) Retraining of development personnel is not required. 2e2a1a3

Disadvantages: 2e2a1b

1) Solves none of the problems of the present NLS system. 2e2a1b1

2) Likelihood of significantly extending the capabilities of NLS is very low. 2e2a1b2

Discussion: 2e2a1c

It appears that this course of action is a dead-end route. The address space problem is very real and

will soon halt NLS enhancements until it is solved. The cost of maintaining and incrementally modifying the present NLS system is proportional to its size, and this cost will continue to rise. Our development resources will eventually be consumed in maintenance activities, and it is doubtful if much of the planned growth for NLS can be accomplished using this approach. 2e2a1c1

PLAN 2--Reimplementation of NLS using existing L10 system. 2e2b

This strategy proposes that major portions of NLS be redesigned and reimplemented to improve and enhance NLS and provide a better foundation for future development work. 2e2b1

Advantages: 2e2b1a

1) Some of the present NLS problems can be solved. 2e2b1a1

-overlay mechanism can be built to solve the address problem. 2e2b1a1a

-the command parsing can be centralized. 2e2b1a1b

-the system may be redesigned so it can be distributed over several PDP10s. 2e2b1a1c

-the system can be made more efficient. 2e2b1a1d

-the functional interfaces may be cleaned up. 2e2b1a1e

Disadvantages: 2e2b1b

1) Doesn't solve some of the most critical problems of NLS (which are due to current development tools, not simply shortcomings in the present implementation of NLS). 2e2b1b1

2) High cost (relative to payoff). 2e2b1b2

Discussion: 2e2b1c

The redesign and reimplementation of NLS using present development tools can obviously solve only those problems that are related to design or implementation inadequacies of the current implementation. Unfortunately, some of the most costly problems of NLS are related to our current

development tools and methodology, and a change in this area is indicated if we hope to be able to address these problems. 2e2b1c1

PLAN 3--Improve L10 development system, then reimplement NLS. 2e2c

This development plan calls for the improvement of the L10 implementation tools followed by the redesign and reimplementation of NLS using the improved system. 2e2c1

Many of the deficiencies of the NLS system as enumerated previously may be directly related to deficiencies in the L10 implementation system. Specifically, we have identified eight shortcomings of the L10 system that have direct impact on the current software problems of NLS. 2e2c2

Some problems of the current L10 system: 2e2c3

1) Inadequate data definition facilities. 2e2c3a

2) Uncontrolled and unverified procedure interfaces. 2e2c3b

3) Minimal type checking performed by the compiler. 2e2c3c

4) Lack of a consistent reference notation. 2e2c3d

5) Inadequate control over the scope of names and definitions. 2e2c3e

6) Insufficiently optimized code. 2e2c3f

7) Machine dependence. 2e2c3g

8) Complete data/procedure definitions not available at compile time. 2e2c3h

In asserting that the L10 system can be changed, we should identify exactly what changes are contemplated and how they may possibly be accomplished. 2e2c4

Plan 3A--First extension to current L10 system 2e2c5

Items 1-5 listed above are principal contributors to the difficulty of change problems of NLS. If we expect to have a meaningful impact on the modifiability of NLS, then it is essential that this set of L10 problems be addressed. 2e2c5a

Let us consider then that this constitutes the minimum set of L10 enhancements that are essential for providing better development tools. 2e2c5b

Advantages: 2e2c5b1

1) Provides a software implementation system for the production of more modifiable software. 2e2c5b1a

2) Cleans up most of the major problems of NLS. 2e2c5b1b

Disadvantages: 2e2c5b2

1) The level of effort required to implement these changes to L10 is large and may easily exceed that effort required to complete the MPS system. 2e2c5b2a

2) Requires a transliteration of NLS; that is, the changed L10 could not directly compile existing L10 code. 2e2c5b2b

Plan 3B--Second extension of L10 system 2e2c6

Plan 3B is to extend L10's scope of names rules to a general name space system incorporating the INCLUDE definition facilities of MPS. 2e2c6a

Advantages: 2e2c6a1

1) Solves the restricted name space problem. 2e2c6a1a

2) Fairly inexpensive to implement. 2e2c6a1b

Disadvantages: 2e2c6a2

1) Does not impact most of the problems. 2e2c6a2a

2) Requires a restructuring of NLS. 2e2c6a2b

3) Requires a new loader and probably new debugging tools. 2e2c6a2c

Plan 3C--Third extension of L10 system. 2e2c7

Plan 3C calls for turning L10 into a globally optimizing compiler in order to increase the execution efficiency of NLS. 2e2c7a

Advantage: 2e2c7a1

1) Gain in efficiency. 2e2c7a1a

Disadvantage: 2e2c7a2

1) Difficult to implement in Tree-Meta L10. 2e2c7a2a

General discussion: 2e2c8

The MPS system was designed and is being developed to solve the problems of the L10 implementation system. The decision was made some time ago to develop MPS independently of the L10 system. Plan 3 is a rejection of this idea and a proposal to enhance L10 until it approaches the capability of MPS. Theoretically, it is possible to accomplish this, but the amount of effort required to significantly extend L10 is greater than the effort required to develop MPS. 2e2c8a

It appears that there are no significant advantages and several disadvantages to this development strategy. 2e2c8b

PLAN 4--Incremental conversion of NLS to MPS. 2e2d

It is technically possible (albeit not efficient) to coerce the MPS system to communicate existing L10 programs. It is therefore technically possible to utilize portions of the present L10 system in a hybred MPS-L10 environment. 2e2d1

Advantages: 2e2d2

1) Permits some conversion to be distributed over time. 2e2d2a

2) User programs may not require conversion. 2e2d2b

3) Some feedback is obtained on the relative merits of the MPS system. 2e2d2c

Disadvantages: 2e2d3

1) The new NLS my be unstable because the interfaces between MPS and L10 sections cannot be verified and controlled. 2e2d3a

2) Restricts the redesign of NLS to compatibility with the present implementation for those portions of the current system which would be candidates for incorporation in the hybred system. 2e2d3b

3) Requires most of NLS to be converted before it can be run under MPS. 2e2d3c

Discussion: 2e2d4

The drawbacks of system instability and redesign constraints make this alternative quite unattractive. Elegance in software engineering is more than just a pretty word. Every ad hoc or "kludged" interface in a software system is a crack in its foundation; an edifice as large and interface replete as NLS can tolerate very few cracks. 2e2d4a

PLAN 5--Reimplementation of NLS using MPS system. 2e2e

This strategy calls for the redesign of NLS to take advantage of the features of the MPS system and simultaneously extend the capabilities of NLS. The redesigned NLS would then be implemented completely in MPS. 2e2e1

Advantages: 2e2e2

1) Potentially solves all of the existing NLS problems (assuming a documentation methodology is developed and utilized for the design and implementation). 2e2e2a

2) Provides an NLS system with significantly improved capabilities. 2e2e2b

3) Provides a solid NLS system and software implementation facilities that will permit future research and development work at minimum cost. 2e2e2c

Disadvantages: 2e2e3

1) High initial cost. 2e2e3a

2) May have to debug MPS facilities while developing new NLS system. 2e2e3b

Discussion: 2e2e4

This strategy has the highest potential payoffs of any

of the proposed plans, but it also has some risks. It appears that simple economics will eventually demand the adoption of this plan. 2e2e4a

CONCLUSION 2f

Within any of the suggested development plans, two approaches can be taken: 2f1

1) as much of the development staff as is possible could be diverted to solve the existing problems and provide a basis for future growth (resulting in a period during which no new user features or improvements are observed), and 2f1a

2) a small group could take a copy of the system and make the intended modifications, leaving the rest of the staff free to add features within the constraints of the aforementioned problems. 2f1b

The NLS in MPS Design Team (NMDT) currently favors this second approach. 2f2

The above analysis indicates the following course of action. The NMDT should begin the redesign work for NLS in the MPS environment. They should draw on the support of the rest of the group as needed and should endeavor to keep the rest of the group abreast of their progress. This leaves the rest of the development staff free to continue enhancing the existing system. At some point in the future we will have two systems, one in MPS (NLS/MPS) and one in L10 (NLS/L10) with additional features. At this point an intensive training effort should begin so that the whole staff can bend itself toward moving the enhancements in NLS/L10 to NLS/MPS in a way that is consistent with its design philosophy and implementation conventions. This should result in maximal gain in user facilities at minimal long-term cost. 2f3

Attachment A--a closer look at Plan 5 2g

Description of the software engineering capabilities of MPS 2g1

To satisfy software engineering objectives, MPS has concentrated on providing the following capabilities: 2g1a

[ ]Control mechanisms which enable modules to be linked together with a minimum of built-in assumptions about how each module interprets control transfer over the link between them. 2g1a1

-Simple function call and return mechanisms alone do not satisfy this requirement since they already impose assumptions about how each module is being used; i.e., each one is either a caller or a callee. 2g1a1a

[ ]Data definition facilities that 2g1a2

-clarify the specification of the data structures which, together with control, completely specify the interfaces between modules, 2g1a2a

-are potentially economical in space and accessing speed without being dependent on a particular machine, and 2g1a2b

-are an aid in developing and describing program components and the structure of algorithms. 2g1a2c

[ ]Facilities for dynamically binding the virtual objects required by a module for execution to real objects. 2g1a3

-E.g., binding a procedure call to a real procedure with a "typed" pointer to a data structure of the correct type. The set of bindings for a module's virtual objects at a given moment comprises the environment for that module. 2g1a3a

[ ]Complete accessibility to the MPS "virtual machine" (which is a set of primitive MPS programs) and to MPS programs as data structures. 2g1a4

-This enables debugging and measuring tools to be built as standard MPS programs and along with dynamic binding allows such tools to be brought to bear on MPS programs whenever necessary. 2g1a4a

[ ]The ability to bundle a configuration of data and program modules together as a module which may be saved for later use just as a simple, atomic module. 2g1a5

-This allows systems to be initialized, partially executed and then bundled up for later use with the overhead of the initial computations factored out; 2g1a5a

-It also allows a configuration which has exhibited a bug to be saved away for later perusal with its state as it was when the bug was discovered; 2g1a5b

-Lastly, it allows useful modules to be constructed by

configuring them from other, existing modules. This is in the spirit of using already available components whenever possible and provides some logical completeness to the system. 2g1a5c

Previous work in this area 2g1b

The modularity/process/port/virtuality ideas have been successfully used by Rudy Krutar in several systems including an interactive extendable language system. 2g1b1

A number of fairly complex, large programs have been implemented and are running in MPS; these include the MPS compiler itself, loading and binding facilities, and the MPS debugging and measurement packages. 2g1b2

Advantages of implementing NLS in MPS 2g2

What we are looking for from MPS and the conversion: 2g2a

Include facility of MPS allows modules to share data definitions and allows programmers to control what is or is not shared. 2g2a1

Change single module rather than reloading entire system 2g2a2

MPS will check consistency between declaration and usage of data and will check consistency of module interconnection, and will indicate to programmers that re-compilation of a module m, also requires recompilation of modules k,l, and n--and in fact will not allow these module to execute until they have been recompiled. 2g2a3

MPS can also supply static information about module interdependency. 2g2a3a

These facilities can be used to supply information about the cost of an anticipated modification to a module in terms of required recompilations of modules which include it. 2g2a3b

Further MPS development should provide the ability for one or more modules to be interpreted while the rest are compiled. This allows programmers great flexibility during software development and debugging, and should provide for easily written (albeit less than optimally efficient) programs to perform tasks which do not warrent large development cost (similar in nature to the current Content Analysis filters). 2g2a3c

Ability to dynamically reconfigure the system allows for insertion of test or debugging modules and replacement of modules for testing updates or new configurations. 2g2a4

More powerful control over the scope of symbols. 2g2a5

Segmention (automatic overlay) system will help us out of our current upper bound problem and will make better use of available memory space. 2g2a6

Virtual external references provide flexibility. Modules communicate via ports and may connect any other module to the port, provided the interface requirements are met, or may replace any module by another that satisfies the interface requirements. 2g2a7

Reliability 2g2a8

-Simpler relationships and dependencies 2g2a8a

with aids for the programmer to keep track of these. 2g2a8a1

-Better definitions of interfaces. 2g2a8b

-Ability to put a module into a test-environment for testing. 2g2a8c

-Mechanical interconnection verification. 2g2a8d

Efficiency 2g2a9

-The system should gain significantly in terms of efficiency because of better global optimization (more efficient overall organization). 2g2a9a

-Fully typed data structures and restricted control flow allow compiler to produce more efficient code. 2g2a9b

-Several basic mechanisms are faster in MPS than in L10. 2g2a9c

-Co-routine linkage can save setup time for frequently used routines and may help in overall design. 2g2a9d

-Better control facilities, especially SIGNAL's. 2g2a9e

-Ability to redefine procedures should clean up many

procedure interfaces and will reduce the number of procedures. 2g2a9f

-Since the compiler is heavily used by system programmers, it behooves us to have it be efficient as well as to have it produce efficient code for the programs which it compiles. Since the MPS compiler is written in itself, all optimization improvements made in the compiler can be brought to bear on the compiler itself. 2g2a9g

Ability to interface special purpose "subsystems" to NLS 2g2a10

May interface modules responsible for NLS file handling, display generation, etc. to new modules to make special subsystems of NLS. 2g2a10a

Transportability 2g2a11

Language for MPS and the system primitives should be relatively easy to move to other machines and operating systems. 2g2a11a

Very few primitives written for the base machine. 2g2a11b

All of MPS written as modules by bootstrapping. 2g2a11c

Compiler completely writtten in MPS. 2g2a11c1

Compiler implemented so that machine dependence is restricted to only a few modules. 2g2a11d

Ability to access remote systems 2g2a12

New design plus MPS dynamic reconfiguration of modules allows for more reasonable linkage of NLS to other subsystems and the distribution of NLS processing over more than one machine. 2g2a12a

Well defined interfaces, dynamic loading, and modularity also make it possible for other groups to build modules to run with NLS. 2g2a12b

Costs of Implementing NLS in MPS 2g3

The cost of the conversion to MPS has at least three different aspects. 2g3a

The actual implementation cost (the manpower and computer resources). 2g3a1

The diversion of development resources for the implementation period. 2g3a2

A transition period of instability. 2g3a3

Detailed implementation estimates will be issued periodically during the design phase for the NLS conversion. 2g3b

Attachment B--Our requirements in terms of an implementation language 2h

A general data definition capability 2h1

Adequate data types 2h1a

clarity of expression, consistency checks 2h1a1

Flexibility of data structuring 2h1b

one is strongly influenced by the data structures available in a language. 2h1b1

General block structuring with scope of names 2h2

Descendent blocks 2h2a

A generalized reference notation 2h3

Array references 2h3a

Function referencees 2h3b

Pointer qualification 2h3c

Name qualification 2h3d

Macro syntax 2h3e

Explicit definition of module interfaces 2h4

Required declaration of all external data and procedures 2h4a

Declaration of formal arguments 2h4a1

Type 2h4a1a

Number (optionality) 2h4a1b

An economical way to call a routine with a variable number of arguments 2h4a1b1

Access permitted 2h4a1c

Read only, read and write (this is in addition to the ← and = initialization capability in MPS). 2h4a1c1

Declaration of external data 2h4a2

Type 2h4a2a

Access permitted 2h4a2b

read only, read and write (this is in addition to the ← and = initialization capability in MPS) 2h4a2b1

In addition, a facility for designating that some routines and data structures in the outer most block are not to be included by another module. 2h4a2b2

Simple and consistent syntax 2h5

Consistent expression syntax 2h5a

Infix operator notation for common operators 2h5a1

Prefix (functional) notation for all other operators 2h5a2

Equivalent to built in functions--must have the same syntax as a function reference 2h5a2a

Mixed mode expressions not allowed 2h5a3

Coercions must be explictly requested. 2h5a3a

Built-in functions provide for conversion of data types. 2h5a3b

Powerful and useful control statements 2h6

Goto's should be superfluous 2h6a

A program is more easily understood if it does not have random Goto statements in it. 2h6a1

18372 Distribution 1
John S. Perry, Duane L. Stone, 1a

DVN 9-JAN-74 19:55 18373

PSO Will Not Meet on the 10th

PSO will NOT meet to exchage information as usual this Thursday at 2:00 in the Parsley We will meet on the 17th instead.. JML KIRK and MEJ are expected to attend, and everyone is welcome.

*****Note: Author Copy*****

1

DVN 9-JAN-74 19:55 18373

PSO Will Not Meet on the 10th

(J18373) 9-JAN-74 19:55; Title: Author(s): Dirk H. Van Nouhuys/DVN; Distribution: /PSO; Sub-Collections: SRI-ARC PSO; Clerk: DVN;

Qucik Reference New DNLS for Old DNLS Users

(J18374) 8-JAN-74 15:54; Title: Author(s): Dirk H. Van Nouhuys/DVN;
Distribution: /SRI-ARC RADC DHC NJN JSP LEG MCG; Sub-Collections:
SRI-ARC RADC NIC; Clerk: DVN;
Crigin: <VANNOUHUYS>NEWT.NLS;3, 8-JAN-74 15:31 DVN ;

DVN 8-JAN-74 15:54 18374

Qucik Reference New DNLS for Old DNLS Users

This is a very brief account of the most important ways in which New DNLS is different to use from Old DNLS. I hope to reissue this document as changes in the experimental system demand and to issue a TNLS version. 1

Questionmark (?) 2

The new NLS is blessed with excellent questionmark facilities. In both display and TNLS ? at any point will print out the choices available to you. Note ? changes its output with each new step in a command. 2a

<control-q> 3

<control-q> puts you into the HELP subsystem and into the HELP data base at a point corresponding to what you were doing in NLS when you struck the character. Both in data base and software HELP is now bug-riddled, but it may soon become useful. 3a

Subsystems: 4

The commands in NLS have been divided into subsystems. The commands we use most are in the editor subsystem. Others are or will be available through: calculator, help, identification, journal, programs, TENEX, and user-options. 4a

In the current experimental system, subsystems come up and down, you have to try them to know which one is working. 4b

To go to another subsystem, type G for Goto and then first letter of the subsystem's name. Quit returns you to the previous subsystem in a ring. The name of your current subsystem appears in the upper left corner of the screen."<" prints out your subsystem ring. 4c

Execute allows you execute one command in a subsystem and pop back to the previous subsystem. 4d

The Journal: 5

It does not work in Experimental NLS. 5a

Recognition: 6

New NLS has several recognition schemes. I assume that any of you will use expert recognition.
<documentation,help,recognition>explains the others. 6a

In expert mode some list of command words is possible at any point

following the prompT C:. From that list, NLS will recognize and echo the most commonly used word by its first character. To use a command word that is not commonest, you have to type a space and then type characters until NLS can recognize. E.g. from the command base state "S" will evoke "substitute", but to get "Set" you must type "se" and to get Stop " st". I have found that 3/4 or more of my commands are first-character commands. 6b

In expert mode, if you type an impossible letter, NLS will question you, and allow you to put in another letter instead. I.e. O D P will succeed althought the command is now Output Printer because no "D" may follow "Output". 6c

New Command Names: 7

Old Commands: 7a

The most important commands that have changed the first command word are as follows, with the old name first: 7a1

Execute Assimilate = The filter option in the commands that copy or delte structures 7a1a

Execute Device Type = Simulate Terminal Type 7a1b

Execute File Veryfy = Verify File 7a1c

Execute Insert Sequential= Copy Sequenctial 7a1d

Execute Logout = Logout 7a1e

Execute Marker Fix = Mark Character (also Delete Marker) 7a1f

Execute Marker List = Show Marker List 7a1g

Execute Status = Show Status 7a1h

Execute Unlock = Delete Modifications (also Undelte Modifications) 7a1i

Execute Viewchange = Goto Useroptions 7a1j

Execute journal = Goto Journal 7a1k

Goto Display Area Vertical/Horizontal Split = Split Window Vertically/Horizontally. 7a1l

Link (in TENEX) = Connect toTterminal 7a1m

Null File = Create File 7a1n

Output Device Printer = Output Printer 7a1o

Output File = Update File Compact 7a1p

Sendprint (in TENEX) = Output Remote Terminal 7a1q

Update = Update File + Options 7a1r

New Comands: 7b

Directory Commands:
Now you can deal with your directory in NLS as well as in TENEX. Delete File, undelete File, Trim, Expunge etc. in NLS. Copy Directory copies your directory into a file as a plex. Options in Copy Directory allow you to see the information TENEX has about your files in various orders. Show Directory puts the same information on the screen so command accept wipes it away. 7b1

Set Commands:
With Alternatives following Set you can control recognition, prompts, viewspecs, and create what used to be called a content analyser pattern. For every Set a Reset command returns you to the default. 7b2

Repetition: 8

By default the system now returns to base command state after every command, BUT, if you end any command with A Repeat Character the system will carry out the cmmand, return to base command state, and go forward in the same command until it meets a field that is not a command word. You may then step back through the command word-by-word with <controlb-a>. The parser will continue to repeat the command in that way until you hit Command Delete. The effect is very much like creating a mode for each command like the old jump mode. 8a

If you hit Repeat Character at command reset, it will repeat the previous command out to the first field that is not a command word. 8b

By default the Repeat Character is <control-b>. 8c

The righthand two buttons of the mouse, up and down, enter <control-b> 8d

Cptionss and Alternatives 9

When several command terms may follow a given command term (as plex, branch, etc. may follow delete or typing or a bug may follow Replace) we speak of alternatives. When typing the Option Character allows you to put in command terms that are otherwise inacessible, we speak of options. With full prompting on, square brackets, [ ], inclose optional terms. 9a

AE(Address Expression) alias DAE (Dynamic Address Expression) 10

Following A: you may use a link, content search, strucrel, etc. and concatinate them as in old TNLS. 10a

Do NOT put periods in front of statement names or numbers or SID's; instead put them in front of structural relationships (i.e. .u .d .b .a or .2d or .5p, or .uussr,j etc.). 10b

Prompting 11

New Display NLS has prompts like the V: and I: in old TNLS and the journal. You can set prompting in one of three modes: Full, Partial, or off. The default is Full. Partial does not show options and some alternatives. The complete list of prompts is: 11a

C: calls for a Command Word 11a1

A: calls for an Address (AE). 11a2

T: calls for you to type something in, e.g. free text, or an ident. 11a3

OK: calls for confirmation of the command, usually CA or REPEAT (<control-b>). 11a4

B: calls for a Bug. 11a5

[ ], Square Brakets indicate that you have to use the Option Character to specify the thing named inside the brackets. In many cases, for example, you may either bug something on the screan or enter a Option Character followed by any AE. The prompt would be: B:/[A:]. 11a6

CA: calls for a command accept. 11a7

Y/N: calls for "y" for "yes" or "n" for "no" in commands like substitute where NLS wants to know if you want to repeat a specification step. 11a8

[**] shows that you may use <control-u> to gain acces to a list of optional command word. 11a9

V: calls for viewspecs 11a10

L: calls for level adjustment. 11a11

SP: calls for a space as a quasi CA e.g. following idents in journal submission. 11a12

RPT: calls for a <control-b> to repeat the use of some buffer as in content searches. 11a13

"> ..." generally appears in the command feedback line when the system is doing something; it is roughly synonymous with "RUNNING" 11a14

Jumping: 12

Jump commands no longer have a special mode of repetition; CA or <control-b> terminate them in the same way they do other commands. 12a

In my use anyway, the most common jump comomand is simply "j" which echos "jump to" an takes a bug, AE, or a comand word. 12b

From/To 13

Now you Move and Copy things from someplace to someplace else instead of vice versa. It's not to hard to get used to and the noise words help, but going back and forth from one system to the other messes up my mind. 13a

DVN 8-JAN-74 15:54 18374

Qucik Reference New DNLS for Old DNLS Users

(J18374) 8-JAN-74 15:54; Title: Author(s): Dirk H. Van Nouhuys/DVN;
Distribution: /SRI-ARC RADC DHC NJN JSP LEG MCG; Sub-Collections:
SRI-ARC RADC NIC; Clerk: DVN;
Crigin: <VANNOUHUYS>NEWT.NLS;3, 8-JAN-74 15:31 DVN ;

DVN 8-JAN-74 15:01 18375

More on Non-Option AE's (follow up on 19285)

...or what you have to step over. 1

DVN 8-JAN-74 15:01 18375

More on Non-Option AE's (follow up on 19285)

(J18375) 8-JAN-74 15:01; Title: Author(s): Dirk H. Van Nouhuys/DVN;
Distribution: /NEWNLS KIRK CHI LEG; Sub-Collections: SRI-ARC NEWNLS;
Clerk: DVN;

RLT 13-AUG-73 07:57 18377

Questions and Information re Bell and Utility Equipment

HI Martin. Thpught it was time I got back to you with some of the info I have gathered up here in the last two weeks plus I am curious as to the progress on the line processor (is it officially named yet?). 1

Our tentative configuration is still a half dozen TNLS terminals and one DNLS. This will probably be it until early next year. A lot depends on how fast your second version of the line processor develops. 2

Questions: 3

Any date on line processor availability yet? 3a

Might we obtain the specs -- two reasons 3b

1 We might be able to get our people to build one or two for us. 3b1

2 We would like to show them to the manufacturing arm to get production cost estimates. 3b2

Are you going to be able to add a printer to the line processor? There is a 2400 baud one available here that might be nice. More info is coming which I will forward to you if you are interested. I will be seeing a demo of it on Aug 21. 3c

What line speeds, on a dedicated link, should we be looking at? 3d

The last word one the Utility was 8 300 baud dial up ports that were capable of 1200 baud. If we can go in faster with the line processor will we just use multiples of 1200 and these ports or what? 3e

Has your 1200 baud modem arrived? I think we can get one up here if you want to try it. However my experience over the last two weeks make their usefullness doubtful. The terminal has to be very good to filter out the line noise. I have had some trouble in this respect. 3f

Can you give me a name, address, and telephone number to contact for Canadian representation for the Delta Data 5200 terminal? 3g

Our VUcom I terminal can only be used for TNLS. Our labs had requested an OEM from CDC on a terminal with edit and addressable cursor. (Because of Bell Canada, Canadian CDC seem to have a lot more development latitude than CDC Terminal Division) The request would require a mod that is uneconomical on less than 100 terminals. Consequently any DNLS terminal we use will have to come from outside.

However with a little luck we might get under the labs umbrella if they make a bulk purchase. Currently one they are looking at is the Super Bee. 4

I am curious, and probably out of line, but is it possible for the software to slow down the I/O on a 1200 baud modem? When dialing up,the first character might indicate usage at 300 baud and the I/O contoller would adjust. This would permit a range of TNLS terminals without limiting access, and ,even more importantly, permit high speed dial-up "mousing" in DNLS. THis is likely a question for DEC or TYSHARE. 5

RLT 13-AUG-73 07:57 18377

Questions and Information re Bell and Utility Equipment

(J18377) 13-AUG-73 07:57; Title: Author(s): Ric L. Treleaven/RLT;
Distribution: /MEH JCN(FOR INFO); Sub-Collections: NIC; Clerk: RLT;

Tickler File for week of 13 August

(am3) 13 August 1

0830 hrs. Branch Chief's Meeting 1a

Directly following above, WWMCCS Progress Meeting with Division - Capt Daughtry 1b

1000 hrs. BERP - Col Thayer 1c

1500 hrs. ISF Confessions 1d

Confessions Tomorrow for ISI - Collect inputs for FJT 1e

1600 hrs. E. Kennedy Dry Run in FJT's office for Steering Group 1f

(at3) 14 August 2

0830 hrs. ISI Confessions Don't FORGET 2a

1000 hrs. D. Nelson Dry Run in FJT's Office for Steering Group 2b

(aw3) 15 August 3

0830 hrs. Proj 5550 Steering Group Meeting 3a

0830 hrs. Branch Chief's Meeting 3b

For TB - RADC/LMCA Subcostodian Training Questionnaire is due in today - 15 August 3c

TPO in final form, Plus Resources and Annex Submissions are due today 3d

Laboratory Activity Reports are due tomorrow. 3e

(ath3) 16 August 4

0830 hrs. Proj 5550 Steering Group Meeting 4a

Laboratory Activity Reports due today: Bucciero must have them by 1000, ISM must have them by 1100, and DOT must have them by 1600. 4b

(af3) 17 August 5

0900 hrs. DCM 5a

For TB and Bobbie - Travel figures due in at 1200 hrs. 5b

Timecards are due today 5c

Tickler File for week of 13 August

(J18378) 13-AUG-73 07:59; Title: Author(s): Frank J. Tomaini/FJT;
Distribution: /JPC DLS WER RFI EJK JLM RHT WPB JHB RBP FJT;
Sub-Collections: RADC; Clerk: FJT;

Susan, any word on the big buffer for 3218? Mike 1

(J18379) 13-AUG-73 08:11; Title: Author(s): M. R. Leavitt/MRL;
Distribution: /SSP; Sub-Collections: NIC; Clerk: MRL;

JBN 13-AUG-73 10:14 18380

August ARPANET NEWS Now in Query

The August issue of the ARPANET NEWS is now online for viewing in NIC query language. The online version for reproduction is not yet available, but should be finished by the end of the week. -- The Editors, JI and JBN

1

18380 Distribution

Peter Kirstein, William B. Kehl, Roland F. Bryan, James G. Mitchell, Jeanne B. North, Allen Newell, John McCarthy, Lawrence G. Roberts, Frank E. Heart, Edward L. Glaser, Thomas M. Marill, T. E. Cheatham, James W. Forgie, Keith W. Uncapher, Edward A. Feigenbaum, Leonard Kleinrock, William K. Pratt, David C. Evans, Douglas C. Engelbart, Bertram Raphael, Daniel L. Slotnick, Jeanne B. North, Barbara Barnett, Stan Golding, Steve G. Chipman, John P. Barden, Martha A. Ginsberg, Shirley W. Watkins, Janet W. Troxel, Connie D. Rosewall, Linda M. Webster, Anita L. Coley, Carol J. Mostrom, Robert J. Gronek, Rein Turn, Mark Medress, Franklin Kuo, Howard Frank, Robert L. Fink, Glenn J. Culler, Frank S. Cooper, Bruce G. Buchanan, Kenneth L. Bowles, Morton I. Bernstein, Paul Baran, Saul Amarel, Roy C. Amara, John E. Savage, Butler W. Lampson, William R. Sutherland, Thomas G. Stockham, Gene Raichelson, Michael O'Malley, Peter G. Neumann, Marvin Minsky, Robert E. Millstein, J. C. R. Licklider, Robert M. Balzer, Herbert B. Baskin, Robert P. Abbott Pitts Jarvis, Barbara A. Nicholas, Jacquie A. Priest, Terence E. Devine, Paul M. Rubin, Paula L. Cotter, O. A. Hansen, Dan Dechatelets, Nancy C. Thies, Robert Silberski, Marcia Lynn Keeney, Margaret A. (Maggie) Bassett, J. A. Smith, Leina M. Boone, Diana L. Jones, Nancy J. Neigus, Terry Sack, Frances A. (Toni) McHale, Lucille C. (Lucy) Gilliard, Ed J. Collins, Gary Blunck, John F. Heafner, Kathy Beaman, David J. King, C. Jane Moody, Sue Pitkin, Jerry Fitzsimmons, Gregory P. Hicks, Gloria Jean Maxey, Roberta J. Peeler, Craig Fields, Ermalee R. McCauley, Margaret Iwamoto, Dee Larson, Robert E. Doane, Brenda Monroe, Jeanne B. North, Pam J. Klotz Cutler Gerald L. Kinnison, Paul Baran, Henry Chauncey, J. T. Sartain, Robert N. Lieberman, Ralph Alter, Nils Maras, Philip H. Enslow, Robert M. Dunn, Joseph B. Reid, William T. Misencik, Toshiyuki Sakai, Louis Pouzin, Yngvar Lundh, Robert H. Hinckley, Marvin Zelkowitz, Don D. Cowan, Louis F. Dixon, Michael O'Malley, Peter Kirstein, David J. Farber, Dave Twyver, Art J. Bernstein, Dave E. Liddle, A. Kenneth Showalter, D. D. Aufenkamp, Derek Leslie Arthur Barber, Tjaart Schipper, Richard M. Van Slyke, E. M. Aupperle, Hubert Lipinski, Robert F. Hargraves, C. D. (Terry) Shephard, Maurice P. Brown, Robert L. Ashenhurst, Peggy D. Irving, Roy Levin, M. P. McCluskey L. Peter Deutsch, John Davidson, Thomas O'Sullivan, Sol F. Seroussi, Scott Bradner, Robert H. Thomas, Michael J. Romanelli, Ronald M. Stoughton, A. D. (Buz) Owen, Robert L. Fink, Jeanne B. North, Steve D. Crocker, Thomas F. Lawrence, John W. McConnell, James E. (Jim) White, A. Wayne Hathaway, Patrick W. Foulk, Richard A. Winter, Harold R. Van Zoeren, Alex A. McKenzie, Abhay K. Bhushan, B. Michael Wilber, Edward A. Feigenbaum, Robert T. Braden, James M. Pepin, John T. Melvin, Harold F. Arthur, Peter R. Radford, Wayne R. Robey, Joshua Lederberg, Connie Hoog, Leonard B. Fall, James A. Blumke, David Hsiao, Michael L. Marrah, Vinton G. Cerf, Richard G. Powell Alan H. Wells, Chuck R. Pierson, Carl M. Ellison, Robert P. Blanc, Jay R. Walton, Steven F. Holmgren, Terence E. Devine, David J. King, William L. Andrews, Milton H. Reese, Kenneth M. Brandon, Lou C. Nelson, Jeffrey P. Golden, Richard B. Neely, Dan Odom, Ralph E. Gorin, Robert G. Merryman, P. Tveitane, Adrian V. Stokes, David L. Retz, Reg E. Martin, Gene Leichner, Jean Iseli, James E. (JED)

Donnelley, William Kantrowitz, Michael S. Wolfberg, Yeshiah S. Feinroth, James Hurt, Anthony C. Hearn, Eric F. Harslem, Robert M. (Bob) Metcalfe, Bradley A. Reussow, Daniel L. Kadunce, George N. Petregal, Michael B. Young, Michael A. Padlipsky, Schuyler Stevenson

JBN 13-AUG-73 10:14 18380

August ARPANET NEWS Now in Query

(J18380) 13-AUG-73 10:14; Title: Author(s): Jeanne B. North/JBN; Distribution: /NLG NAG NSAG PI NIC; Sub-Collections: NIC IC NLG NAG NSAG PI; Clerk: JBN;

From: Padlipsky.CompNet at MIT-Multics 08/13/73 1321.9 edt Mon 1

2

This is a test of the "mail" to Jnl distribution mechanism sent 3

via the FTP "MLFL" command. 4

(J18381) 13-AUG-73 10:23; Title: Author(s): Michael A. Padlipsky/MAP
; Distribution: /USING ; Sub-Collections: NIC USING; Clerk: MAP;

From: Padlipsky.CompNet at MIT-Multics 08/13/73 1325.3 edt Mon 1

2

This is another test of the "mail" to Jnl dist. mechanism, sent 3

via the FTP "MAIL" command instead of "MLFL". 4

(J18382) 13-AUG-73 10:27; Title: Author(s): Michael A. Padlipsky/MAP ; Distribution: /USING ; Sub-Collections: NIC USING; Clerk: MAP;

RWW 13-AUG-73 10:56 18383

Phone Call to Ed Schelonka Aug 10 1973

I talked to Ed Schelonka about the RFP item in the Commerce Business Dailey for # Aug 1973 requestiag Technical Support to ARPA Network Program Page 2. This item contained items that looked on the surface for support which the NIC is providing and I felt need for more information. Ed said that he has terminated his RCA cntract and is looking for support at 100K $ level for people to live at RML, use the network, check resources, protocols etc. to answer his management questions. He talked with LGR after his visit here July 6 and is aware that we are planning some changes in NIC including charging non ARPA sites. He hopes to visit us for a day 3-4 weeks from now. If thaat doesn't happen we should definitely visit him. Contact here is important. I'm sending him a copy of the NIC part of our proposal as background for his visit. 1

RWW 13-AUG-73 10:56 18383

Phone Call to Ed Schelonka Aug 10 1973

(J18383) 13-AUG-73 10:56; Title: Author(s): Richard W. Watson/RWW;
Distribution: /MDK; Sub-Collections: SRI-ARC; Clerk: RWW;

DSK 13-AUG-73 11:17 18384

Revised Calculator Language Changes

This updates 18339. It will be implemented if we receive no more suggestions by August 20.

DSK 13-AUG-73 11:17 18384

Revised Calculator Language Changes

We need to write a grammar for the calculator subsystem. Before we can do this, I propose we discuss what name changes would be in order. There are certain new system conventions about command names which we must heed (set, show, quit) and also the main rule: VERB/NOUN. 1

NEW CALCULATOR COMMANDS 2

EKM and I have agreed that this is what we want. We need your suggestions. Please respond by 20-AUG. 2a

System-supplied noise words are shown in parantheses. 2b

COMMANDS RETAINING OLD FORMAT 2c

Clear (Current Accumulator) 2c1

Insert (Accumulator after) <ENTITYNAME> <DSEL> 2c2

Use (Accumulator #) 2c3

Write (New File) 2c4

COMMANDS REQUIRING CHANGE 2d

Evaluate (Expression:) SP <LSEL?> (formerly "Value" (of)) 2d1

Quit--NLS standard "Quit" <SUBSYSTEM> 2d2

[NOTE: formerly we had Quit Return as well. The purpose was to allow the user quick exit/reentry to make some change (such as Jumping on the displayed file) which could only be made in NLS. It was mainly useful in DNLS. It helped overcome problems associated with screen size constraints. Now we propose deleting the function (at a savings internally) because the calculator user will be able to execute NLS editor commands from within the subsystem.] 2d2a

Replace <ENTITYNAME> <SSEL> (by Accumulator) 2d3

Set Format (of Output Values)--The system then interrogates the user on specific settings. 2d4

Currently there is a feedback terse/verbose type option under Format. I propose having the calculator obey the

standard NLS feedback setting, and the user may execute the NLS "SET FEEDBACK ..." command if he wishes to change this while in the calculator. 2d4a

Show Accumulators (formerly "List Accumulators") 2d5

OPERATORS, OPERANDS (The "Calculate" Command) 2d6

I propose we make A, S, M, and D act exactly like VERB commands which expect a NOUN, the typed in or addressed numerical or accumulator ID value. We should treat the special symbols (-,=,*,X,x,/) in the same logical way, giving appropriate feedback in the Command Feedback Line. (As indicated below under SUMMARY, these commands are all top-level first-letter defaults. In fact, only "Subtract" currently shares a first letter with another command.) 2d6a

Add (formerly 'A) 2d6b

Subtract (formerly 'S) 2d6c

Multiply (formerly 'M) 2d6d

Divide (formerly 'D) 2d6e

\+ [DNLS feedback to be "+ (Add)"] 2d6f

\- [DNLS feedback to be "- (Subtract)"] 2d6g

*,X,x [DNLS feedback to be "<typed in char> (Multiply)"] 2d6h

/ [DNLS feedback to be "/ (Divide)"] 2d6i

[NOTE: in TNLS the feedback for the above will be simply the typed in operator] 2d6i1

The parameter which follows the VERBS listed above is a <CALCNSEL>, a Calculator Number Selection 2d6j

--bugged 2d6j1

--'#n where n=1-10 (an accumulator ID) 2d6j2

--typed in number 2d6j3

--an addressed number (format?) maybe this requires

typing OPTION (formerly in TNLS, an exclamation point( ))

2d6j4

SUMMARY 3

Add 3a

Clear (Current Accumulator) 3b

Divide 3c

Evaluate (Expression:) 3d

Format (Result Values) 3e

Insert (Accumulator after) 3f

Multiply 3g

Quit Calculator 3h

Replace <ENTITYNAME> <SSEL> (by Accumulator) 3i

Subtract 3j

Set Format (of Output Values) 3j1

Show Accumulators 3j2

Total (in CALC-file) 3k

Use (Accumulator #) 3l

Write (New File) 3m

\+ 3n

\- 3o

*, X, x 3p

/ 3q

NOTE --> We should draw up our plans now so that the documentation staff can be allowed enough time to get out two revised userguides and the HELP data base information about the Calculator language.

4

DSK 13-AUG-73 11:17 18384

Revised Calculator Language Changes

(J18384) 13-AUG-73 11:17; Title: Author(s): Diane S. Kaye/DSK;
Distribution: /RWW CHI EKM JCN NDM JDH MDK PR; Sub-Collections: SRI-ARC;
Clerk: DSK;
Origin: <KAYE>CALCGRAM.NLS;7, 13-AUG-73 11:13 DSK ;