(J31001) 15-AUG-74 15:32; Title: Author(s): Geoffrey S. Goodfellow/GSG; Distribution: /JED; Sub-Collections: NIC; Clerk: GSG;

Or point me at any on-line documentation, by SNDMSG to Geoff@Sri-Ai, 1

or Journal Ident GSG. 2

3

Thanks, 3a

Geoff Goodfellow 3b

4

(J31002) 15-AUG-74 15:33; Title: Author(s): Geoffrey S. Goodfellow/GSG; Distribution: /LMB; Sub-Collections: NIC; Clerk: GSG;

Or point me at any on-line documentation, by SNDMSG to Geoff@Sri-Ai, 1

or Journal Ident GSG, 2

3

Thanks, 3a

Geoff Goodfellow 3b

4

RJ 16-AUG-74 09:04 31004

Attendence list for the demos held August 8th & 9th at SRI-WDC.

(J31004) 16-AUG-74 09:04; Title: Author(s): Rita Jordan/RJ;
Distribution: /RJ NDM RLL JCN DCE RWW; Sub-Collections: NIC; Clerk: RJ;
Origin: <JORDAN>DEMO,NLS;3, 16-AUG-74 08:55 RJ ;

RJ 16-AUG-74 09:04 31004

Attendence list for the demos held August 8th & 9th at SRI-WDC.

Below is a list of the attendees at the DARPA sponsored demonstration for members of the Executive Panel DoD Internetting Study Group, held in the SRI Washington Office, demonstrating the capabilities of TENEX, MULTICS, NLS and DNLS. 1

The attendees at the August 8th demo were: 1a

NAME	TITLE	ORG.	PHONE #	
Cecil V. Armintrout	Dep. Ch. Com. Div.	DIA	OX7-8900	1a2
Albert G. Facey, Jr.	STF. SPEC. SWNETWKS	D.TACCS	695-3806	1a3
Robert R. Jefferson	Chief Transmission Eng.Div.	DCEC	437-2466	1a4
Robert E. Lyon	Div. Ch.	DCA	437-2321	1a5
Philip Selvaggi	Div. Ch.	DCEC/DCA	437-2356	1a6
David C. Russell	DEP. Dir IPT	ARPA	OX4-4002	1a7
Burt Sutherland		BBN/TENEX		1a8
Wren McMains		MIT/MULTICS		1a9
Carrol Kerns		SRI		1a10
Dean Meyer		SRI		1a11
Dave Myers		SRI		1a12
Susan Lee		SRI		1a13
Toni Letaw		SRI		1a14
Rita Jordan		SRI		1a15

Attendees for the August 9th demo were: 1b

NAME	TITLE	ORG.	PHONE #	
David C. Russell	Dep. Dir. IPT	ARPA	OX4-4002	1b2
W.C. Unkenholz	Chief NSA		688-6035	1b3
E.V. Hoversten	Prin. Dep. to Assoc. Dir.	DCA	692-0093	1b4

RJ 16-AUG-74 09:04 31004

Attendence list for the demos held August 8th & 9th at SRI-WDC.

J.C.R. Licklider	Dir. IPTO	ARPA OX4-4001	1b5
C.M. Anderson	Sr. Res. Assoc. William & Mary & NASA Langley	804-827-3997	1b6
Burt Sutherland	BBN-TENEX		1b7
Wren McMains	MIT/MULTICS		1b8
Toni Letaw	SRI		1b9
Carrol Kerns	SRI		1b10
Dean Meyer	SRI		1b11
Arlie Capps	SRI		1b12
Ed Rodrigues	SRI		1b13

SMT 17-AUG-74 19:54 31005

KWAC Meeting

(J31005) 17-AUG-74 19:54; Title: Author(s): Stan M. Taylor/SMT;
Distribution: /JAKE RLR FGB BJM RMS2 RWW DCE JCN JHB DLS IMM TLH CKM;
Sub-Collections: NIC; Clerk: SMT;

SMT 17-AUG-74 19:54 31005

KWAC Meeting

Doug, This note is to confirm what I have already told Jim Norton by phone, I will be able to attend the session as planned on 9 -13 September, I am looking forwarrd to some exciting times, including some more training --- if possible, [on my own if necessary], I suggested to Jim that we could use the time on the plane out to your session rather profitably if you could send us some pre-publication drafts on the 'NEW' NLS, 1

FGB 19-AUG-74 05:52 31006

NAVSEC USERS

(J31006) 19-AUG-74 05:52; Title: Author(s): Frank G. Brignoli/FGB;
Sub-Collections: NIC; Clerk: FGB;

FGB 19-AUG-74 05:52 31006

NAVSEC USERS

Pete, Here is revised list of NAVSEC users, I got message(s) from Bair, thanks, Frank,

NAVSEC USERS

(NAVSEC) Valid Users 1

mail address: 1a

Naval Ship Engineering Center 1a1

Code 6102-c 1a2

Prince Georges Center 1a3

Hyattsville, Maryland 20782 1a4

Phone: 202-436-1551 1a5

Users: 1b

Anthony, Charles B, 1b1

Bono, Peter R, 1b2

Claffey, James A, 1b3

Fratantuono, Mary A, 1b4

Anklowitz, Philip (no middle initial) 1b5

Mellis, James G, 1b6

Program Management Outline

(J31007) 19-AUG-74 09:28; Title: Author(s): Susan R. Lee/SRL;
Distribution: /CKM SRL; Sub-Collections: SRI-ARC; Clerk: SRL;
Origin: <LEE>OUTLINE.NLS;1, 19-AUG-74 08:13 SRL ;

SRL 19-AUG-74 09:28 31007

Program Management Outline

This is just for practice!!

Program Management Outline

The following is an abbreviated version of an outline to be used for information regarding program management. The file was constructed using NLS and designed to make use of strucure. 1

We will use this outline to demonstrate several new concepts in NLS. 2

Programs 3

Program A (ongoing) 3a

BACKGROUND: 3a1

Here would be the textual Background information
.....
.....
.....
..... 3a1a

SUMMARY: 3a2

Here would be the textual Summary information
.....
.....
..... 3a2a

OBJECTIVES: 3a3

Here would be the textual Objectives information
.....
.....
.....
..... 3a3a

PREVIOUS WORK: 3a4

Projects/Contractors 3a4a

Project 1 Stanford Research Institute - ARC 3a4b

Principal Investigator 3a4b1

Name 3a4b1a

Douglas C. Engelbart (DCE) 3a4b1b

Summary 3a4b2

Here would be the textual Summary information
.....

see (18368,2;gwyn) for an example (from an ARC proposal)
.....
..... 3a4b2a

Objective 3a4b3

The primary objectives of this project have been wide-ranging and encompass many aspects of aiding "office workers". 3a4b3a

Statement of Work 3a4b4

Here would be the textual Statement of Work information .....
.....
.....
..... 3a4b4a

Milestones 3a4b5

Phases Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 3a4b5a

xxx ...s....r....rF 3a4b5b

xxx ....s.r....r.............rF 3a4b5c

xxx ....s....r.............r.rF 3a4b5d

xxx ....s...r.............r.....rF 3a4b5e

xxx ....s.........r.....r........rF 3a4b5f

s=start r=review F=finish 3a4b5f1

(or whatever layout seems appropriate) 3a4b5f2

Technical reports 3a4b6

Links to file(s) of abstracts of reports (or to actual reports if any are in the Journal) 3a4b6a

Status reports 3a4b7

Links to file(s) of abstracts of reports (or to actual reports if any are in the Journal) 3a4b7a

April 1974 QMR: ARC (norton,saveqmr,1;xbbzm) 3a4b7b

Program Management Outline

Project 2 Bolt Beranek and Newman -BBN 3a4c

Principal Investigator 3a4c1

Name (and IDENT-for more information) 3a4c1a

Summary 3a4c2

Here would be the textual Summary information
.....
.....
.....
..... 3a4c2a

Objective 3a4c3

Here would be the textual Objective information
.....
.....
.....
..... 3a4c3a

Statement of Work 3a4c4

Here would be the textual Statement of Work information .....
.....
.....
..... 3a4c4a

Milestones 3a4c5

Phases Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 3a4c5a

xxx ...s.....r.....rF 3a4c5b

xxx ....s.r.....r.............rF 3a4c5c

xxx ....s....r.............r.rF 3a4c5d

xxx ....s...r.............r.....rF 3a4c5e

xxx .....s.....r.....r.....rF 3a4c5f

s=start r=review F=finish 3a4c5f1

(or whatever layout seems appropriate) 3a4c5f2

Technical reports 3a4c6

Links to file(s) of abstracts of reports (or to actual reports if any are in the Journal) 3a4c6a

Status reports 3a4c7

Links to file(s) of abstracts of reports (or to actual reports if any are in the Journal) 3a4c7a

Project 3 Massachusetts Institute of Technology - MIT 3a4d

Principal Investigator 3a4d1

Name (and IDENT=for more information) 3a4d1a

Summary 3a4d2

Here would be the textual Summary information
.....
.....
.....
..... 3a4d2a

Objective 3a4d3

Here would be the textual Objective information
.....
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.....
..... 3a4d3a

Statement of Work 3a4d4

Here would be the textual Statement of Work information .....
.....
.....
..... 3a4d4a

Milestones 3a4d5

Phases Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 3a4d5a

xxx ...s.....r.....rF 3a4d5b

xxx ....s.r.....r..............rF 3a4d5c

xxx ....s....r..............r.rF 3a4d5d

xxx ....s...r..............r.....rF 3a4d5e

xxx .....s.....r.....r.....rF 3a4d5f

s=start r=review F=finish 3a4d5f1

(or whatever layout seems appropriate) 3a4d5f2

Technical reports 3a4d6

Links to file(s) of abstracts of reports (or to actual reports if any are in the Journal) 3a4d6a

Status reports 3a4d7

Links to file(s) of abstracts of reports (or to actual reports if any are in the Journal) 3a4d7a

Project 4 University of Southern California = USC 3a4e

Principal Investigator 3a4e1

Name (and IDENT=for more information) 3a4e1a

Summary 3a4e2

Here would be the textual Summary information
.....
.....
.....
..... 3a4e2a

Objective 3a4e3

Here would be the textual Objective information
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.....
..... 3a4e3a

Statement of Work 3a4e4

Here would be the textual Statement of Work information .....
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.....
..... 3a4e4a

Milestones 3a4e5

Phases Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 3a4e5a

Program Management Outline

xxx ...s.....r.....rF 3a4e5b

xxx ....s.r.....r..............rF 3a4e5c

xxx ....s....r..............r.rF 3a4e5d

xxx ....s...r..............r.....rF 3a4e5e

xxx ....s.........r.....r.........rF 3a4e5f

s=start r=review F=finish 3a4e5f1

(or whatever layout seems appropriate) 3a4e5f2

Technical reports 3a4e6

Links to file(s) of abstracts of reports (or to actual reports if any are in the Journal) 3a4e6a

Status reports 3a4e7

Links to file(s) of abstracts of reports (or to actual reports if any are in the Journal) 3a4e7a

Project 5 Hudson Institute = Hudson 3a4f

Principal Investigator 3a4f1

Name (and IDENT=for more information) 3a4f1a

Summary 3a4f2

Here would be the textual Summary information
****
****
****
********** 3a4f2a

Objective 3a4f3

Here would be the textual Objective information
****
****
****
********** 3a4f3a

Statement of Work 3a4f4

Here would be the textual Statement of Work

information .....
.....
.....
..... 3a4f4a

Milestones 3a4f5

Phases Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 3a4f5a

xxx ...s.....r.....rF 3a4f5b

xxx .....s.r.....r.....rF 3a4f5c

xxx .....s....r.....r.rF 3a4f5d

xxx .....s...r.....r.....rF 3a4f5e

xxx .....s.....r.....r.....rF 3a4f5f

s=start r=review F=finish 3a4f5f1

(Or whatever layout seems appropriate) 3a4f5f2

Technical reports 3a4f6

Links to file(s) of abstracts of reports (or to actual reports if any are in the Journal) 3a4f6a

Status reports 3a4f7

Links to file(s) of abstracts of reports (or to actual reports if any are in the Journal) 3a4f7a

Project 6 University of Hawaii - UH 3a4g

Principal Investigator 3a4g1

Name (and IDENT=for more information) 3a4g1a

Summary 3a4g2

Here would be the textual Summary information
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.....
..... 3a4g2a

Objective 3a4g3

Here would be the textual Objective information
.....
.....
.....
..... 3a4g3a

Statement of Work 3a4g4

Here would be the textual Statement of Work information .....
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.....
..... 3a4g4a

Milestones 3a4g5

Phases Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 3a4g5a

xxx ...s.....r.....rF 3a4g5b

xxx ....s.r.....r.....rF 3a4g5c

xxx ....s....r.....r.rF 3a4g5d

xxx ....s...r.....r.....rF 3a4g5e

xxx .....s.....r.....r.....rF 3a4g5f

s=start r=review F=finish 3a4g5f1

(or whatever layout seems appropriate) 3a4g5f2

Technical reports 3a4g6

Links to file(s) of abstracts of reports (or to actual reports if any are in the Journal) 3a4g6a

Status reports 3a4g7

Links to file(s) of abstracts of reports (or to actual reports if any are in the Journal) 3a4g7a

PROPOSED WORK: 3a5

Projects/Contractors 3a5a

Project 7 3a5b

Principal Investigator 3a5b1

Name (and IDENT=for more information) 3a5b1a

Summary 3a5b2

Here would be the textual Summary information
.....
.....
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..... 3a5b2a

Objective 3a5b3

Here would be the textual Objective information
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..... 3a5b3a

Statement of Work 3a5b4

Here would be the textual Statement of Work information .....
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.....
..... 3a5b4a

Milestones 3a5b5

Phases Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 3a5b5a

xxx ...s.....r.....rF 3a5b5b

xxx .....s.r.....r.....rF 3a5b5c

xxx .....s....r.....r.r.rF 3a5b5d

xxx .....s...r.....r.....rF 3a5b5e

xxx .....s.....r.....r.....rF 3a5b5f

s=start r=review F=finish 3a5b5f1

(or whatever layout seems appropriate) 3a5b5f2

Project B 3a5c

Principal Investigator 3a5c1

Name (and IDENT=for more information) 3a5c1a

Program Management Outline

Summary 3a5c2

Here would be the textual Summary information
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..... 3a5c2a

Objective 3a5c3

Here would be the textual Objective information
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.....
..... 3a5c3a

Statement of Work 3a5c4

Here would be the textual Statement of Work information .....
.....
.....
..... 3a5c4a

Milestones 3a5c5

Phases Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 3a5c5a

xxx ...s.....r.....rF 3a5c5b

xxx ....s.r.....r.............rF 3a5c5c

xxx ....s....r.............r.rF 3a5c5d

xxx ....s...r.............r.....rF 3a5c5e

xxx ....s.........r.....r.........rF 3a5c5f

s=start r=review F=finish 3a5c5f1

(or whatever layout seems appropriate) 3a5c5f2

Project 9 3a5d

Principal Investigator 3a5d1

Name (and IDENT=for more information) 3a5d1a

Summary 3a5d2

Program Management Outline

Here would be the textual Summary information
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****
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3a5d2a

Objective 3a5d3

Here would be the textual Objective information
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****
3a5d3a

Statement of Work 3a5d4

Here would be the textual Statement of Work information
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****
3a5d4a

Milestones 3a5d5

Phases Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 3a5d5a

xxx ...s.....r.....rF 3a5d5b

xxx ....s.r.....r..............rF 3a5d5c

xxx ....s....r..............r.rF 3a5d5d

xxx ....s...r..............r.....rF 3a5d5e

xxx ....s.........r.....r.........rF 3a5d5f

s=start r=review F=finish 3a5d5f1

(or whatever layout seems appropriate) 3a5d5f2

RELEVANCE TO DOD: 3a6

Here would be the textual Relevance information
****
****
****
****
3a6a

MILESTONES: 3a7

Program Management Outline

```
      Phases Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec          3a7a
      xxx ...s.....r.....rF                                          3a7b
      xxx .......s.r.....r..............rF                          3a7c
      xxx ..........s....r..............r.rF                        3a7d
      xxx ...........s...r..............r.....rF                    3a7e
      xxx ....................s.........r.....r........rF            3a7f
         s=start  r=review  F=finish                                 3a7f1
         (or whatever layout seems appropriate)                      3a7f2
Program C (new)                                                      3b
   SUMMARY:                                                          3b1
      Here would be the textual Summary information
      ********************************
      ********************
      ************                                                  3b1a
   OBJECTIVES:                                                       3b2
      Here would be the textual Objectives information
      ***************
      ****************************
      ********************
      ************                                                  3b2a
   BACKGROUND:                                                       3b3
      Here would be the textual Background information
      ***************
      ********************************
      ********************
      ************                                                  3b3a
   PROPOSED WORK:                                                    3b4
      Projects/Contractors                                           3b4a
      Project 16                                                     3b4b
         Principal Investigator                                      3b4b1
```

Program Management Outline

Name (and IDENT=for more information) 3b4b1a

Summary 3b4b2

Here would be the textual Summary information
.....
.....
.....
..... 3b4b2a

Objective 3b4b3

Here would be the textual Objective information
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.....
.....
..... 3b4b3a

Statement of Work 3b4b4

Here would be the textual Statement of Work information .....
.....
.....
..... 3b4b4a

Milestones 3b4b5

Phases Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 3b4b5a

xxx ...s.....r.....rF 3b4b5b

xxx ....s.r.....r.............rF 3b4b5c

xxx ....s....r.............r.rF 3b4b5d

xxx ....s...r.............r.....rF 3b4b5e

xxx .....s.....r.....r.....rF 3b4b5f

s=start r=review F=finish 3b4b5f1

(or whatever layout seems appropriate) 3b4b5f2

Project 17 3b4c

Principal Investigator 3b4c1

Name (and IDENT=for more information) 3b4c1a

Program Management Outline

Summary 3b4c2

Here would be the textual Summary information
.....
.....
.....
..... 3b4c2a

Objective 3b4c3

Here would be the textual Objective information
.....
.....
.....
..... 3b4c3a

Statement of Work 3b4c4

Here would be the textual Statement of Work information .....
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.....
..... 3b4c4a

Milestones 3b4c5

Phases Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 3b4c5a

xxx ...s.....r.....rF 3b4c5b

xxx ....s.r.....r.............rF 3b4c5c

xxx ....s....r.............r.rF 3b4c5d

xxx ....s...r.............r.....rF 3b4c5e

xxx .....s.....r.....r.....rF 3b4c5f

s=start r=review F=finish 3b4c5f1

(or whatever layout seems appropriate) 3b4c5f2

Project 18 3b4d

Principal Investigator 3b4d1

Name (and IDENT=for more information) 3b4d1a

Summary 3b4d2

Here would be the textual Summary information
.....
.....
.....
..... 3b4d2a

Objective 3b4d3

Here would be the textual Objective information
.....
.....
.....
..... 3b4d3a

Statement of Work 3b4d4

Here would be the textual Statement of Work information .....
.....
.....
..... 3b4d4a

Milestones 3b4d5

Phases Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 3b4d5a

xxx ...s.....r.....rF 3b4d5b

xxx ....s.r.....r.............rF 3b4d5c

xxx ....s....r.............r.rF 3b4d5d

xxx ....s...r.............r.....rF 3b4d5e

xxx .....s.....r.....r.....rF 3b4d5f

s=start r=review F=finish 3b4d5f1

(or whatever layout seems appropriate) 3b4d5f2

RELEVANCE TO DOD: 3b5

Here would be the textual Relevance information
.....
.....
.....
..... 3b5a

MILESTONES: 3b6

Program Management Outline

```
Phases Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec          3b6a
xxx ...s.....r.....rF                                           3b6b
xxx .......s.r.....r..............rF                           3b6c
xxx ..........s....r..............r.rF                         3b6d
xxx ..........s...r..............r.....rF                      3b6e
xxx ....................s.........r.....r.........rF           3b6f
   s=start  r=review  F=finish                                  3b6f1
   (or whatever layout seems appropriate)                       3b6f2
```

MIKE 19-AUG-74 10:17 31008

Let's get together this week to discuss some Englebart and Research Assistant type things,,,,,,some quick ideas of mine follow;

(J31008) 19-AUG-74 10:17; Title; Author(s); Michael T. Bedford/MIKE; Distribution; /IMM MIKE; Sub-Collections; NIC; Clerk; MIKE;

MIKE 19-AUG-74 10:17 31008

Let's get together this week to discuss some Englebart and Research Assistant type things.....Some quick ideas of mine follow:

hopefully you've got some things to talk about too; otherwiase we'll never be able to justify a lunch out of this.

MIKE 19-AUG-74 10:17 31008

Let's get together this week to discuss some Englebart and Research Assistant type things.....some quick ideas of mine follow:

Does the group now have a better idea of what your responsibilities and constraints are ? 1

MIKE 19-AUG-74 11:04 31009

draft of letter to Elaine Meagher acknolwedging receipt of 2nd paper "Programming in Educational Television ",

(J31009) 19-AUG-74 11:04; Title: Author(s): Michael T, Bedford/MIKE; Distribution: /LHD; Sub-Collections: NIC; Clerk: MIKE;

MIKE 19-AUG-74 11:04 31009

draft of letter to Elaine Meagher acknolwedging receipt of 2nd paper "Programming in Educational Television ",

want to take a look at this before you sign it ?

MIKE 19-AUG-74 11:04 31009

draft of letter to Elaine Meagher acknolwedging receipt of 2nd paper "Programming in Educational Television ",

Ms. J.E. Meagher
12 Marlborough Avenue
Ottawa, Ontario 1

Dear Elaine: 2

I hope you'll excuse the delay in my acknowledging receipt of "Programming in Educational Television". As Mike may have mentioned to you, I have been out of town for the last three weeks (out of the country for the last two weeks - Stockholm for ICC and IFIPS). Your paper was waiting for me on my return. 3

My initial, and necessarily superficial, review of the paper indicates that as in your previous paper, the subject matter has been approached in a thorough and comprehensive manner. As far as the deviation from the outline of your work that we originally agreed upon, I remember that we also agreed that that outline would have to remain sufficiently flexible to cope with the your changing perspectives of the subject material as your worked through the program. 4

There is no problem with confidentiality of this material from Bell Canada's point of view. I believe that Mike has already sent you a copy of Business Planning Paper #21, containing the contents of your first paper for us. We would be pleased to provide you with a few more copies for your own distribution needs, and would be happy to do the same with "Programming in Educational Television", if that would be convenient to you. In any case, please feel free to disseminate it as you feel appropriate. 5

Since this letter is already somewhat delayed, and since you will be moving by the end of this month, and since the company's ability to draw up a check by a specified date is limited at best, I will send this letter to you at your Ottawa address, and will forward the check for $570 to your Philadelpia address as soon as it becomes available. 6

FGB 19-AUG-74 13:25 31010

NSRDC Directories

(J31010) 19-AUG-74 13:25; Title: Author(s): Frank G. Brignoli/FGB;
Distribution: /JHB; Sub-Collections: NIC; Clerk: FGB;

FGB 19-AUG-74 13:25 31010

NSRDC Directories

Jim, here is the directory information , Frank

FGB 19-AUG-74 13:25 31010

NSRDC Directories

Jim, if it is possible i would like the following five directories (AVRUNIN , BRIGNOLI , NAVSEC , COMRADE , and NAVLIS) , each with 250 pages , set up as given below, The NSRDC directory should be left as is for the time being, Thanks, Frank, 1

Directory: AVRUNIN 2

Users: ILA 2a

Directory: BRIGNOLI 3

Users: FGB 3a

Directory: NAVSEC 4

mail address: 4a

Naval Ship Engineering Center 4a1

Code 6102-c 4a2

Prince Georges Center 4a3

Hyattsville, Maryland 20782 4a4

Phone: 202-436-1551 4a5

Users: 4b

Anthony, Charles B, 4b1

Bono, Peter R, 4b2

Claffey, James A, 4b3

Fratantuono, Mary A, 4b4

Anklowitz, Philip (no middle initial) 4b5

Mellis, James G, 4b6

Directory: COMRADE 5

Mail Address: 5a

Naval Ship Research and Development Center 5a1

Code 1832 5a2

Comments on Output Processor Section in Final Report

(J31011) 20-AUG-74 09:50; Title: Author(s): N. Dean Meyer/NDM;
Distribution: /DVN EKM; Sub-Collections: SRI-ARC; Clerk: RJ;
Origin: <MEYER>COMP.NLS;4, 20-AUG-74 09:47 RJ ;

Comments on Output Processor Section in Final Report

1F1 1

Paragraph is really not necessary, and feels awkward. 1a

1F1A1 2

Replace "at execution time" with "when the user gives NLS a command requiring the OP". 2a

1F1A1A 3

When it is initialized the OP is given a table ,,,NLS routines and which includes info on current viewspec settings,,,levels". 3a

1F1A2A1 4

"trivial" _ "small" 4a

1F1A2B 5

"sets flags" 5a

1F1A2B2 6

"tables are used to" 6a

1F1A2C 7

"process" _ "format" 7a

comma after each statement 7b

1F1A2C1 8

"straightforward" _ "easy" 8a

"expand" _ "adapt" 8b

1F1A2D 9

Delete comma after "directives" "written on" 9a

1F1A2D1 10

"The text of the directive itself is removed from the point image of the statement unless the user specifies otherwise." 10a

1F1A2E 11

Not true! The beauty of it is that the directives are just extensions of ones you already know, Delete "Both users dir...and" "are" _ "is" 11a

1F1A2E1 12

"for" _ "in" "fonts, and" 12a

1F1A2E1 - 1F1A2E3 13

The OP interprets the users specifications of font, character size, leading, columns, etc., the COM file it produces includes all the information the Comp 80 needs to place things on the page, 13a

The user may accept a simple default, or may learn to use as much of the flexibility and power of this device as his typographical skills allow, 13b

1F1A2E4 14

"subset" _ "interface to the detailed flexibility of the Comp 80" 14a

1F1A2E4B 15

"...in points, inches, or centimeters," 15a

1F1A2E4C 16

Should be substatement of above, 16a

1F1A2E4D 17

Delete "or 4" 17a

Delete "3 options" 17b

1F1A2E5 18

"to tape in Los Angeles via the ARPA Network" 18a

1F1A2E5C4D 19

Delete "and between characters" 19a

1F1B 20

"Formatting a File" 20a

1F1B1 21

sign and a number (if required). 21a

1F1B3 22

instead of "All meas,..page" say "Vertical measurements are taken from the top of the page, and horizontal measurements from a reference point set with respect to the left edge of the page," 22a

1F1B3A 23

delete comma 23a

1F1B3B 24

don't forget to fill in "N". 24a

"TM" sets the number of blank lines to be left at the top of each page, in this example three. 24b

1F1B3G - 1F1B34 25

"makes" _ "puts" 25a

1F1B3J 26

"by default" _ "usually" 26a

1F1B3K 27

"Lmax"" _ "ymax" 27a

1F1B3F 28

"includes" _ "is" 28a

1F1B4 29

"according to level of hierarchy "of" should be "in" 29a

1F1C 30

"about" _ "at" 30a

1F1C1 31

"at the 1972" remember to put in link "prepare" _ "adapt" 31a

1F1C1E 32

remember link "sendprint options have" "a normal" _ "part of an" 32a

1F1C2A 33

in last sentence, "is" _ "this document represents" 33a

delete "in terms of typefaces" 33b

1F1C3A 34

First sentence pretty dramatic, 34a

"Of course,,,augmented," might read:
"The inexperienced user can acquire these tools gradually as his work requires them; but to allow him the benefit of our more experienced users, some standard formats have been developed," 34b

1F1C3C 35

links 35a

hyphen in photo-reduction? 35b

1F1C3D 36

delete "for users" "insert the required directives," 36a

"such diverse,,," _ "a diversity of layouts, such as" 36b

1F1C3E 37

Dirk: Let me give you a more up-to-date thing here, 37a

1F1D1A 38

delete "widely distributed" "except" _ "including" 38a

"highly various" _ "a great variety of" 38b

"on ,,,occassion" _ "in certain instances" 38c

1F1D2A1 39

"ready" _ "produced by the OP" 39a

"production you could call routine" _ "routine production" 39b

"For them" _ "To them" 39c

Comments on Output Processor Section in Final Report

1F1D2A3A 40

"formats to" _ "formats from" 40a

1F1D2A4A1 41

"problem of" _ "problem in" 41a

1F1D2A4A2 42

"NET" _ "network" 42a

1F1D2A5C2 43

"are" _ "on"
"differentiallY" _ "proportionally" 43a

1F1D2A5C3 44

"differentially" _ "proportionally" wrong: all faces could be justified, only between words. No face between characters. Courvier was proportionally spaced although less compaction since face designed to be monospaced, 44a

1F1D2A5D1 45

"sweep" _ "intensity" 45a

1F1D2A5D2 46

delete statement? 46a

1F1D2E4 47

"to microfiche from NLS" 47a

1F1E1A 48

"glosses"??? 48a

"paged indexes" _ "indexes referring to page numbers" 48b

1F1E1B1 49

"from which to print" 49a

EJK 23-AUG-74 14:53 31024

Ciao.

(J31024) 23-AUG-74 14:53; Title: Author(s): Edmund J. Kennedy/EJK;
Distribution: /RADC; Sub-Collections: RADC; Clerk: EJK;

EJK 23-AUG-74 14:53 31024

Ciao,

I'm leaving very shortly, 1

See you after Labor Day, 2

Try to bear up without me, 3

MIKE 21-AUG-74 07:57 31014

example of the journal system for hilary

(J31014) 21-AUG-74 07:57; Title: Author(s): Michael T. Bedford/MIKE;
Distribution: /MIKE; Sub-Collections: NIC; Clerk: MIKE;

MIKE 21-AUG-74 07:57 31014

example of the journal system for hilary

this won't show up in my filefor several (hours ?)

MIKE 21-AUG-74 07:57 31014

example of the journal system for hilary

this is a test for Hilary 1

this should be statement two 2

this shuld bea substatement 2a

ILA 21-AUG-74 11:57 31016

test message

(J31016) 21-AUG-74 11:57; Title: Author(s): I. Larry Avrunin/ILA;
Distribution: /FGB; Sub-Collections: NIC; Clerk: ILA;

ILA 21-AUG-74 11:57 31016

test message

hello Frank this is to test your directory 1

TP011

(J31017) 22-AUG-74 10:43; Title: Author(s): Dean F. Bergstrom/DFB;
Distribution: /ELF; Sub-Collections: RADC; Clerk: DFB;

TPO11

<BERGSTROM>TPO11.NLS;2, 21-AUG-74 14:48 DFB ;

3,11 TPO NO, 11 - SOFTWARE SCIENCES TECHNOLOGY

3,11,1 GENERAL OBJECTIVES:

(U) The general objectives of this TPO are to develop techniques to improve the reliability, reduce the cost, and increase the usefulness of computer systems to the Air Force,

3,11,2 SPECIFIC GOALS AND TECHNICAL APPROACHES:

(U) The Overview Chart (Page 3,11-2) illustrates the plan for meeting the general objectives, The objectives are a distillation of requirements of the systems listed on the right side of the chart, These systems are essential to any application of Air Force power in response to a directive from the President of the United States, In addition, data processing supports data reduction activities in practically all other systems, To support these systems, the five areas of effort in this TPO are oriented toward the major goals or products shown on the overview chart, Each of the areas of effort will be discussed in the order indicated on the overview chart,

3,11,2,1 (U) SOFTWARE QUALITY - The goals of this technical area are to provide the Air Force with capabilities to improve the quality (i,e,, reliability, transferability, maintainability, efficiency) of its software while lowering the cost to attain that quality, This shall come about by the development of technologies for the quality control of computer Higher Order Languages (HOLs) and procedures for the generation of cost effective error-free software systems,

The goals of the Higher Order Languages (HOL) effort are: (1) to produce high quality compilers in an automated fashion, thereby cutting down on the cost and time necessary to build compilers, and (2) to develop the methodology necessary to control HOLs in order to eliminate certain problems with their use and thereby promote their use,

The first goal is being achieved by capitalizing on state-of-the-art compiler building techniques and producing a compiler building tool called JOCIT, standing for JOVIAL Compiler Implementation Tool, The first JOCIT for implementing JOVIAL/J3

compilers was completed in November 1973, as can be seen from the milestone chart. The compiler was modified to meet some unique requirements of WWMCCS, was tested and accepted by WWMCCS users, and will become a WWMCCS standard compiler by September 1974. (Thus RADC was able to provide SAC and NORAD with an acceptable JOVIAL Compiler at a saving conservatively estimated to be $658,000). Again looking at the chart, it can be seen that a follow-on effort to develop a JOCIT for JOVIAL/J73 will be completed in FY-77. There are also plans underway to develop similar tools for FORTRAN and COBOL, and the totality of all four compiler tools would feed the Language Control Area which is discussed later.

There are also efforts in this area which will provide the Air Force with the ability to evaluate its applications with respect to which HOL and/or type of compiler will meet its needs and also provide the ability to better specify the HOL or compiler.

With respect to advancing the state-of-the-art of compilers, there is an ongoing effort to make extensible language compilers efficient enough for practical use, and a planned effort to implement a compiler for an "error resistant" language.

The second goal of the Higher Order Language efforts is aimed at providing the Air Force with a measure of control over the HOLs it uses. The first effort undertaken was to develop a HOL called JOVIAL/J73 which is more responsive to Air Force needs and should thus increase HOL usage. The original specification of this HOL was completed in FY-73, and it is planned to modify the language in FY-75 and 76 to make it more "error resistant".

The development of a compiler validation system is part of this effort. A compiler validator for JOVIAL/J3, called JCVS, has been developed and augmented to a degree where it is the most complete single test of a compiler in existence. The success of this tool has prompted the development of a similar system for JOVIAL/J73 compilers. An evaluation of compiler validators already in the field for COBOL and FORTRAN is also underway. A BASIC compiler validator is also under test in-house and a follow-on is planned to utilize modern "theorem-proving" techniques to build an "absolute" compiler validator.

The problem of multiple interpretations of programming

languages, arising from incomplete, ambiguous specifications, was attacked by the development of a system called Semantics Oriented Language (SEMANOL) which enables one to precisely specify and check out the syntax and semantics of a HOL. SEMANOL was applied to JOVIAL/J3 in FY-73 with satisfying results and will be utilized in FY-73 to "debug" the JOVIAL/J73 specification mentioned above. Future plans include the application of this system to other Air Force standard HOLs such as FORTRAN and COBOL.

In order to collect proper data on HOLs used in the Air Force so that constructive changes can be made, statistics gathering packages for JOVIAL and BASIC are being developed, both in-house and contractually. These packages will utilize information available to HOL compilers to provide the data which was drastically lacking in the past when HOL or compiler updates were attempted.

Other work in this area includes studies into HOL requirements of specific Air Force systems such as DAIS (Digital Avionics Information Systems) and the comparison of all HOLs in use by DOD.

The last product on the milestone chart, in FY-80, represents the gathering of the tools and technology developed from the Compiler Technology and Language Control area into neat packages which will give the Air Force complete control over all standard HOLs it plans to use now and in the foreseeable future, (i.e., FORTRAN, COBOL, JOVIAL/J3 and JOVIAL/J73.) To help in this control, the design of a Language Control Facility and the implementation of a reporting system will begin in FY-75.

The goals of the Software Reliability efforts are to investigate and develop techniques for increasing the reliability of complex system software.

Initial design of a centralized data facility on software error, cost and productivity data was initiated in FY-74. An effort was initiated to study existing methods of detecting and evaluating software failures during testing and operational phases of large Command and Control Software Systems. Efforts were also initiated to study the nature of software reliability modeling, software errors, their classification and number, their removal during testing and correction, the prediction of their occurrence,

and techniques for writing low error content software. A prototype Software Implementation Monitor (SIMON) was also designed in FY-74 and is currently under development.

3.11.2.2 (U) SOFTWARE ENGINEERING - The goals of this Technical Area are to develop programming aids and tools required by programmers, test engineers and maintenance personnel and to develop the means to make these tools readily available for DOD software developments across the country.

The goals of the Programmer Tools effort are to develop software tools which will assist the writers or programmers of software, and support test engineers and maintenance personnel. These tools are generally in the form of computer programs, support software and other automated aids and provide help in the generation of software. A multitude of tools have been developed and are currently available. Unfortunately, these tools are usually on a specific machine and/or for a specific language. A vehicle for making these tools available despite this drawback is the National Software Works (NSW) which is discussed later. A number of tools which have great potential for improving software reliability and productivity are proposed or are currently in development, e.g., structural complexity analyzers and automatic error data collectors. Analyzers which determine the extent of compliance to programming conventions, and analyzers for searching out coding blunders are planned for development in FY-75 and FY-76.

Emphasis in the area of software test tools will be placed on the development of new and more powerful tools which support extensive analysis of logical paths in software as a function of input data sets. The systems also provide valuable statistical records of tests completed, logical paths tested and not tested, and assist in the generation of new test cases and timing/code optimization.

New tools are also being developed such as block analyzers for determining scope of variables, and loop analyzers for determining potentially singular point conditions.

Other approaches to testing software involve methods for proving software formally correct and include inductive proofs on

programming assertions, semi-automatic theorem provers, and exhaustive test case analysis.

Because of the diversity of existing tools for testing, and writing software, a significant problem to be faced in quality software production is that of cataloging and classifying the different types of tools available and of making these tools available to Air Force and other government users. This cataloging will include an analysis of each software tool to determine languages or operating system dependencies, known errors or deficiencies, and functional requirements and other peculiarities of the package that may impact intended users of the tools. Also included in the analysis will be recommendations for improving the general utility of each tool for wider usage, and the possibility of moving the tools to other environments and translating the packages to other programming languages.

The goals of the Modern Programming Practices area are to undertake the development of techniques for formalizing the design of software.

Traditionally, software design has been based upon natural language narratives, flow charts and decision tables. New approaches currently being (or planned to be) investigated involve the use of the HIPO technique (hierarchy-input-process-output), transition diagrams, levels of design abstraction, pseudo languages and special design languages, such as the University of Michigan's PSL (Problem Statement Language), National Cash Register's ADS (Accurately Defined System), and IBM's PDL (Problem Design Language). Fully automatic translation from design to programming language is considered a design goal in many of the above systems.

Other techniques being considered for the designer include systems for testing the completeness of narrative type software specifications for consistency checking, and for performing termination checks on software designs. Other efforts being undertaken include the development of structured programming preprocessors for JOVIAL, COBOL, and FORTRAN, and implementation of programming support libraries for the above languages.

A detailed set of guidelines will also be completed in FY-75 that will serve to transfer present technology in structured

programming (SP), top-down programming, chief programmer teams (CPTs) and programming support libraries (PSLs) to the Air Force for further application. Areas to be investigated include the development of SP language standards for COBOL, FORTRAN, JOVIAL J3 and J73, analysis of data structuring methods, and development of requirements for a CPT and PSL. Other aspects of software quality architecture and software quality engineering will also be explored including the metrics of software quality.

The goal of the National Software Works effort is to improve the productivity of DOD software development by making available to programmers and managers, in a uniform fashion, those types of software tools in widespread use in the research community.

Two equally important tasks confront the R & D laboratory: the development of tools and the exporting of tools. Once a particular set of software tools is developed, a means must be available to distribute these tools to various users. Often, this task is hampered because of the transferability problem - the problem of getting programs developed at RADC on one computer out into a user community of different computer types. Because software can be transmitted accurately over digital communication links, a promising solution is to make these software tools available through the ARPA sponsored National Software Works (NSW).

The NSW is directed toward the development of the necessary interface programs on the ARPANET to allow users access to an integrated set of tools and programming and/or management aids which might exist at different installations or sites throughout the country. A user at one site would have a standard method of using a tool at a site thousands of miles away. The NSW would provide a framework for tool encapsulation, centralized accounting, centralized file management, and front-end processing.

NSW service will begin in FY-76 with the connection of the Data Services Design Center as a user bearing host. Later, RADC will connect its MULTICS and WWMCCS computer to the ARPANET in order to make available RADC developed tools. Thus the often sought links between the laboratory and the user will be achieved. Minimal modifications to the operating systems will be made to convert the RADC computers into tool bearing hosts.

NSW and the ARPANET will provide an environment whereby the producers of software tools can easily interact with the user of the tools. Files and programs can be transfered between sites with ease. Information can quickly pass from the tool producer to the tool user and back again in much less time than before. Where the laboratories before were isolated centers of research, now a close interaction with users is possible.

The development of a quality software production and analysis center requires just such a close interaction between users and producers of tools. A software reliability center can be implemented which maintains data on the quality of software produced by vendors. Information on software running in the field can be returned to the center for updating reliability files. Samples of software can be transfered to the center through NSW and analyzed for quality. Statistics can be collected and retained for future software contractor qualification. In this way high standards for software vendor selection can be maintained. This would directly aid a USAF acquisition which has software components.

3.11.2.3 (U) SYSTEM SOFTWARE - The goals of this Technical Area are to support Air Force WWMCCS sites, enhance the capability of WWMCCS, develop for users the ability to manipulate large data bases and to develop techniques for providing multi-level security.

The goal of the Security Technology effort is to develop the ability to share EDP systems and the information therein with the assurance that classified information stored and processed will receive appropriate protection.

The specific goals and products of this program are organized into three categories:

The development of an abstract mathematical model of computer security design requirements compatible with the Department of Defense security system for protection of classified information. Further, the development of an explicit methodology for application of these models to the design and certification of specific systems.

The development of a prototype secure computer system

which will provide the multi-level information processing capablity described under General Objective,

The application of the computer security techniques developed to specific Air Force requirements. In particular, technology transfer support will be provided to current ADP system developments which presently cannot satisfy economic constraints nor required operational capabilities due to the current lack of valid computer security controls implemented in the hardware and software,

The approach being taken by ESD for developing a secure computer system begins with a formal definition (i.e., model) of secure operation. This model defines the operations necessary for the utility as well as the security of a computer system. A hardware/software security kernel, totally responsible for the system's security, then takes place as a direct implementation of the security model. ESD has completed two different types of models for computer security and has implemented one of them on a PDP-11/45 minicomputer to provide a feasibility demonstration. The development of a secure general purpose large scale computer system is being undertaken based on the methodology developed during the feasibility demonstration. This development, using the security kernel approach, will use an appropriate target computing system whose utility has been previously established. In addition, development of audit, surveillance, and secure DMS subsystems will be undertaken to provide application aids for a secure computer system. Finally, to facilitate use of secure computer systems, more efficient, less expensive terminal and communication security equipment designs will be developed,

Software Executive Services - The goals of the Software Executive Services effort are: to provide requirement analysis, quality assurance, testing support and design recommendations for the Air Force WWMCCS community, and to provide system software support to operational users requiring capabilities to manipulate large data bases,

RADC, at the request of Hq USAF/ACD, completed a study of the Extended Instruction Set (EIS) for the Honeywell 6000 series computers. The results of the study had a major impact on the decision by JTSA (Joint Technical Support Activity) to upgrade all the WWMCCS computers to include EIS,

In addition, RADC, using the RADC Honeywell 635 computer, studied the feasibility of using Honeywell 600 computers for the major command update program and as backup for the H/6000 WWMCCS. Results of the RADC effort had a major effect on the Hq USAF/ACD decision not to use the H/600 computers.

RADC developed a technical plan for the Air Force Data System Design Center (AFDSDC) to assist that oganization in performing their function as the Air Force focal point for reporting WWMCCS deficiencies to JTSA. The plan is currently being followed and RADC has become the prime source for technical assistance to AFDSDC. A letter of agreement has been initiated defining the roles of RADC and AFDSDC in supporting the Air Force WWMCCS sites.

RADC, in cooperation with ESD/MITRE and JTSA has performed field tests on the Honeywell developmental Network Processing System (NPS) to test its functional capabilities and to determine its utility/applicability to the WWMCCS community. The test reports are being prepared. Analysis of results point out that current NPS implementation decreases system throughput in comparison with existing software.

The technical efforts described above, active involvement with WWMCCS users through requirements conferences and documented needs plus explicit direction in PMD R-P4010(1)/63728F Technical Support to Air Force HIS 6000 Sites have led to a two pronged development program. A number of tasks are proposed which address development of fixes to current pressing problems which must be solved in the near term to allow users to perform their missions. A longer term solution, running concurrently with the fixes, is proposed to attack the user problems caused by deficiencies inherent in the design of the WWMCCS operating system software.

The major thrust of this program is to improve the responsiveness of the WWMCCS system software to meet the stated requirements of its users. The Restart/Recovery task addresses the requirements from SAC and NORAD to have the system 95% to 100% available. This is currently accomplished with costly redundancy. The short term approach addresses procedures which may be used in conjunction with the existing software/hardware configuration to facilitate recovery of data bases and decrease the time to restart the system and return the users to the point of processing just

before system failure. The goal of these procedures is always to attain zero loss of information and minimal system downtime.

Real Time/Priority Processing - SAC has a documented requirement for response times of less than two seconds during crisis situations. TAC has stated they require less than ten second response for 50% of their application jobs. These requirements cannot be met with the current WWMCCS. Our approach is to modify the Honeywell provided TPE (Transaction Processing Executive) to achieve real time processing. We are currently under contract with Honeywell to provide these modifications. Design is almost completed, flow charting will start immediately. After completion of the models an effort is planned to apply this strategy to real time transaction oriented applications.

Front End Processing - Plans are to continue to test new releases of the Honeywell NPS (Network Processing System). We will play a major role in developing a firm NPS specification which will eventually become a standard package in WWMCCS.

File System - The current response time problem with data retrieval under WWMCCS is a direct result of the limitations of the WWDMS and GCOS file system. Using existing tools previously developed by RADC (data access systems, flexible indexing systems and software monitors), we plan to model various approaches for handling the retrieval problem in order to lead us to intelligent design changes critically needed for WWMCCS.

System Architecture - Up to now we have been talking about plans and efforts which address enhancing specific components of WWMCCS. They represent modifications or patches for near time solutions. We also plan to conduct efforts which will address the enhancements of the total WWMCCS in terms of reliability and responsiveness. These efforts will be based on arriving at a modularized operating system which will replace GCOS. The pay off would include:

Configuration according to specific requirements, thereby increasing responsiveness and reducing overhead, and clearer code which will reduce software errors and increase reliability. The concept of virtual machine monitor (VMM) is one of the approaches we plan to pursue to arrive at modularity. We plan to initiate a

contract with the Harvard Computation Laboratory to study the fundamentals of VMM and also plan to initiate an effort to study the applications of VMM to the Honeywell 6000 computer. In this application, an attempt will be made to run GCOS and MULTICS simultaneously on the H/6000 computer.

In addition to supporting WWMCCS, RADC is also supporting HQ AFCS and the Defense Mapping Agency in providing aids to their large file problems. RADC has provided HQ AFCS an in-house developed on-line retrieval system operating on the RADC/H635 computer to support their operational needs. In FY-75 it is planned to augment the current capability with additional file manipulating functions. The Defense Mapping Agency has requested that RADC examine their large file processing needs, with the goal of designing a management information system for their cartographic data base. In FY-75 an initial study of this problem is planned.

3.11.3 RELATED EFFORTS:

(U) The following efforts are related to work being pursued under this TPO. In general, compiler-compiler efforts being pursued by industry involve "many-to-many" language-to-computer configurations. This is different from RADC's "one-too-many" approach in JOCIT, which it is felt should produce higher quality compilers. In addition, the JOCIT effort is the only known effort producing compilers for the JOVIAL language.

Automatic Validation Systems (AVS) efforts under investigation by other organizations are principally concerned with the FORTRAN language, hence no developments are being pursued along this line other than transfer of a FORTRAN test tool to RADC. Development of an AVS type capability for JOVIAL is required.

In the area of data management software, industry is now producing generalized data management software hence the emphasis for this program is shifting from large scale developments to tools for specifying, selecting and tuning generalized data management software. In security, ARPA sponsored work at MIT on Multics will be used directly in the development of a long range solution to the security problem. In the tools for knowledge workers area, the ARPA sponsored research at Stanford Research Institute is being exploited directly and other related research is being followed closely. There

is no other major activity in this area where a subset of an organization is attempting to systematically exploit sophisticated on-line computer tools.

All other software efforts are being considered either complementary to work being pursued at RADC, or are serving as a baseline upon which further advancements are being made. None of the efforts below are considered duplicative in any way.

SOFTWARE QUALITY

NASA presently has a contract with McDonnell Douglas (Contract Number NASA-27202) to design a compiler-compiler capable of producing compilers for all HOLs which NASA uses, or plans to use, such as FORTRAN, SPL, CLASP, etc.

NELC has a contract with Intermetrics Corporation (Contract Number N00123-73-C-1177) to design a HOL for the AADC computer. This effort is under project W3150, Program Element 63202N.

The U.S. Army Electronics Command is developing a Compiler Generation Tool for TACPOL, a PL-1 Command and Control Subset. This work is being performed in-house under System Software Program Element 627703, Program Element 15662703A327, Task Element 03, Work Element 36108.

IBM Federal Systems Division, Owego, is working on a compiler-compiler to handle several DOD HOLs.

Boeing Corporation is performing an analysis of present HOLs for B-1 follow-on implementations. At the present time, JOVIAL/J73 is one of the strongest contenders.

Univac of Minneapolis is using IR&D funds to develop translators between the Command and Control HOLs in use by DOD, namely, JOVIAL, CMS-2, and TACPOL.

AFAL has a program entitled the Digital Avionics Information System (DAIS) under the TPO-S1 which has chosen JOVIAL/J73 as the HOL in which its mission software will be written.

NASA/MSC has implemented an AVS for FORTRAN programs written for the Univac 1108 as part of the Mission Trajectory Control Program and the Skylab Activities.

Software Reliability studies at Carnegie-Mellon University, University of Wisconsin and MIT in Common Base Languages (Dennis) and NSF sponsored work at SRI and University of California at Irvine are also on-going government sponsored programs.

Air Force sponsored work on the Attack Assessment Program for SAMSO includes provisions for collection and analysis of software error data.

U.S. Army and Navy sponsored work at PIB (Shooman) involves software error collection/analysis and procedures for software modeling and reliability prediction.

SOFTWARE ENGINEERING

The Air Force is currently AVS testing FORTRAN programs on the IBM 360/370 and Assembly Code on the IBM 7090 written as part of the Minuteman Program.

The Army is investigating the problem of verifying Safeguard Software at Huntsville, Alabama.

The Navy is investigating the software verification problem in support of system software activities at NEL.

Projects employing Structured Programming and Chief Programmer Teams and Top Down Programming include government sponsored programs such as: Safeguard (PAR Program), AWACS/JOVIAL Support, RTCC/Skylab Real Time Computing Complex); Systems 7, 370/EMS (Energy Management System), NMCS and NIPS System 360FFS (National Intelligence Processing System 360 Formatted File System).

SYSTEM SOFTWARE

ESD has been working with the computer industry and has participated in computer security test programs. A description of these efforts is presented in ESD-TR-73-51, "Computer Security Technology Planning Study."

Several industrial IR&D efforts concerning computer security have taken place. These include the Data Security Study performed by IBM's Systems Development Division, efforts by the Data Systems Operations Division of Honeywell Information System Inc., and projects on computer security at System Development Corporation and TRW Systems Division. These efforts will not meet Air Force security requirements without the guidance to be provided by this Technology Planning Objective.

ARPA has supported a development program under Project MAC conducted at Massachusetts Institute of Technology to simplify the security related aspects of MULTICS. This program is now jointly sponsored with the Air Force and is the basis for the large scale, general purpose secure prototype system development.

NSA has established a computer security division that is investigating a number of computer-related communications security problems. NSA is expected to take a leading role in the communications security portions of this program.

The Joint Technical Support Activity is currently involved in studying ADP multi-level security capabilities, data management system multi-level features, and ADP network security. The JTSA program is being fully coordinated with this program to prevent overlap. Some, but not all, of the security problems confronting the Air Force WWMCCS community are being addressed in this effort.

SAC, through the 436M SPO, has Computer Sciences Corporation developing an on-line interactive control program called SONIC. Initial investigations by RADC and the Air Force Data Systems Design Center reveal that its transferability to other WWMCCS users is minimal.

RADC/IR has a front end processing development program called TOSS (Terminal Oriented Software System). It is currently being considered as the prime candidate for intelligence networking applications.

The SAC PACER program, being directed by RADC/IR, has a continuing effort in restart/recovery, with major orientation to data base integrity and recovery.

NORAD, through the 427M SPO, has developed a Real Time Monitor (RTM) to handle their interactive processing requirements. MAC has developed a real time operating system (RTOS) under WWMCCS operating system. The Joint Technical Support Activity has a continuing effort in improving the Worlwide Data Management System (WWDMS) to meet the WWMCCS target requirements.

3.11.4 REQUIREMENTS:

Requirement Identification Number	Title	TPO Applicability
TN-ESD-24-72-17	Security Controls in Multi-Users Computer Systems	Essential
SAC-ROC-74-1	Multi-level Security	Essential
USAF Development Directive 79	Command, Control & Data Systems Software	Essential
AFSC Program Directive 415L-2-73-51	MAC Integrated Mgt System (MACCCIMS)	Significant
AFSC Program Directive 1992/01-1-73/27	Technical Support for AFDSC Multics	Essential
AFSC Program Directive 1992/02-1-73-28	Acquisition of Multics for AFDSC	Essential
ESD-TR-73-51 Requirements of Several Major AF Commands	Computer Security	Essential
SATIN IV PMP R-P4020-(1) (SATIN IV)	SAC Automated Total Information Network	Essential
PMD-R-P2145(2) 33401F	Secure Telecommunications Terminals	Significant

CCIP-85	AF Command & Control Information Processing 1980's	Essential
SADPR-85	AF ADP Requirements 1980's	Essential
STALOG	Study of Automation of Logistics	Essential
AFSCNET	AFSC Computer Network	Significant
PMD R-P4010(1)	Technical Support to AF HIS 6000 sites	Essential

3,11,5 RESOURCES:

(U) The funding and manpower required to support this TPO is listed on (Page 3,11-). No other major support requirements have been identified.

3,11,6 TPO FOCAL POINT:

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TPO12

(J31018) 22-AUG-74 10:48; Title: Author(s): Daniel R. Loreto/DRL2;
Distribution: /ELF; Sub-Collections: NIC; Clerk: DRL2;

<LORETO>TPO12.NLS;1, 21-AUG-74 07:47 DRL2 ;

3,12 TPO No, 12 - COMPUTER SYSTEMS TECHNOLOGY

3,12,1 GENERAL OBJECTIVES:

(U) The objective of this TPO is to develop the various computer related technologies which are required to allow computer systems to be used for the efficient and economical solution of numerous Air Force operational problems,

The efforts directed toward meeting this objective are in two major areas - Computer Architecture and Interactive Processing, Computer Architecture deals with the organization of computer components and sub-systems, Interactive processing addresses the problems of automatic signal classification, man-machine interface, and the automation of operational functions,

The objectives of the efforts in the Computer Architecture area are to: (1) demonstrate the application of Associative Processor (AP) techniques to the solution of Air Force high data rate real-time data processing problems; (2) develop technology which will allow sharing of DOD computing resources such as computers, computer peripherals, data bases and software facilities; (3) develop technology which will make possible the orderly design, test and evaluation of special computer architecture required by the Air Force before the architecture design is given to a contractor to build,

Efforts in the Interactive Processing area are directed toward: (1) developing the facilities and the expertise required to solve the complex data processing problems of automatic signal classification technique development, and assisting a wide variety of users in actually developing automatic classification and identification equipment for use in various Air Force surveillance systems; (2) developing cost effective interactive graphics techniques and systems which will lower Air Force operational costs and increase effectiveness,

3,12,2 SPECIFIC GOALS AND TECHNICAL APPROACHES:

(U) The plan for attaining the TPO objective is shown in the overview chart (Page 3,12-2), The technical efforts covered

by this TPO are oriented toward providing the four major products shown,,IFirst=10;

3,12,2,1 (U) ASSOCIATIVE PROCESSOR COMPUTING SYSTEM - The goal of this product is to provide techniques capable of meeting the ever increasing data processing requirements of the Air Force as typified by the high data rate real-time processing demands imposed by systems such as the Airborne Warning and Control System (AWACS).

As indicated by the Milestone Chart (Page 3,12-), this goal is being achieved by RADC's Associative Processor Testbed facility. The testbed facility consists of an Associative Processor tied to RADC's HIS 645 sequential computer, a situation display capability for purposes of providing operator interaction with the executing programs, and equipment for monitoring the performance of the testbed equipment while executing operational type programs. Completion of the testbed system is planned during FY-76, when a data manipulation capability for effecting high utilization of processing elements will be installed to complement the interim capabilities available at the present time.

The major on-going effort for assessing the capability of an associative processor to meet real-time requirements is directed toward the AWACS requirements. Associative Processor Application Software, to accomplish the functions required by AWACS, is being developed for analysis and demonstration on the AP testbed. This activity, which is being accomplished both in-house and contractually, will concentrate on the data processing aspects of active and passive tracking, radar data correlation, display processing, and signal processing. Completion is expected in mid FY-76. Major improvements in capability are envisioned for AWACS-like systems using an AP approach rather than a sequential computer. AP active tracking tests to date indicate a capability of handling five times as many radar tracks. Efforts to develop software for other Air Force system functions requiring real time processing capability will be started upon completion of the AWACS work. In addition, Syracuse University is developing software to perform functions such as matrix manipulations, fast fourier transforms, partial differential equation solutions, and traffic control/collision predictions, and MITRE Corporation is developing software in functional areas directly applicable to ESD project requirements.

During FY-75, the Associative Processor testbed will become a remotely accessible Associative Processing Research Facility. Under this mode of operation, DOD agencies and contractors will be able to enter batch jobs from remote stations on a twenty hour per day basis.

Two AP design studies are being conducted in support of RADC TPO-9 "Telecommunications". This TPO supports improvements to the Defense Communications System (DCS). The first is the Communications Processing System study which will examine various architectures, including the Associative Processor, in the design of a processor to handle all types of communications traffic both digital and analog. Completion is planned for mid FY-75. The second design study is for an associative communications multiplexer which will compress and multiplex digital signals using an Associative Processor. Completion is planned for the end of FY-75.

The prime end goal of the Associative Processor Project is the development of hardware and software specifications for a cost-effective, highly reliable Associative Processor Computing System (APCS) suitable for airborne and tactical environments. These specifications and the rationale developed by the project during the 1973-1976 time period are expected to lead to a 6.4 program to actually fabricate the evolved APCS design. This program, estimated at 14 million dollars, will result in a militarized Associative Processor and its supporting software directed toward applications such as AWACS and the Advanced Airborne Command Post. The computer system will serve as the basis for continued software development and application programming at RADC and can be used as a prototype design for operational Air Force systems. Target date for completion is FY-79.

3.12.2.2 (U) DISTRIBUTED COMPUTATION SYSTEMS - The objective of this product is to provide the Air Force with mechanisms for maximizing the utilization of its computing resources. Distributed Computation Systems are of two types: (1) computer systems which are physically distributed but tied together by means of a network such as the ARPANET, and (2) computer systems which have, on a single mainframe, a variety of functionally distributed capabilities which can strategically be brought together in an optimum fashion to provide highly efficient/low cost solutions to the

Air Force real time/special requirements. Milestone Chart (Page 3,12-) covers both types of Distributed Computation Systems.

To achieve the first objective of providing the capability to efficiently and effectively utilize the dispersed computational resources inherently present in a distributed heterogeneous computer network, the Distributed Computation Techniques and Applications effort will identify problems inherent in present netted computer systems which deter resource sharing among computers. It will explore existing software and hardware systems to determine what fixes can be made to overcome the problem with these systems. It will then propose possible system architectures which should lead to a system which allows efficient resource sharing in a manner which makes the mechanics of network use completely transparent to the network resource user. It will implement the software fixes proposed by the study and test them in actual operational systems. Any additional techniques which appear promising will also be explored.

The System Architecture effort will involve simulation and, if possible, implementation of the architecture proposed by the Distributed Computation Techniques and Applications study. These will be thoroughly tested to determine their applicability to actual operational systems such as the World Wide Military Command and Control System (WWMCCS).

The AFSC Network effort will develop the interfaces to connect 16 AFSC computers to the ARPANET in two phases. In the first phase, three CDC-6600 machines at ASD, ADTC and AFWL will be connected to the net. In the second phase, the remaining 13 sites will be connected.

The second objective of the Distributed Computation Systems product area is to develop an effective low cost approach for producing cost effective computing capability required to solve special processing functions which are peculiar to the Air Force and which cannot be satisfied by computers existing in government and industries inventories. For this purpose, a program called Configurable Processor has been initiated. A Configurable Processor is a functionally distributed computation system which can be structured by means of firmware to assume the optimal, cost effective architecture form required by the problem and the software which

provides solution to the problem. The design which is a by-product of the configured system will be given to a contractor to build only after it has been tested and evaluated using significant benchmark software. After the design has been released to the contractor, the "configured architecture" will then serve as an interim computer so that software development can be continued while the special computer is being built.

The configurable processor concept is an outgrowth of the associative processor program, the microprocessor technology developments which now provide complete computer functions on a single integrated circuit chip, and the advances which have been made in the microprogramming technology.

The configurable processor program will begin with the purchase of off-the-shelf Micro Function Components including microfunction chips, a microprogrammable control unit and a multi-dimensional access memory. These components will be assembled into an extremely inexpensive system which through firmware can be made to act as any architectural form (sequential processor, parallel processor, multi-processor, etc.) having any desired word/logic length. The Configurable Processor Design, Test and Evaluation will be accomplished on these assembled components and as such will represent a Configurable Processor Testbed Facility.

Configurable Processor Application Software will be developed to demonstrate the process of structuring the configurable processor based on: (1) the structure of the problem, and (2) the structure of the software for implementing the problem solution.

The end product will be: (1) an inexpensive, Air Force Configurable Processor Testbed Facility, (2) utility software for facilitating the configuration process, and (3) validation data which will demonstrate the process and the benefits that a Configurable Processor Facility brings to the Air Force.

3.12.2.3 (U) SIGNAL CLASSIFICATION - The automatic classification of signals is required to support many Air Force objectives including space defense, remote surveillance, base defense, and tactical interdiction. Devices (signal classifiers) which analyze the output electronic signals from the transducers of various sensor systems, including radar, photometric, seismic,

acoustic, etc,, and automatically recognize these signals as occurring in a specific target class, must be developed. These classifiers will increase the effectiveness of the sensor system since false alarms will be eliminated/reduced and will allow more accurate and rapid assessment of the threat by commanders. Classifiers may be implemented as part of a data processing system, be part of other ground or airborne installations, or be contained in sensors impact implanted into enemy territory.

The technical approach to the design of these classifiers is to use advanced pattern recognition techniques (software) residing on a general purpose computer interactively coupled to a high performance graphics console to provide general purpose design tools. These tools allow the design engineer to analyze a data set, extract features characteristic of each target class, evaluate these features and design the target classifier. Since several solutions can be developed rapidly, the most cost effective in terms of accuracy versus complexity (i.e., the number and type of features or method of classification required) can be implemented.

Up to this point, development work has centered around the tools and techniques to allow problem solution. With the validity of our interactive pattern recognition approach having been verified on specific previous applications, our attention for FY-76 and beyond is on the implementation of a fully operational Pattern Recognition Design Facility, a unique capability within DOD and industry. This facility is needed in order to support the future signal classification workload as a production oriented capability, addressed to specific user requirements. In order to arrive at this posture in a timely fashion, the Milestone Chart (Page 3.12-) line items associated with waveform processing and preprocessing and with the updating of the On-Line Pattern Analysis and Recognition System (OLPARS) must be completed.

Waveform Preprocessing Techniques encompass those ancillary projects necessary for a viable system. In FY-74, such items as hybrid feature extraction software, hybrid preprocessing routines, and the configuring of a peripheral image dissector, permitted the handling of digital, analog, and photographic waveform data input. In FY-75, the item will be expanded to include a data

link from the RADC HIS 6180 to the PDP 11/45 computer, so that each computer may be used to the greatest advantage.

The Waveform Processing System (WPS) addresses the problem of quickly and efficiently extracting discriminatory feature information from the waveform data. When completed in early FY-77, it will allow the analyst to dynamically interact with the data in defining and testing candidate feature sets. The result will be a more effective design in a minimum of time.

Improvements in the prototype version of OLPARS are of two categories: (1) the implementation of the logic design capability on the PDP 11/45 computer resident with the WPS, and (2) the implementation of the logic design under the MULTICS operating system on the RADC HIS 6180 computer. In the first OLPARS version, full advantage will be taken of the high performance graphics terminals associated with the PDP 11/45 system, and of the interplay between the feature extraction and logic design software. The MULTICS/OLPARS version will take advantage of the inherent flexibility of the MULTICS operating system and provide, for the first time, a multi-user capability for pattern recognition applications. If RADC becomes a host on the ARPA network, the multiple users could be from any agency with access to the network. By this method, we not only produce results in the terms of specific classifier designs for certain users, we also will be able to export our software capability to those users who would like to do their own analysis.

Using the capability of the interim Pattern Recognition Design Facility which currently exists, RADC is pursuing a vigorous program in selected applications areas to support user signal classification requirements. The Aerospace Shape Identification (Radar) line item includes a study of the feasibility of recognizing characteristic shapes of aircraft and space objects by analyzing the narrow pulse radar returns. With sufficiently descriptive features which are independent of orientation, one would dramatically decrease the storage and speed requirements for any classification system.

In a related area of Photometric Signature Analysis, RADC is studying actual space object signatures derived from telescopically collected reflected sunlight in order to determine certain characteristic information. In the first part of this

effort, in direct support of SAMSO's Satellite Observables Program (per TN-SAMSO-RADC-1708-73-01), the analysis is performed on selected satellite signatures as determined by SAMSO. In the second portion, the photometric data collected on various selected space objects will be analyzed to determine features and classification logic for automatic discrimination purposes. This second portion is in support of the Air Force Avionics Laboratory and is directed initially toward tumbling rocket bodies. Results of both the photometric and aerospace shape work are directly applicable to the needs of ADC as expressed in ADC-ROC 16-71.

Another major applications area, represented by the Acoustic/Seismic/Magnetic Data Analysis area, includes projects which deal with the processing of ground based analog sensor data. In each case, the project involves aspects of signal processing, to determine sensor and event characteristics, and the application of classical pattern recognition to design discrimination logic.

The first of these projects involves the processing of aircraft acoustic signatures for the purposes of remotely monitoring air base activity. This project, in support of RADC TPO-7 "Tactical Surveillance and Control", involves the collection and analysis of a large aircraft signature data base of take-offs, landings, and fly-overs. Logic will be designed to discriminate between the aircraft events of interest and thereby monitor the base activity. The discrimination logic in this application, as in all of the others, initially is in the form of software programs and equations, but can be implemented in microcircuits and integrated with the sensor electronics as required.

Another project, in support of ESD Advanced Development Program 681E and RADC TPO-7 "Tactical Surveillance and Control", involves the modernization of line sensors to be used in the Base Installation Security System. The sensor outputs consist of magnetic and seismic waveforms which are generated by valid intrusions and by false alarm events. The modernization task involves the analysis of the sensor waveforms and the design of discrimination logic to sort out valid intrusions from the false alarms, such as wind and lightning. Once a desirably low false alarm rate has been achieved, these improved sensors based on RADC's new design classification logic will be acquired by ESD for installation at air bases throughout the world.

The last of the projects being pursued in the ground-based sensor area is the Nuclear Data Analysis project in support of the Arms Control and Disarmament Agency (ACDA). In this project, short period seismograms of teleseismic Eurasian events will be analyzed with the objective of automatically classifying earthquakes from underground nuclear explosions. Using the extensive event data base collected by ACDA, RADC will analyze the signals, extract the discriminatory information and design classification logic for the task.

The last of the applications areas to be discussed is one represented by the Milestone Chart line item entitled Speaker Identification. In support of RADC TPO-2 "Intelligence Analysis and Exploitation", a data set of human speech is being analyzed. The analysis is focused on determining, and if possible, quantifying inter-speaker similarities and intra-speaker differences for application in security related speaker recognition devices.

New pattern recognition techniques for feature extraction and target classification are continually being evaluated and the potentially useful ones added to those tools so that they evolve to solve an ever increasing spectrum of problems. Development in this area is expected to continue through at least FY-77.

3.12.2.4 (U) COMPUTER GRAPHICS SYSTEMS - The goal of the computer graphics technology area is to provide cost effective solutions to the problems encountered in developing low cost multi-terminal computer graphics systems which will present computer generated data to an operator and allow him to interact with it. The data presented can be in the form of alphanumeric symbology or line drawn graphics. The system must allow the operator to interact with the data base and modify or control the overall processing function by means of his input devices while observing the results with some type of display. This technology and the technology being developed under RADC TPO-4 "Intelligence Data Handling", fully complement each other since TPO-4 efforts are directed toward image analysis which is not a goal of this TPO.

One of the most effective types of display presentation is the interactive graphics display. In this mode, the operator has access to and control over the computing process with the results presented to him in the form of graphical figures. There are

numerous levels of performance and cost associated with each system, as well as a variety of possible implementation schemes. The selected system must represent a balance between performance, cost and flexibility.

The RADC computer graphics program is a combination of both contractual and in-house efforts. All of these efforts depend heavily on the interactive processing facility recently installed at RADC. This facility includes a flexible computing system as well as high performance graphics and allows the operator to both perform development functions as well as to simulate several applications functions for specific operational users. The Milestone Chart (Page 3,12-) outlines the computer graphics program.

The Air Force Global Weather Central (GWC) Interactive Graphics System effort is directed toward providing their analysts and forecasters with the ability to generate, edit, analyze and update various weather charts and forecasts in the interactive mode. This will increase the flexibility as well as decrease the cost of the various operations involved. The final system configuration will include numerous terminals and several forecast locations as well as a direct hook-up to the main GWC computer facility. This is a multi-phase, multi-year effort which will result in the automation of a significant portion of the GWC operation. This will be accomplished through the implementation of several mini-computer based graphics systems, as well as the development of specialized software and techniques to handle the particular characteristics of the environmental data. The effort is being pursued in support of MAC-DAR-L72-7 with full implementation scheduled for FY-78.

One of the prime considerations in applying computer graphics is that of economy. The specific approach that will reduce the per-terminal cost of multiple terminal graphics systems is the use of raster (or digital TV) techniques. Such a system not only has the potential for high performance at relatively low cost, but also offers the unique feature of being able to mix computer generated graphical data with pictorial information. The Raster Graphic Techniques effort is aimed at investigating the feasibility of performing the graphics functions using interactive TV displays. The goal is to provide performance equivalent to present selective address systems with a significant reduction in cost. The culmination of the program in FY-78 will be a Multi-Terminal Raster

Graphics System which demonstrates equivalent performance at much lower cost than previously available systems.

The Graphics Software Techniques area represents a group of related and continuing efforts aimed at decreasing the complexity and increasing the efficiency of graphics software and the means to generate it. To provide a testbed within which to work, a complete graphics software system has been configured to operate on our graphics facility. Among the areas which will be pursued in future development efforts are the investigation of graphic data base structures and their effect on processing efficiency, as well as the practicality and desirability of including a graphic extension within a higher order language, particularly the block structured declarative type.

The Graphics Modeling effort is aimed at the development of a modeling system to investigate the various parameters utilized in the design of interactive graphic systems. These include the use of satellite processors, distributed as opposed to concentrated data bases, the effect of response time on various interactive devices, and operator performance within such a system. The result will be more effective and efficient system designs while minimizing the overall cost.

3.12.3 RELATED EFFORTS:

(U) Numerous efforts which are related to this TPO are being pursued by other Air Force Laboratories and other agencies, both within DOD and in industry. Close technical liaison is being maintained on these efforts and any technical advances made will be applied to this TPO. Conversely, the results of efforts under this TPO are made available to other agencies for application to their programs. Following is a summary of the major efforts related to the products of this TPO.

ASSOCIATIVE PROCESSOR COMPUTING SYSTEM - The Federal Aviation Agency is studying the use of an associative processor for air traffic control processing. A prototype STARAN was used for conflict prediction studies at the Knoxville, Tennessee test site. Further studies are being conducted with three contractors, each applying benchmark problems to their machine. The Defense Mapping Agency

(DMA) is leasing an associative processor to study its applicability to the post processing functions of cartography.

DISTRIBUTED COMPUTATIONAL SYSTEM - The ARPANET designed and implemented by the Defense Advanced Research Projects Agency (ARPA) embodies many of the prerequisite features which will provide the basis for this advanced study. Specifically, it includes all the protocols which allow transfer of data and programs between computers and between peripherals and computers. The National Software Works program, sponsored by ARPA in conjunction with RADC TPO-11 "Software Sciences Technology", having the objective of giving a programmer access to many software development tools, will coordinate closely with and use many of the results of this program.

CONFIGURABLE PROCESSOR FACILITY - Univac has a program under IR and D which will be used to design their next generation computer systems. They intend to build a microprogrammed multi-processor with an extremely flexible internal communications scheme to support the program. IBM, under internal corporate research, is designing a direct execution machine (a machine which directly executes higher order language code).

TARGET RECOGNITION - The Army is applying pattern recognition techniques to speaker identification photograph analysis, shock trauma analysis and mine fusing applications. The Navy is using pattern recognition for speech recognition and for sonar target identification. NASA is doing work in identification of various earth resources using multi-spectral scanners. The Arms Control and Disarmament Agency is utilizing pattern recognition techniques to identify nuclear blast detonations.

It should be noted that the preceding work has been done in close cooperation with RADC. Some of the work was actually completed on the RADC system by other services after training and familiarization by RADC personnel. These agencies have either begun development or are considering development of a research tool patterned after the RADC On-Line Pattern Analysis and Recognition System (OLPARS); or are planning to continue using the RADC system.

COMPUTER GRAPHICS SYSTEMS - There are numerous efforts in computer graphics being pursued both within DOD and in other government agencies. The Army is developing cartographic analysis

techniques using interactive graphics while the Navy is synthesizing radar backgrounds and clutter to test radar signal processing systems. NASA has used computer graphics extensively for both computer aided design and flight simulation. More recently within the National Oceanographic and Atmospheric Administration computer graphics has been applied to the analysis of meteorological data particularly relative to severe weather conditions. ARPA has been one of the prime movers in the development of graphic techniques primarily through its university contracts.

3.12.4 REQUIREMENTS:

(U) There are numerous Air Force requirements for the technologies being developed under this TPO. High speed data processing techniques, software first techniques, automatic target identification techniques, and interactive graphics systems are being developed to satisfy the following requirements:

nsrdc directories

(J31019) 22-AUG-74 12:06; Title: Author(s): Frank G. Brignoli/FGB;
Distribution: /JCN; Sub-Collections: NIC; Clerk: FGB;

FGB 22-AUG-74 12:06 31019

nsrdc directories

Hello again Jim, I've got a few more requests concerning directories and some existing idents. I'm sending them on to you this time but you might drop me a line ttelling me if sending them on to feedback would be more appropriate. 1

Please set up the following directories for NSRDC. 2

Directory: ISDS 2a

Mail address: 2a1

Naval Ship Research and Development Center 2a1a

Code 1851 2a1b

Bethesda, Maryland 20034 2a1c

Users: 2a2

Benigni, Daniel R. 2a2a

Brengs, Raymond A. (RAB2) 2a2b

Skall, Mark W. 2a2c

Brainin, Jack (no middle initial) 2a2d

Ralls, Audrey A. 2a2e

Directory: MATHSCI 2b

Mail Address: 2b1

Naval Ship Research and Development Center 2b1a

Code 1805 2b1b

Bethesda, Maryland 20034 2b1c

Users: 2b2

Cuthill, Elizabeth H. 2b2a

Ernst, Herbert M. (HME) 2b2b

Also, I would like the following adjustments made to the way our journal mail is handled. 3

Delivery for FGB made to <BRIGNOLI> not <NSRDC> 3a

Delivery for ILA made to <AVRUNIN> not <NSRDC> 3b

Delivery for PRB made to <NAVSEC> not <NSRDC> 3c

Finally, I would like the following idents made valid users of the NSRDC directory: PNR AH MH . I would like PRB to be made valid for <NAVSEC> only. The only valid users for the <NSRDC> directory will then be FGB ILA MH AH PNR . 4

Thats it Jim, I hope that I've not been too confusing, If there are any question, holler, Thanks, Frank 5

(J31020) 22-AUG-74 13:22; Title: Author(s): Ray S. Tomlinson/RST;
Distribution: /NLG; Sub-Collections: NIC NLG; Clerk: RST;

A Protocol Experiment

Eric R. Mader

William W. Plummer

Raymond S. Tomlinson

I. Introduction

In early February, 1974 the main line printer on BBN's TENEX system failed and it was decided to use the PDP-11 line printer via the ARPANET both for the direct purpose of obtaining listings and also the indirect purpose of studying network protocols.

II. The Basic Protocol

The design was based on the protocol described by Cerf and Kahn in INWG Note #39, Familiarity with that document is assumed, The following is a brief sketch of the protocol, Not all features described in this section have been implemented, See Section VI,

At any instant, the sender has two pointers into the stream of bytes to be sent, Bytes to the left of the LEFT pointer have already been sent and acknowledged, Bytes in the "window" between the LEFT and RIGHT pointers have been sent (zero or more times), but no indication of successful transmission has been received, Bytes to the right of RIGHT remain to be considered at some time in the future,

In operation the sender is constantly sending bytes from the input data stream resulting in the RIGHT pointer advancing, Positive acknowledgements produced by the receiver cause the LEFT edge of the window to move towards the RIGHT edge,

LEFT and RIGHT are actually numerical byte positions within the data

stream, The low order 16 bits of RIGHT are sent with each message as a

sequence number so that the receiver can identify which part of the data

stream it is receiving in case messages are not received in the same

order they were transmitted, The receiver has a finite amount of buffer

space available in which it can reassemble an image of the data in the

transmitter's window, The receiver discards any messages which have

sequence numbers outside of its buffer area, However, messages to the

left of LEFT must be acknowledged even though they are discarded,

Otherwise, a lost ACK would cause the sender to retransmit (and the

receiver ingore) the message indefinitely, Messages received with bad

checksums are also discarded,

As "good" messages are received, the holes are filled in the receiver's

buffer and continuous segments at the left edge are passed to the

physical line printer (in our case), The receiver informs the sender of

this action by sending an ACK (acknowledgement) message. This message specifies the sequence number of the byte it would like to receive next (the new value of LEFT in the sender) and the current amount of buffer space it has available (new maximum window width in the sender). The sender ignores ACK's to the left of LEFT and to the right of RIGHT.

Thus, both the sender and receiver are prepared to handle multiple copies of messages.

Failures such as messages with bad checksums, messages lost during transmission (data and ACK's), and messages discarded due to sequences numbers which were apparently out of range, all manifest themselves to the sender as a dropped ACK. A dropped ACK will cause the sender's LEFT edge to stop advancing, leaving the unacknowledged message at the left of the sender's window, and possibly a corresponding hole at the left of the receiver's image of the window. Eventually, transmission will cease and a (10 second) timeout will trigger in the sender, causing

retransmission of all data within the window, Note that at the instant

of a timeout, there is no guarantee that the un-ACK'd message will be

exactly at the left edge of the window or that it is the only

unacknowledged message in the window, Retransmissions are likely to

cause the receiver to see data that it has seen before, but duplicate

messages will be discarded due to sequence number considerations,

III, "Say Again"

An extension to the INWN #39 protocol which was implemented was the

ability to let the receiver force retransmission of the entire window by

turning on a flag in any message back to the sender, This is useful in

cases where the receiver believes that a data message has been dropped

and it wants to force retransmission rather than wait for a timeout in

the sender, Clearly, this relies on the network to preserve ordering of

the messages, Also, it is not useful if the error rate is high because

the whole window is retransmitted in order to get retransmission of a single message or two,

IV, Establishing an Association

In the experiment two flags were used to establish an association, FRST (FiRST flag) was the equivalent of SYN described in INWG Note #39 and served to identify the first message of an association, This instructed the receiver to accept the sequence number in the message as a definition of the starting point of sequence numbers for the association,

The second flag is a receiver-to-sender flag called HUH which is a request by the receiver for a definition of the sequence numbers, Upon receipt of a message containing an HUH, the sender responds by turning on FRST in the next data message, Normally, HUH is sent only if the receiver had been restarted, or if it is replying to messages on a port

that it knows is not part of an association.

V. A Problem

A severe problem uncovered with the protocol was concerned with establishing an association. If the PDP-11 (receiver) was reloaded while the spooler (sender) was running, the first few pages of the data stream were printed about six times before normal operation was established. The cause was traced to the following sequence of actions:

1. The sender would be in a loop, timing out and retransmitting because the receiver had not responded.

2. Upon being restarted, the receiver would see a whole

window's worth of messages, and respond to each with an HUH.

3. For each HUH the sender would reset the window and include a FRST flag with the first message in each of the (six) retransmissions.

4. The receiver would see the first message of the first retransmission containing a FRST, accept the sequence number, and print the data from that and the following messages. Then, another message containing the FRST flag would appear and the cycle would repeat (five more times). Note that the ACK's generated in the repetitions were ignored by the sender because they were to the left of the window.

As a "cure" for the above the receiver program was modified so that after sending an HUH, messages are ignored until one with a FRST flag appears. This solution is unacceptable in general because it leaves the receiver port useless if either the message containing the HUH or the response gets lost in transmission. Although a timeout was used to guard against this, the timeout cannot be trusted because it might cause

two messages with FRST flags to be received -- just the problem which is being avoided!

An alternate cure which does not depend on the network to be lossless would be to modify the sender to respond to a HUH by ignoring all messages for at least a round trip delay time before sending its response containing the FRST flag. This results in having to define what this time is. In general this cannot be done when messages can become trapped for indefinite amounts of time in network partitions.

This will be discussed more fully in a subsequent document.

VI. Features not Investigated

None of the programs to date have supported any of the following features:

1. Window size control. The window size was a constant (2048 bytes). In a future experiment the window size will be varied not only by indications of buffer space in the receiver, but also as a function of estimated transit time, (see below).

2. Reassembly. Since reassembly is conceptually easy, it is likely to be one of the first extensions. A message corrupter will be included in the receiver to test the functioning of the reassembly mechanism.

3. Expanded Internetwork Addresses

4. Multiple Associations

5. Reliable Making and Breaking of Associations

VII. Implementations Notes

The sender involves approximately ten pages of assembly code for the network message interface. Two processes are involved: one which fills a buffer by reading the input data stream, and a second process which

sends network messages from the buffer and processes replies from the 196

receiver. The two processes are joined by a coroutine mechanism, but in 197

the future will be two parallel TENEX processes. 198

199

The receiver program consists of approximately four pages of BCPL code 200

in addition to IO device drivers and routines which implement queueing 201

primitives. 202

203

Each message contained between zero and 255 bytes of data arranged (as a 204

coding convenience) in a way which is directly compatible with the BCPL 205

string handling routines. Messages contained a single byte of checksum 206

which was the low eight bits of the twos complement negation of the twos 207

complement sum of all other bytes in the message. We recommend that 208

some more reliable checksum function be employed in the future; even 209

using eight-bit ones complement arithmetic would be better. 210

211

Source files for the various programs are available from the authors at 212

Bolt Beranek and Newman, 50 Moulton Street, Cambridge Mass., 02138. 213

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215

216

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VIII, Simple Rate Calculations 218

219

If we assume that an active association has reached steady state, that 220

processing delays are lumped into the transit time T, and that there are 221

no errors, then the maximum data rate may be calculated as follows. 222

223

Assume the sequence numbers being passed by the RIGHT pointer are some 224

function of time, R(t). Messages received by the receiver will be the 225

same function of time but delayed T (a transit time) seconds. Since 226

processing time is zero, the acknowledgments will bear this same 227

function, R(t-T). Acknowlegements received by the sender will have 228

sequence numbers R(t-2T). 229

230

Acknowledgements at the sender determine the LEFT pointer, L(t). Also, 231

it is known that R(t) is ahead of L(t) by the width of the window which 232

is a constant in steady state. Thus, we have the two relations: 233

234

$$L(t) = R(t-2T) \quad (234a)$$

$$L(t) = R(t) - W \quad (234b)$$

235

Now, let R(t) = Bt, i.e., sequence numbers are increasing linearly with 236

time. (Microscopically, short bursts will alternate with longer periods 237

of inactivity, but the average bandwidth will be B.) The result under 238

the assumptions is that the bandwidth is: 239

240

$$B = W/2T \quad , \quad (240a)$$

241

That is, the bandwidth in bytes per second is just the steady state 242

window width divided by the round trip delay time. Conversely, the aboe 243

relation can be determine the buffer sized needed: in oreder for thee 244

receiver to guarantee to accept information that was transmitted, it 245

must supply buffering equal to (or greater than) the window size. The 246

window size must be equal to or greater than the desired bandwidth times 247

the round-trip delay time, i.e. equal to the number of messages in a 248

round-trip "pipeline". 249

250

The bandwidth in the presence of a relatively low error rate may be

calculated, Assume that B and W are expressed in terms of (full)

messages rather than byte numbers, Each error has two effects: a time

out delay of D seconds and retransmission of W messages, So, the time

Q(M,N) required to transmit M messages burdened by N errors is the sum

of the time to transmit the data once, N*D seconds of time out delay,

and the time to transmit the window N more times,

$$Q(M,N) = (2T/W)*M + N*D + N*2T$$

Dividing by M to get time per message and multiplying the last term by

(W/W):

$$Q(M,N)/M = (2T/W) + (N/M)*D + (2T/W)*(N/M)*W ,$$

But (M/N) is just the fraction of messages in error, Call this E,

$$Q(E) = (2T/W)*(1 + EW) + ED$$

$$B(E) = 1/[(2T/W)(1+EW) + ED]$$

The advantage to using the "say again" mechanism (Section III.) can now be seen: it forces D to be zero, allowing a reasonable average data rate in the presence of errors. Note the effect of a 10 second time out on a network with an E of 0.01, assuming W to be 20 messages and T of 0.5 second, B(D=10) is 6.7, but with forced retransmission, B(D=0) is 20.

IX. A Sequence Number Consideration

In order to reject duplicate messages, sequence numbers must contain a sufficient number of bits such that it is impossible to cycle through more than half the sequence number space in a message lifetime at maximum transmission rate. Assuming a 1 MegaByte per second network and a maximum lifetime of 500 seconds, the sequence number field of each

message must be capable of holding the number 2*500*10**6 which is 10**9 286

or about 2**30, Thus, a 32-bit (4-byte) sequence number field is 287

recommended, 288

289

290

291

X, Additional Control Functions 292

293

In response to an attempt to establish an association (SYN) it is felt 294

that the receiver should be able to deny the attempt (RELease) in one of 295

the following three ways: 296

297

REJECT, (I'm busy, Try again later,) 298

ABORT, (I don't understand what you are sending, 299

(Bad port, etc,)) 299a

ABNORMAL (SYN arrived on a established connection,) 299b

(Receiver breaks connection and issues this REL,) 299c

300

During an established association, the sender should be able to RELease 301

the association in either of these ways: 302

303

DONE, (I'm done sending to you,) 304

GAG, (Stop, You are sending garbage (ACK's),) 305

306

These may be coded as combinations of bits in the FLAGS which are 307

convenient for programming, 308

309

310

311

312

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Bug in TNLS text scanning

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Bug in TNLS text scanning

Problem in using TNLS in scanning for text using the ;text; type delimiter. When a backspace is performed in the string the search ends up at the beginning of the file rather then at the correct position. All indications are that the text string was properly located and any changes go at the beginning of the file. 1