xc AUDACIOUS
IBM - CFSS
GIPSY (minn. OK)
Chapt 2
AEC/RECON
JENSEN

SRI -
STOP WORD LIST

3
Chapt 4

copy to Fenichel

5507 Suffield Court
Columbia, Maryland 21044
January 25, 1995

Dear Charlie:

Here are the further comments on the early online systems that I promised you in the last letter. Picking up on the items that I said I would check at my office:

I found two papers on Converse, but then I noticed that you included Converse in chapter five. In any event, I have enclosed the title page and table of contents of the proceedings of the FID/IFIP Joint Conference, held in Rome in June 1967. It has a whole section on online systems, starting at page 591, with Converse included as one of these. This must be one of the earlier conferences that dealt with the application of online systems.

Also enclosed is the title page and contents pages of the 1955 book on Machine Translation of Languages, although I am not sure whether there is any clear relationship to online information retrieval systems.

I checked in report AIP/UDC-8 and found that my memory was correct - we were using the 1401 version of CFSS running in emulation mode on a 360/30. The relevant page is enclosed.

Regarding my comment on chapter 4, page 53 at the bottom, apparently the file did contain Euratom keywords. AEC/OSTI must have been using them at that time.

For chapter 4, page 54 at mid-page, I promised to give an example with UDC numbers. Here it is:

```
FIND (33 'AND' 621.6 'AND' 621.039.56)
```

would have been the search request needed to find "the economics of fluid distribution in nuclear reactor control and operation".

Comments on Chapter 5, pages 49-72 and 90-96:

Page 49 at mid-page: if you want to contact him, Ray Jensen's address is 8703 Fox Hills Trail, Potomac, MD 20854. The University of Oklahoma GIPSY system was also being used at the National Oceanographic Data Center, which became part of NOAA in October 1970. I'm not sure what the applications were - I think they may have had a marine biology information retrieval system.

Page 57, line 3: The use of a "stop word list" was incorporated into the original IBM 704 programs for KWIC indexing. By the time we converted the KWIC

indexing programs to the 1401 at Chemical Abstracts in 1961, I was using a "stop word list" of around 900 words in producing *Chemical Titles* for CAS.

I can't spot any gaps in coverage in the portion of chapter 5 that you sent to me. I assume that you are covering the early development of RECON and its evolution into Dialog, NASA RECON, and AEC RECON some place. At NOAA, we had terminal number ten in the AEC RECON network in 1972, so it must have started some time earlier than that. I recall that we had to remember never to turn off the power on our terminal during the work day, as it would cause the entire network to go down. I have copies of some of the papers from back in the 1960's about NASA RECON.

Best wishes for the completion of the work. It's quite a job that you've bitten off! If I can be of any further help, please let me know.

Sincerely,

Robert R. Freeman

A GENERAL-PURPOSE TIME-SHARING SYSTEM

Jules I. Schwartz, Edward G. Coffman, and Clark Weissman
System Development Corporation
Santa Monica, California

INTRODUCTION

Since June 1963, a Time-Sharing System has been operational at the System Development Corporation in Santa Monica. This system was produced under the sponsorship of ARPA and has utilized ideas developed at both Massachusetts Institute of Technology[3,4] and Bolt, Beranek, and Newman,[1,11] as well as some original techniques. Time-sharing, in this case, means the *simultaneous* access to a computer by a large number of independent (and/or related) users and programs. The system is also "general purpose," since there is essentially no restriction on the kind of program that it can accommodate. The system has been used for compiling and debugging programs, conducting research, performing calculations, conducting games, and executing on-line programs using both algebraic and list-processing languages.

This paper is divided into four major discussions. These are: (1) an outline of the capabilities provided for the user by the equipment and program system; (2) a description of the system's operation, with an analysis of the system scheduling techniques and properties; (3) a somewhat detailed description of two of the currently operating system service programs; and (4) a conclusion and summary.

CAPABILITIES FOR THE USER

Equipment Configuration

The major computer used by the Time-Sharing System (TSS) Executive is the AN/FSQ-32 (manufactured by IBM). Also used by the system is the PDP-1 (manufactured by Digital Equipment Corp.), which is the major input/output vehicle for the various remote devices.

The remote input/output devices available to users include Teletypes, displays, and other computers. These devices can be run from within SDC, and from the outside, with the exception of displays, which can be operated only a short distance from the computer. It is expected that computers to be used at remote stations will eventually include the CDC 160A, the DEC PDP-1, and the IBM 1410. (Currently only the 160A is being used, from an installation 400 miles distant from the Q-32.) Figure 1 is a description of the system's remote equipment configuration.

SRI

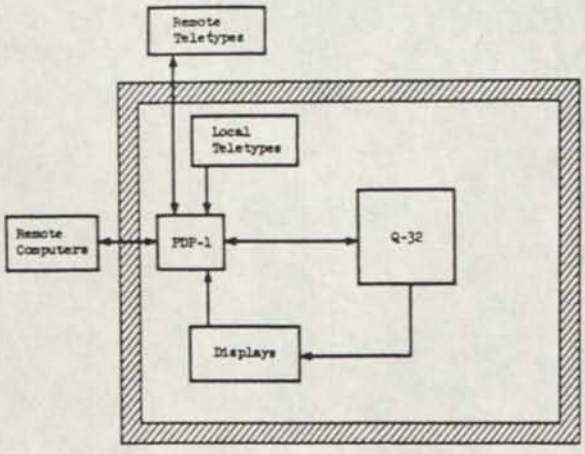

Figure 1. Remote Equipment Configuration.

announces the world's largest full-text, searchable database containing the statutes of all 50 states

1969

- Henriette Avram at Library of Congress produces MARC data interchange standard for catalog data
- ARPANet, first packet-switched data communications network, developed by Robert Taylor and Lawrence Roberts at Advanced Research Projects Agency, U.S. Department of Defense, begins test operation
- ERIC database of U.S. Office of Education brought online, for limited use, through DIALOG, an outgrowth of the earlier RECON system
- Data Resources Inc (DRI) becomes the first major numeric database service
- Canadian Institute for Scientific and Technical Information implements its CAN/SDI system
- European Space Agency initiates the first online information retrieval service in Europe, on an experimental basis, using NASA RECON software
- QUIC/LAW begins operation at Queen's University, under Hugh Lawford, with online, full-text legal information system

1970

- First overseas access to an online database, from Paris to DIALOG in Palo Alto
- Fourth generation computers, the 370 series, (large scale integration) introduced by IBM
- ELHILL software, developed by Carlos Cuadra at SDC, chosen to support National Library of Medicine's AIM-TWX experimental online database service

1971

- MEDLINE, the online version of MEDLARS, for the medical community, first major online dial-up service
- OCLC, under Frederick Kilgour, initiates first shared library cataloging system
- Pandex, the first commercial database, brought up on DIALOG for limited access
- Roger Summit, of DIALOG, and Richard Kollin, of Pandex, work out the basis for user charges for Pandex – by connect hour – which became the initial standard for the industry, at the ASIS meeting in New York

1972

- DIALOG offers first public, online commercial database service
- ORBIT, under Carlos Cuadra, offers its commercial database service

copies to: 49 project file (2)
DION (RAND)
ESD
SRI – Online System
DION
CROCETTI

December 31, 1962

Lt. Melvin Conway
ESRC, Hanscomb Field
Bedford, Massachusetts

Dear Lt. Conway:

It was a real pleasure to receive your call this morning and to learn that ESD has an interest in our RECAP project (Research Aimed at Computer Augmentation of a Programmer). The fact that the estimated charges for the project, as listed in our proposal ESU 62-89 Revision No. II, represent a larger sum than you can invest should not be any great barrier.

As you may know, SRI has been investing its own basic research funds in this program for two years. But practically speaking, the Institute can't carry this burden indefinitely and can't afford the added burden represented by the contact, communication, and coordination work required for handling many small "subscribers." So I imagine that a lower-limit ante of something like 100K per year from the first few subscribers would represent our current attitude, at least until we had a total that was of the order of 300K. If you could fund something over 100K per year, we would be agreeable to working out an independent contract with you on a basis that would be compatible with a multi-sponsor program.

I am enclosing a list of the other agencies and contacts therein to whom we have submitted the RECAP proposal, and you are welcome to contact any of them if you would like to explore the possibility of going in jointly with one of them on a contract with us instead of letting a smaller independent contract as mentioned above. We have received negative letters from the AEC (9 and 10) and from NSA (7), relatively promising responses from ARPA (1) and NIH (2), and no response at all from the others. A site-inspection committee from NIH will visit us January 8, and their first committee meeting to act upon our proposal will meet the first of March.

With ARPA, we are in the rather definite stage of talking details, but on a basis that is more development oriented than we had proposed--and as I mentioned on the phone, to do all of our experimental work on a work station that we build and tie to the Q32 at SDC (400 miles from here). The way Licklider and his assistant, Dick Chapman, talked at our last meeting two weeks ago, we should reach a definite agreement (one way or another) with ARPA by the end of January. If the ARPA possibility actually matures, there would be several rather natural areas of complementary research still required to round out the RECAP project as we feel it should be covered. In such a case, an independent contract from you would work out very nicely. We can discuss such possibilities further with you if you are interested.

I should add also that Mr. Fred Dion (RAWID) in the Information Processing Laboratory at RADC has corresponded and visited with us over the past year and a half. He is supporting some work at Ramo-Wooldridge in mathematical manipulations on a real-time work station, and is associated with a real-time computer-display system that they are setting up in-house at Rome. I've never met Dr. Crocetti to whom somebody at RADC advised us to forward the proposal. I think, in fact, that he is in a different Directorate from Dion. I should think that Fred Dion would be your best initial contact there.

After attending the Command Control conference at Hot Springs, I gathered that there was a close connection between MITRE and ESD, although I couldn't quite understand the exact nature of it. However, I had several long talks with John Jacobs and Dave Brown of MITRE, who expressed quite a bit of interest in the program we are trying to launch, and to whom I subsequently sent copies of the AFOSR Summary Report (3223). Perhaps, if it affords any possibility of a source of more funds for you, it might do some good to contact them. Jacobs is one of the vice presidents, and Brown is in charge of a good share of the information-processing-system development.

I am really delighted that you are interested, and hope to hear from you again soon. We stand very willing to discuss any contract arrangement that is to your interest.

Sincerely

Douglas C. Engelbart
Senior Research Engineer

DCE:etm

Enclosure

1. Dr. J. C. R. Licklider
Advanced Research Products Agency
OSD Room 3E-163
The Pentagon
Washington 25, D. C.

2. Dr. Bruce Waxman, Executive Secretary
Advisory Committee on Computers in Research
Division of Research Grants
Department of Health, Education, and Welfare
Norfolk Building, Room 208
Bethesday 14, Maryland

3. Mr. J. R. Marvin
Director, Code 491
Department of the Navy
Office of Naval Research
Washington 25, D. C.

cc Mr. James R. King
Resident Representative
Office of Naval Research
Stanford University
Stanford, California

4. Dr. Richard H. Wilcox
Head, Information Services Branch
Department of the Navy
Office of Naval Research
Washington 25, D. C.

5. Rome Air Development Center
Griffiss Air Force Base
Rome, New York

Attn: Dr. C. P. Crocetti, RASH

6. Mr. Greg McClurg
Scientific Adviser to Colonel Hazeltine
Operations Research Division
Army Research Office
Arlington Hall, Virginia

7. Director of National Security Agency
Fort Meade, Maryland

Attn: R4 (Dr. H. H. Campaigne)

8. Mr. Herman Lowell
Office of Advanced Research and Technology
National Aeronautics and Space Administration
Washington 25, D. C.

cc Dr. T. L. K. Smull, Director
Office of Research Grants and Contracts
NASA, Washington 25, D. C.

9. Dr. Sid Fernbach
Computation Department Head
Lawrence Radiation Laboratory
P. O. Box 808
Livermore, California

cc Mr. Russell Manfelt, USAEC
San Francisco Operations Office
211 Bancroft Way
Berkeley, California

10. Dr. C. V. L. Smith
Atomic Energy Commission
Germantown, Maryland

To: Torben Meisling

Date: 7/21/66

From: Pat Conley

Location: cc WSproject(1) MIT - Project MAC

Subject: Projects Relating to Man-Computer Program

Answering: ESD RADC SRI - Online System

Project 3578

Client: AFOSR Project began: 3/1/61 Project terminated: 6/30/64

Title: Research in Individual Information Handling

Proposals:		
EU 60-251	effective 3/1/61	$26,924
EU 60-251	effective 2/20/62	26,924
ESU 62-85	effective 3/20/63	35,997

Total Project Funds: $89,845

Contract No. AF 49(638)-1024

Project Leader: D. C. Engelbart

Project 4385

Client: Office of Secretary of Defense

Project began: 2/4/63 Project terminated: 5/8/64

Title: Research Aimed at Computer Augmentation of a Programmer

Proposal:		
ESU 62-89	effective 2/4/63	$195,000
ESU 62-89 Rev. A	" 4/29/64 (?)	48,689

Total Project Funds: $243,689

Contract No. SD-163

Project Leader: J. H. Wensley

Project 4506

Client: ESD Project began: 5/1/63 Project terminated: 12/31/6?

Title: Research on Computer-Augmented Information Management

Proposal: ESU 63-7

Total Project Funds: $39,716

Contract No. AF 19(628)2914

Project Leader: C. Bourne; Project Supervisor: D. C. Engelbart

Project 4590

Client: MIT Project began: 7/8/63 Project terminated: 8/31/63

Title: Services of D. C. Engelbart for technical assistance on Project MAC

Total Project Funds: $6,550

Purchase Order No. SR 95209

Project Leader: D. C. Engelbart

SRI 2903

STANFORD RESEARCH INSTITUTE

To: Date:

From: Location:

Subject: Projects Relating to Man-Computer Program-- Page 2 Answering:

Project 4784

Client: U. S. Naval Training Device Center

Project began: 12/31/63 Project terminated: 12/30/(

Title: Automatic Psychomotor Skill Training

Proposal: ESU 63-49

Project Funds: Sub 1 $24,917 (D. C. Engelbart)
Sub 2 30,000 (Woodworth)

Total Project Funds: $54,917

Contract No. N61339-1517

Project Leader: D. C. Engelbart

Project 4987

Client: ESD

Project began: 4/1/64 Project terminated: 4/30/6

Title: Research on Computer Augmented Information Management

Proposal: ESU 64-11

Total Project Funds: $59,638

Contract No. AF 19(628)-4088

Project Leader: D. Lincicome; later D. C. Engelbart

Project 5061

Client: NASA

Project began: 6/11/64 Project terminated: 7/11/65

Title: A Research Study of Computer-Aided Human Control of Computer Display

Proposal: ESU 64-43

Total Project Funds: Sub 1 $76,626 (W. K. English)
2 5,000 (J. Yarborough)

Total 999 $85,626

Contract No. NAS1-3988

Project Leader: W. K. English

Project 5150

Client: Office of Secretary of Defense

Project began: 6/29/64 Project terminated: 3/31/66

Title: Computer Facilitation of a Computer Programmer

Proposals:		
ESU 64-74	$58,643	effective 6/29/64
ESU 65-7	39,900	" 4/26/65
ESU 65-66	40,649	10/27/65

Total Project Funds: $139,192

Contract No. SD-269

Project Leader: D. C. Engelbart

Project 5919

Client: RADC Project began: 2/23/66 Project termination: 3/22/67

Title: Computer Augmented Management System

Proposal: ESU 65-106

Project Funds:		
Initial to 9/30/66	$60,000	
Rec'd 7/6/66	33,528	

Total Project Funds: $93,528

Contract No. AF 30(602)-4103

Project Leader: W. K. English

(See next page for additional information on this project)

Project 5890

Client: NASA-ARPA Project began: 2/8/66 Project termination: 4/7/68

Title: Study for the Development of Human Intellect Augmentation Techniques

Proposal: ESU 65-115

Project Funds:	
Initial to 6/7/67	$325,000
Proposed addition	167,476

Total Project Funds: $492,476

Contract No. NAS1-5904

Project Leader: D. C. Engelbart

Project 5919 (continued)

Client: RADC

Project extended (in dollars (from ARPA) and scope to support the multiconsole time-sharing system)

Proposal: ESU 67-10

Additional Funds: $565,676 (received May 1967)

Project 6631

Client: SOG Project began: 5/16/67 Project terminated: 11/15/((exten(1/16/(

Title: Feasibility Study of File Structuring and Techniques for Data Storage and Retrieval

Proposal: ESU 67-31

Total Project Funds: $23,997

Contract No. XG-2960(62-2269)67R

Project Leader: D. C. Engelbart

cc (ESD) (AFS Project) (SRI Online Sys)

January 2, 1964

TO: ESD File

FROM: D. C. Engelbart

SUBJECT: Telephone discussion with Lt. Herin and Major Jeffries

---

Lt. Earle Herin called on Monday, December 30, to say that the work statement handed to their contracts people by Conway for the new contract with us had been rejected. It was the same statement used for our earlier contract and they wanted a different one ("we don't want to buy the same piece of goods all over again.") I told him I would prepare a new one and call him back with it. In working on the statement, the question arose as to the possibility of negotiating with ESD to raise the contract price to cover equipment costs that heretofore hadn't been charged them. After discussion with Roy and with Pete Browning, we decided to go ahead on that basis if Herin would think it reasonable.

Herin called me this morning before I had a chance to call him. I quoted the following paragraph to a stenographer, "Put into operation the information-management subsystem as designed and largely implemented during the first five-month contract period. Integrate its services into the research and programming system used by the project researchers, including both their off-line and on-line activities. Improve user conventions, methodology, and terminology as indicated by system analysis and evaluation, and similarly evolve changes in the information structuring and programs of the subsystem." I told Herin that it would seem all right to me either to put this in as Item 3 along with the Items 1 and 2 of the original work statement, or to put this paragraph in by itself as the whole work statement. He said that he would get together with his contracts man and work out a statement for the PR.

I also asked him to change the original work statement by deleting the following from the last sentence of Part B, "at no cost to the Electronic Systems Division." And explained how we felt we should start charging them for the direct equipment costs as incurred by the researchers on their project. Then I went on to ask his opinion of the likelihood

of our getting extra funds to pay for these expenses rather than to have to reduce the manpower. He said he didn't know, and would try to find out. I said we'd plan on writing our proposal as for the extra-fund possibility, at about 1K/month, unless we heard otherwise from them.

Then I got a call from his boss, Major Jeffries about two hours later. Told him the whole story about RECAP getting the O. K.to move back up here and establish the 160A and phone link between us and the Q-32, and how these direct charges to ARPA's project were in a different category from the free-use, no-charge deal with the Q-32, so that we felt it only fair for ESD to pay for the equipment time that its researchers used. Jeffries went along with this, but said that they were really up against it now for funds and he couldn't see at all their finding this extra money. Said he'd been looking for an extra 30K so that they could make this be a year's contract instead of an eight-month contract, but had given up on that, too.

Jeffries will change the cost-charge item in the work statement to allow expenses for "equipment used to communicate with the Q-32." I told him about our off-line tapewriter plans, and he said that an off-line piece of equipment like that would be considered as being used to communicate with the Q-32 and would therefore represent allowable charges. He apparently was worried about the reaction of his contracts types to this equipment-charge change.

Conclusion: No extra funds forthcoming, but probably can make the equipment charges to the contract at the expense of less manpower.

DCE/rt
cc: R. Amara
P. Browning
T. Humphrey
J. Noe

NC (ESD as project file

January 16, 1964

SRI Online System

To: ESD File

From: D. C. Engelbart

Subject: Call from Lt. Herin

Herin reports that the reviewers of our first report feel that it needs "more substance," and that he wonders if we could beef it up. Mentioned Major Jeffreys said that a reader who wanted to make a system like ours wouldn't be able to from the description that we gave.

I expressed the feelings that

(a) much of the detail work of the system evolved out of the ARPA work, which would be reported in full detail at a later date and which wouldn't be appropriate in the ESD report (since ESD contributed only about one-fifth of what ARPA has), and

(b) we considered the report really as a progress report in the first leg of a continuing project--a leg of such short duration that one could hardly expect a comprehensive system development and description, and

(c) I feel that our emphasis is on exploring the utilization of the services we described--that there was no attempt at novelty in the implementation of these services, that we consider it as instrumentation for the research that we are trying to get at, etc.

I didn't exactly refuse to add more to the report, in fact I explicitly stated that I was only giving a point of view. Herin apparently feels my position was sound, and said he'd go back into the fray to champion our stand. I asked him to let me know if he was getting too bloody so that we could give a little to make it easier on him. But I did point out that we didn't have any more funds to put into this, from their support, and that I wasn't sure just when it could get done.

He mentioned another item (better news): Major Jeffreys mentioned something to him about getting another 8K to add to the 60K, for use on "communicating equipment" to the Q-32. In my last memo, on the call from Jeffreys I mention that they would interpret our proposed tapewriter equipment as being an ok expense here. Herin also said that it looked as if the paragraph I dictated over the phone would be accepted for the new work statement.

I mentioned that some of our people might be in the area, to visit them. He seemed to hope sincerely that they could. We agreed that face-to-face talking would be very helpful.

D. C. Engelbart

na

CC: J. D. Noe, R. C. Amara, T. L. Humphrey

VCC

XC (ESD)

SRI Online System (support)

April 29, 1964

Lt. Earle Herin
Electronic Systems Division
Air Force Systems Command
Laurence G. Hanscom Field
Bedford, Massachusetts

Dear Lt. Herin:

This is to notify you of some recent changes in our Augmented Human Intellect Program -- changes that affect the way in which we shall conduct the Information Management research under our ESD contract. (We have evolved the acronym RECLAIM for this project -- Research on Computer Aided (or Augmented) Information Management.)

CHANGES AND FIRST-ORDER EFFECTS

Two significant events are involved: (1) A NASA contract is being negotiated now to concentrate upon the hardware, human procedures, and computer algorithms needed to make a human as quick and efficient as possible at the job of composing and modifying a single frame of text on a CRT display. The work statement specifies that this research be coordinated with the activities of the other projects in our program, aiming for maximum efficiency at their symbol-manipulation tasks. (2) Our ARPA support is being cut back and service from the Q-32 cannot be counted on beyond September 1, 1964.

The latter event affects RECLAIM planning the most, but as you see below, we are not entirely unhappy about leaving the Q-32 -- and the NASA project compensates significantly for the reduced ARPA funding. Total program funding will be at a level of about $260,000 per year.

We plan to use the existing RECAP-RECLAIM Q-32 services to help bootstrap ourselves into a new system. (Under separate cover we are mailing our first-edition of the User's Guide to these services.) We are as yet unsure of the hardware configuration to which we will move -- it will likely be the CDC 160A linked to the SRI B5000 -- the latter time shared only with off-line computation.

THE PROBLEM OF MIXING TWO KINDS OF SYSTEM EXPERIMENTATION

I am enclosing a copy of a memo (DCE 8 Oct 63) which develops the dual concepts of User System and Service System. These concepts are useful in the following discussion, and you may wish to refer to the memo for its more detailed discussion. In the world of the real-time computer user, the

Service System provides him a terminal with buttons, keyboards, display screen, etc., and backs this up with storage and computational service on a demand basis. To make all of this of use to him, the user needs a coordinated set of concepts, conventions, methods and skills that we call the User System. The present SRI program places heavy emphasis upon User-System exploration as opposed to Service-System development. The former is important both to learn how to harness real-time computer aid and to derive some measure of value to be put up against the Service-System designer's cost -- value of a computer service feature in terms of User System effectiveness against cost of providing that feature. (See particularly Sec. 4.1 on p. 5 of the memo.)

Mixing of the two kinds of system experimentation arose and has troubled us as follows: Our User-System exploration required real-time computer service, but our use of the Q-32 for this purpose forced us into an experiment in new Service System design. What to us was an instrumentation problem for the experiments we wanted to perform, became the dominant instead of the subordinate activity. The type of real-time service available over a 400-mile telephone line, from an experimentally developing time-shared computer system trying to serve a wide variety of users, has in our experience proven to be very restrictive to our User-System-oriented research. The complications of working at a distance, in a shifting system environment, and being vulnerable to the inevitable bugs of a whole chain of developmental activities have absorbed nearly all of our energies into concern with Service-System development problems.

After wrestling with these complexities, we implemented a much-delayed first working system. But we find that the effective computational power available through the long line, past the time-sharing system's overhead, and into our slot of the shared time, isn't that much greater for the majority of our transactions than would be available from our 160A, backed up by a tape and a drum. Most certainly the smaller transactions, whose response speed is critical to the whole flavor of a close-coupled responsive working relationship, can be serviced faster in a private, small-machine, local system.

OUR NEXT COMPUTER CONFIGURATION

We feel that our exploration of possibilities and needs for the type of computer augmented User System we pursue would better be done for the next several years with a local, private, expanded 160A system (e.g. drum and tape) than by continuing with our present dependence on the Q-32. It would be better still to get big-machine backup service -- over a channel perhaps a hundred times the capactiy of the dataphone link, to a local computer without other real-time-user competition.

It looks now as if tying to the B5000 can provide this latter service at an operating cost (including B5000 time) less than the present rental of the dataphone link to the Q-32. The expanded 160A system would be almost exactly the same cost as the present phone-link configuration. The decision awaits further study -- some of it from the early months of RECLAIM activity (and the resulting growth of its plans), and some from SRI analysis of engineering and programming feasibility for the B5000 link and usage.

For whichever configuration we shift to, SRI will bear the reprogramming costs attributable to moving the RECLAIM processes to another computer system.

BASIC PLANS FOR OUR OTHER PROJECTS

Our NASA project is slated to set up basic input and editing facilities on the 160A -- to keep improving them and experimenting with new devices and techniques, but always keeping serviceable the best generally usable configuration. These facilities are aimed to make it really fast and easy to compose and modify text (including program instructions) on a single-frame scale of activity.

The re-oriented ARPA project will add onto these the necessary computer processes, conventions and working methods to make it easy for a person to sit on line and compose, modify, inspect, search and analyze within a working data structure of perhaps 40,000 characters -- what a small 160A drum can comfortably hold (leaving room for stored routines). The arrangement being set up with ARPA now calls for me personally to spend an average of several hours per day trying to do useful work on line, continuously experimenting with changes in the system, trying to evolve a personalized User System that can really make me more effective at designing programs, writing code, writing analytical think pieces, studying another's memo, etc.

Before the September 1 date, we expect to be operating full swing with these two projects on the 160A -- the ARPA work making a bootstrapped transition from the Q-32. We plan soon to switch from a leased line to a dial-up link to the Q-32, which will reduce considerably the link cost through the Summer when usage will be lighter. The cost of the leased link is about that of a tape transport and drum for the 160A, so transition to an expanded 160A configuration will cause little change in service charges.

RECLAIM PLANS

First, regarding personnel - Mr. Humphrey has decided to concentrate upon his PhD dissertation and preferred not to bear the simultaneous responsibility of project leader. Mr. Donald Lincicome, who has been associated with our program through at least four years of its development, has been assigned project leader. Dr. Huddart, Mr. Tomlin and I are still slated for active participation.

We plan to carry on as specified in our last proposal and its associated work statement. Within the context of the total AHI Program, RECLAIM will assume responsibility for specifying and monitoring the conventions and procedures for managing the program's working and reference information. It will aim ultimately to move into the computer-aided realm all of the information, conventions and procedures (within several years, perhaps).

Note that this does not imply <u>doing</u> all the information-management work for the other projects. Each project pays its own way as far as the work involved in that project, but each is interested in using and evaluating the developments of the other. The activities of all represent a test bed for each.

RECLAIM will use the Q-32 facilities through the summer. We are actually unworried about getting it immediately on line with the next system, without any gap, because of the off-line tapewriter-in, printer-out techniques which we were planning anyway to explore. (See Sec. III-B of our latest proposal).

The User's Guide describes the Z-Code techniques that we developed over the past few months (under AFOSR sponsorship, and with additional SRI money). With this we are now set up for basic off-line input of the sort mentioned. We will have 160A-to-magnetic-tape-to-B5000 communication (hand-carried reels) by July, which provides fruitful opportunity for developing these off-line procedures. These procedures will be compatible with the on-line techniques of the NASA-ARPA projects, in that the on-line and off-line phases of our work will be coordinated.

The new set of on-line processes for RECLAIM work will benefit in their specification and design from what we have learned and will learn from designing and using the present Q-32 processes. We intend to minimize the implementation time of this new system, consistent with needs, possibilities and growth potential.

Over the next few weeks, the plans for RECLAIM will be taking more definite form, and we will keep you posted. We shall try sending you copies of project memos as a means of communication.

Since the changes discussed above are a bit larger than would be expected from the previous course of events, we plan to contact you by telephone soon to discuss this with you.

Sincerely yours,

D. C. Engelbart
Program Head
Man/Machine Information Systems

DCE/na
Enclosures

cc Wing
Browning (via Wing)

COMMON WORDS

7 DEC 1965

Online Search Study

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SUBJECT: Real-Time Computer Aid for Human Information Manipulation

copy to RADC CB project files (4) STEP

REFERENCE: RAW-64-579 -- From PSA 16 September 1963

TO: Directorate of Procurement
Rome Air Development Center
Attn: RAKS
Griffiss Air Force Base, New York 13442

1.0 Stanford Research Institute

Stanford Research Institute is a not-for-profit corporation chartered by the State of California. The Institute was founded in November, 1946 by action of the Trustees of Stanford University, and many members of the Board of Directors of the Institute are also on the Board of Trustees of the University, although there is no operational connection between the two organizations. Headquarters and principal laboratories of the Institute are at Menlo Park, California. Regional Office locations include New York City, Detroit, Wash. D.C., Pasadena, Calif., Tokyo, Japan, and Zurich, Switzerland.

SRI is one of the largest research institutes, with excellent facilities, and a highly competent research staff with broad interests, training, and experience in the physical sciences, life sciences, engineering, and economics. The Institute has a total staff of 2300 persons, of whom over 1,200 are in technical and professional categories. Advance degrees are held by 600 staff members; of these 275 hold Ph.D. or equivalent degrees. The Institute has Top Secret clearance under Western Contract Management Region (RWIP), United States Air Force, Mira Loma Air Force Station, Mira Loma, Calif.

2.0 Qualifications and Facilities

2.1 Personnel: Eight professionals are engaged full time in original and coordinated research that is directly relevant to the subject research. Nine other professionals are providing part-time backup service in engineering, psychology, content analysis, and systems analysis.

2.2 Special Facilities: (A) Experimental laboratory equipped with a character generator and cathode-ray-tube display incorporated into a flexible console arrangement to provide real-time man-computer interaction. A CDC 160A computer to provide instantaneous real-time service for the smaller service processes (B) a telephone tie-line connecting this computer as a satellite to the Q32 computer in the Command Laboratory (an ARPA-supported activity)at Systems Development Corp., in Santa Monica. The Q32 is a fast computer of the SAGE class, with 48-bit word length, 65-thousand-word core memory, 500,000 words of high-speed drum storage, 18 tape transports, that is to be operated in a time-sharing mode to give service to a number of satellite computers, display consoles, and teletypewrite stations. (It's storage is to be increased next year with the addition of a high-transfer-rate disk file and words of core.)

2.3 Objectivity, since Stanford Research Institute is a not-for profit organization, does not hold patents, and it is not in manufacturing nor sales.

SRI has been active in the area encompassing the subject described above for a number of years. Descriptions of representative completed and current projects are listed below. A printed brochure outlining interests and capabilities in this area, and biographies of pertinent staff personnel are attached.

3.0 Representative Prior and Present Projects

3.1 These current projects form the nucleus of a coordinated research program which was conceived and developed at SRI, and which is planned as a continuing and growing activity.

3.11 Augmented Human Intellect Study

Contract AF 49(638)-1024
Air Force Office of Scientific Research, Washington, D.C.

This project has been active since March of 1961, and represents mainly a one-man effort to set the stage for present and future research aimed at improving the effectiveness of human intellectual activity through the use of real-time computer aids. The first year and a half was mainly a conceptual study, leading to the Summary Report, "Augmenting Human Intellect: A Conceptual Framework".[1] This work set the stage for the proposals and subsequent projects with ARPA and ESD described below. Recently this AFOSR work has been concerned with basic problems in computer-aided data transcription and with detailed aspects of computer-aided "micro-documentation",[2] as well as general continued development of a research foundation for a coordinated research program in the "augmented human intellect" area.

3.12 Research on the Computer Facilitation of Computer Programming

Contract ARPA - SD-163
Advanced Research Projects Agency

A direct outgrowth of the long-term research strategy developed in the above project. The objective of this project (started March 1963, five to six man level) is to establish a computer-based experimental laboratory (equipped with real-time computer service, a computer-driven cathode-ray-tube display at a console, light pen, keyboards, etc.) and to pursue a coordinated system of computer aids, system language and data structuring, and human procedures and methods. The goal is to improve human effectiveness at the whole gamut of tasks involved in designing, writing, debugging and documenting computer programs. Enclosed proposal copy[3] outlines method of approach.

3.13 Research on Computer-Augmented Information Management

Contract AF 19(628)2914
Air Force Systems Command, Electronic Systems Division
Bedford, Massachusetts.

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[1] Copies of references 1 thru 4 are enclosed.

The objectives and method of approach for this project also are a direct outgrowth of the AFOSR-sponsored study. The project began in July, 1963, and proceeds at a $2\frac{1}{2}$ to 3-man level. Dealing only with software and system development (using hardware and basic software of the ARPA project), this project concentrates on improving the management of information involved in minute-by-minute, day-by-day and month-by-month problem-solving activity of a computer programmer and of a research group. The developments of this project will be used and evaluated not only by programmers within the ARPA-project programmer-aid system (and hence by our own researchers in their programming activity), but by the growing list of researchers (of section 2.1) in our coordinated augmented-human-intellect program for managing their individual, group, and external-source working information. Again, improved management is pursued by integrating real-time computer aids with new language and data structures, and new methods and procedures, within a coordinated working system.

3.2 Large Information Processing Systems

3.21 The Institute designed for the Air Force (Air Technical Intelligence Center), a comprehensive system for the systematic acquisition, abstracting, translating, dissemination, review, storage, and retrieval of a significant segment of the open-source foreign scientific literature. During the course of this project a comprehensive review was made of the operation and techniques of several of the largest technical information files maintained by the Air Force and other government agencies.

3.22 Another project which was completed after a two-year effort was the design and implementation of a complete data-handling system for an aerial reconnaissance project (ULD-1 Electronic Recon System - Contract AF 33(604)17231. This effort included system studies, computer selection, installation planning, program writing, and assistance with the final system test. For this project, a large data processing system was installed at the Institute for the programing and testing effort, and subsequently delivered to the client as a complete, operating system. Some special-purpose equipment such as magnetic tape converters, and special man-machine operator consoles were also developed as part of this program.

3.3 Miscellaneous Projects Related to Large Information Processing Systems.

Several related projects have been conducted by the Institute in various phases of the technical information problems, both in gross and specialized aspects of data handling, storage, and retrieval.

The following is a partial listing of these:

Technical assistance in implementing STEP (Scientific Technical Exploitation Program) as a systematic means of reviewing technical literature and identifying important material.

A graphical data processing study, which considered the handling of raw data, identification, programing, selection, indexing, storage, access to storage, and presentation.

Investigation of the feasibility of constructing a special file for the retrieval of information--a file to contain descriptions of up to two million documents with the capability of indicating simultaneously all documents related to an inquiry.

Development of an information system to aid in controlling the leadtime of a variety of significant military research and development projects.

Development of a technique for high-speed automatic reading of printed alphanumerical material.

Development of the Videograph printer for the transfer of video images to paper.

Development of high-speed document handling techniques.

Research to develop a system of materials suitable for draftsmen to use in making original drawings which would be reproducible by transmission photocopying.

Mobilization planning studies for various agencies with the DOD, which considered detailed manufacturing problems and the transition from drawings to hardware.

Procurement planning and control studies, including major activity on the "Missile Manufacturer's Planning Report."

Studies of storage means for graphical data, including microfilming.

Studies on the encoding of data in operational situations.

Another project on which the Institute provided assistance was the design of the data processing and file portions of a bomb-damage assessment system for the joint military services. This very large information handling system will maintain a current status record of all items of military potential (weapons, ships, bridges, etc.) on a global basis. The system has necessarily been designed with methods of rapid file maintenance and the incorporation of special communication and display equipment. For this project the Institute also assisted in the selection of the data processing and auxiliary equipment.

3.4 Multiple Instantaneous Response File --MIRF
RADC Contract AF 39(602)-2772

The basic MIRF unit has been developed as a complete system for retrieval of document index information, and need not be connected to a computer. It includes an operator console with electric typewriter, paper-tape punch and other display facilities. The unit also includes two separate associative memories, one a dictionary and the other the file of indexing information for ASTIA documents. The indexing information for each item in the file includes the explicit serial numbers for eight descriptors, the explicit accession number of the document (file item) and an 80-bit single-field superimposed search code of the relevant descriptors. In use, the operator types in the descriptors in English for his inquiry. The dictionary permits a unique match and generates the coded serial number of the descriptor or informs the operator that it is a non-allowed indexing term. A search question, for the File, is derived by superimposing the codes of the desired group of descriptors. Generally, the number of descriptors used in a search question will be less than the number in a document. When this search question is complete, the File is quizzed in parallel and an immediate indication is given if any file items logically include the quizz. The unit permits and can handle multiple responses. Thus, following a "yes" response the number of documents is displayed to the operator. If the quantity is satisfactory to the operator, the indexing information on each responding item is then typed out.

3.5 Graphical Data Processing Research Study and Experimental Investigation
Contract DA 36-039-SC-78343
U. S. Army Signal Supply Agency, Fort Monmouth, New Jersey

This program has as its goal the design and construction of prototype equipment with a capability to learn to recognize certain features in maps, photographs, or other visual data. It is envisioned that the machinery will consist basically of two parts. The first part will be a fixed logic machine designed to filter the optical information and produce an output which is invariant under certain known transformations of the input (e.g., rotation, translation, size, noise, etc.). The output of the fixed part of the machine will preserve information relating only to the essential features of the input pattern. Various methods of optical sampling have been devised which together with implementations of certain theorems from Integral Geometry will prove useful in this first part of the machine.

The second part of the machine is the part which actually learns. It will be a network of interconnected elements called threshold logic elements whose thresholds and interconnecting weights can be modified. The machine training is then identified with the judicious changing of these weights and thresholds to produce useful outputs. The machine's memory of the essential features of the distinction between various patterns resides distributed among all of these weights and thresholds. Since the memory is distributed and not totally dependent on any one component, such machinery promises

to be highly reliable even though parts of the equipment may fail. The main areas of research are in (1) methods for selectively modifying the weights and thresholds and (2) components out of which to build the threshold logic elements and weights and components for the fixed logic part of the machine.

DRC/hh
9/25/63

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Electronic Systems Division
CLIENT Air Force Systems Command
L. G. Hanscom Field
Bedford, Massachusetts
CONTRACT NO. AF 19(628)-2914

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1 May to 31 May 1963

AUTHOR Charles P. Bourne

DATE ISSUED 5/31/63

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CONTRACT NO. AF 19(628)-291

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TITLE RESEARCH ON COMPUTER AUGMENTED INFORMATION MANAGEMENT

AUTHOR Charles P. Bourne

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