**Consolidated Automated Support System (CASS)
Automated Technical Information (ATI)
Display System using
ASCII Data Files**

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ABSTRACT

PRESENT REALITY

The Consolidated Automated Support System (CASS) Automated Technical Information (ATI) System used to display Technical Manuals and Test Program Instructions is a page turner system. Each page of a manual is a raster page (bitmapped graphics) displayable at 72 dpi. Selection of these pages is accomplished by using ASCII index files.

**PROPOSED APPROACH FOR INTER- ACTIVE
ELECTRONICS TECHNICAL MANUAL (IETM) LIKE
INTERACTIVITY AT NO ADDITIONAL COST**

Expanding the content and use of the ASCII index files and linking the indexes causes the CASS ATI to appear to the user as a form of an IETM with less graphic files required. This approach will save development dollars and make the CASS ATI more user friendly. The addition of duplicate Computer Graphics Metafile (CGM) for each raster file makes the optical disk data used for CASS ATI totally updatable.

1. INTRODUCTION

CASS was designed for the Department of Defense as a replacement Automated Test Equipment (ATE) system. ATE Systems are used to maintain fleet avionics systems from Navy Aircraft. CASS was to replace existing ATE which was becoming difficult to support. Parts obsolescence and replacement part availability resulted in long down times. Increased system down time dynamically influences the readiness posture of fleet units.

The CASS was engineered prior to Continuous Acquisition and Lifecycle Support (CALS) initiatives becoming a reality. Many of the uses of CALS initiatives were not widespread nor considered available.

Several options were recommended to the government for a technical data display system for CASS. One, an early form of an IETM, tied such documents as an internal Master Test Program Set Index (MTPSI) and Maintenance Action Form (MAF) to the Navy Maintenance Program Data system. A second system proposed was the present ATI Display System. It became the adopted system. The most probable reason was the dramatic difference in cost between the approaches. The ATI approach was considerably less in up-front cost.

The ATI system is a page turner system where each page of a technical document is a raster file. The control scheme for the system is the use of ASCII index files to select the raster file you wish to use. The index files provide an access path to the appropriate raster file you wish to view. Without a meticulous indexing system, you could go to a starting page for the document and you would then have to turn page-by-page until you located the information from the document that you desired. Using a meticulous, well defined, indexing system, you can go to the page (file) you desire. This will reduce the page turning and expedite data access.

The CASS System developer created the ATI raster scheme using their own compression algorithm. This makes the compression scheme unique for CASS.

The following steps were used to create the ATI raster files: (1) They first created technical document pages in a "what you see is what you get (WYSIWYG)" presentation. Then using a system created for them by a second party called a Bitmap Server (a software product which produced the raster file from the bitmap page and placed appropriate header data for the raster file within the file structure) they produced raster files. These raster files and ASCII index files were created on the CASS developer's production system. They were transferred using the file transfer protocol, TCP/IP, from their Hewlett Packard UNIX Workstations onto a VAX

with a VMS Operating System for the next step in the process. Once on the VAX, in a directory readied for this data, the files were compressed using the CASS developer's unique compression algorithm. When all raster files were compressed and all index files were present, this data was copied onto a previously formatted and initialized read many/write many (WORM) optical disk, ready for use with the CASS ATI System.

The CASS ATI System is initiated by installing a CASS ATI Optical Disk into the Alphatronics Optical Disk Reader and selecting the ATI Icon on the CASS Station.

After being initiated, the CASS ATI allows use of the files from the optical disk by the CASS Station ATI System. Each of the compressed raster files will be uncompressed for display on the CASS Station ATI as they are used.

2. INHERENT PROBLEMS

- a. CASS ATI has a unique compression algorithm created by the CASS developer and is used only on the CASS ATI. If Operational Test Program Set (OTPS) developers of CASS ATI does not have the CASS developers Bitmap Server, they will have to develop or acquire a software product to perform that function.
- b. The CASS ATI display is virtually unreadable when fonts with less than 12 point type are used.
- c. A developer of CASS ATI technical information has to have or acquire an Alphatronics Optical Disk Drive and a VAX or MicroVAX system. The drive may be a SCSI device or one that works with the VAX "Q" Bus.
- d. The raster file requirement for CASS ATI is a one bit deep raster format and the header requirement is unique to CASS ATI.
- e. The CASS ATI raster files after being placed on an optical disk are not updatable due to the unique raster format and compression algorithm used.
- f. Naval Air System Command's preliminary thoughts were "the CASS ATI display should look as close as possible to what the sailors are used to seeing". They felt this approach would save considerably in the amount of retraining dollars required. Although that was the concept, there was NO plan to print the technical manual

directly from the screen. Even if printed, the technical manual would not have the same appearance as technical manuals the sailors have seen in the past.

- g. The printer attached to the CASS is a dot matrix printer. It's primary use is for printing error codes from the source code. Attempts to use this printer to produce a paper copy of what is viewed on the CASS ATI screen are basically fruitless due to the poor quality of print available and the long period of time required to print the pages. The CASS uses a dot matrix printer and the CASS ATI works at 72dpi. That means the quality of your print is 72dpi or worse.
- h. Therefore, when the development process is complete, all you have is a page turner system. You will have a "raster" file for each page and ASCII indexes used to control the selection of the raster file you view.

3. SOLUTION IDEAS

The CASS ATI is what we have to work with so we must find areas where we can:

- a. *Reduce the total amount of raster files or pages we have to "turn".*
- b. *Find ways to make the CASS ATI more interactive or more closely resemble an IETM.*
- c. *Generate DoD Software distributed as a "Bitmap Server". This product allows the creation of the ATI raster files which cuts down on total development cost for CASS ATI Technical Documents.*
- d. *Develop an approved standard document or specification to control the development and creation of technical documents on CASS.*
- e. *Develop a software solution which will allow editing and updating the CASS ATI raster files that exist as legacy data on optical disks.*
- f. *Provide documentation and training on "how to develop CASS ATI technical documents".*

4. ANALYZE, ADOPT AND IMPLEMENT SOLUTIONS

The Naval Aviation Depot Norfolk analyzed each of the solution ideas and found each worked and would produce a positive result. Each solution when implemented influenced the ideas for other solutions.

- a. Changing to a method where fewer pages were necessary was the easiest fix. The CASS ATI display area is approximately 14 inches in height by 14 inches wide. Initial General Electric documents on CASS ATI used an 8 1/2 by 11 format or an E size drawing format that was so large it would not fit on the screen.

When this larger format is used, the CASS ATI user has to pan to see the full diagram. While presenting the Drawings in this format was comparatively easy, using this approach was not easy. First, you may display several drawings in a row, then page several more times before part information concerning the appropriate drawing item is available.

After considering several ideas, the solution adopted was to have all pages be 11 inches high by 14 inches wide. Use a two column format. This means you can put almost two pages of information on one page.

An additional solution adopted is to have the Illustrated Part Breakdown drawing in column one of the two column 11 by 14 page. Have the other column contain the Group Assembly Parts List (GAPL) information for the drawing in column two (See Figure 1). Find numbers or index numbers for the drawing in column one would only be present if part information was present in column two. If more than one page is necessary to show an entire assembly, duplicate the graphic on the next page with a new set of index numbers. Do this until all assembly data is shown. This means the user would not have to search from page to page between the illustration and the part data. Also, use this approach when graphics are required for maintenance or troubleshooting procedures.

- b. The next solution adopted was to use the ASCII indexes for more than just controlling which raster page was used. The CASS ATI use of indexes and limitations within the station software precluded the use of hotspots on either the ASCII files or the graphic files.

Each ASCII index file could contain ASCII text lines called *header data* or *entry data*. Each header line starts with [h]\ and entry lines start with [e]\. Header line data is displayable on the CASS ATI screen and was positionable by spacing the data as required. A syntax

requirement is that header lines must appear first followed by entry lines. An entry line contains [e]\ followed by the data to be observed on the screen, followed by the second backslash (\). The second backslash (\) followed immediately by a third backslash (\) or a number to represent the page number of the data.. An example is shown below:

[e]\This is screen viewable.\filename.inx.

The .inx extension is used for index files and .gra is used for graphic files. (See Figure 2).

The CASS ATI station software also has additional limitations:

- 1) There is a limited number of lines which can be displayed on the screen at one time (approximately 38)
- 2) If all of those lines are using header information, no interactivity is possible.
- 3) The last five lines on the page need to be entry lines instead of header lines to make entry lines easily accessible.
- 4) You can use up to 250 entry lines. Move the cursor on the CASS ATI screen to the bottom of the page to scroll through the entry lines.
- 5) Entry lines wrap, so up to 255 characters can be used on one entry line.
- 6) Only the last portion of the line is selectable on the CASS ATI If an entry line wraps.
- 7) An entry line with [e]\ and no spaces following is used to space between entry lines.

Considering all these limitations, we found we could use ASCII files to contain basically **ALL** the text you normally use within a technical document. This means the only pages you would have to turn would be those illustrations which you *had to have*. Some wide tables of textual data cover more of the page than could be realistically displayed in columns of ASCII text (the ASCII files covered a space within an 8 1/2 by 11 inch area on the screen) may also need to be rasterized.

Interactivity between ASCII index/text files is enhanced by using "Go To files" or "Go To

information". Examples are in Figures 3 and 4. One prerequisite, this approach requires considerable up-front analization and planning. However, the ASCII files are simple to create. They can be created using any ASCII editor and most word processors. If you are storing all your program data in a common product data base, data can be exported into columized ASCII directly into ASCII index files. This would take a minimum of programming effort.

The Naval Aviation Depot Norfolk has created and is using an Integrated Product Database called "PRIME" and from that we export ASCII files directly into ATI index files. An example of this is the wirelist. An example of this is shown in Figure 5.

Moving the text data normally placed into Graphic Pages to ASCII index files also ensured good readability. The displayable data is very legible at 10 point type and is not dependent on a raster presentation of a graphics file.

- c. Creating a "Bitmap Server" as DoD software to be used to build raster files in the required format, has been accomplished by the Naval Aviation Depot Norfolk in a product called "**Convert**" and by the Naval Aviation Depot Jacksonville in a product called "**CASSGRAP**".

"**CASSGRAP**" is a product which works on a PC and is available by contacting the CASS Program Office at the Naval Aviation Depot Jacksonville.

"**Convert**" at present works on a Sun UNIX platform and is in the process of being changed to work on other UNIX platforms and on PCs with DOS operating systems.

The "**Convert**" program accepts files printed to encapsulated postscript and converts them into CASS ATI raster formats. This allows movement of these files to the VAX directory established as a temporary residence for CASS ATI files. These files can be later copied to an optical disk for use on the CASS ATI. "**Convert**" is available by contacting the CASS Program Office at the Naval Aviation Depot Norfolk.

- d. Developing and implementing the solution to use standardizing documents that require all developers to create technical documents with similar appearance; and embraces the other

solution ideas which have been adopted is a more difficult task than the other solutions combined. Each idea must be blessed by the appropriate controlling activity and satisfy fleet representatives as the correct approach.. We worked together with the Naval Air Technical Services Facility (the activity responsible for the quality of our technical manuals), CASS Program Offices, Fleet Representatives and generally anyone else that would listen and take part and have created the following:

- 1) Technical Manual Contract Requirements and limited deviations for existing controlling Military Specifications for Technical Manuals to allow the use of the adopted solutions.
 - 2) A CASS ATI Technical Document Development Guide which covers all technical documents being developed for CASS ATI, how to use the CASS ATI, how to create optical disks which contain CASS ATI technical documents, and all other pertinent data. This document is created in the form of an IETM and will be distributed on a 3 1/2 inch floppy disk to be used on a PC with windows. Instructions on how to load the disk onto a PC will be provided. (Presently this document is in the approval cycle and when approved will be used as the primary development document for all CASS ATI Technical Documents.
- e. The solution of creating DoD software to allow editing of CASS ATI raster files after they are placed on an optical disk is proceeding. Software has been developed to bring the CASS ATI raster files back to a bitmap raster file which can be edited on a raster editor. The software is still in Beta Testing and appears to work satisfactorily. The problem is, raster editing, for the most part, has many limitations in comparison to vector graphics editing. On this solution, the jury is still out. However, one can make a CGM file of each prior to the rastorization process and include it on the delivered optical disk. This would provide a vector graphics file which is editable and can be updated as needed.
 - f. The solution of providing documentation and training for other developers and for prospective developers has been fully implemented. The documentation is now made available to the

CASS Program Office and is present in RFPs which contain the CASS Red Team Acquisition Package. Training has been provided to all developer sites as requested through the CASS Program Office.

4. SUMMARIZATION

All of the solutions were necessary to arrive at a point where we can develop much more user friendly technical documents for the CASS ATI. Each step improved our product and made successful development of cost effective more interactive technical documents less difficult to accomplish.

The most rewarding seems to be the use of program product data in ASCII text files instead of having each in

a raster format. By pulling data directly from product databases into these ASCII files we have reduced the amount of quality control required dramatically. This cuts development costs. Having to create less raster files cuts development costs. Being able to use any ASCII editor to create many of the ASCII text files cuts development costs.

The whole idea in our present downsizing environment is that we need to find as many ways as possible to reduce costs while still providing exceptional products for our fleet users. This fits!

What the future holds for CASS ATI, I don't believe anyone knows fully. If a fully capable IETM system is just around the corner, that's great. For now, these solutions seem doable and very cost effective.

Index No.	Part Number	Description	SM&R Code	U P A
	002CH001-01	HOUSING ASSY, PANEL INTERFACE DEVICE (97057) (SEE PAGE 15 FOR NHA)	XBGD	REF
- 1	002PA001-01	PANEL ASSY, FRONT (97057)	AGGG	1
- 2	000PA006-03	PANEL, FRONT (97057)	MDGZ	1
- 3	000GA001-04	GASKET (97057)	PAGZ	1
- 4	8112-6.000-10-32-A-2	HANDLE ROUND (51506) (ATTACHING PARTS)	PAGZ	2
- 5	8208-A2	FERRULE (51506)	PAGZ	2
- 6	MS24693-C273	SCREW, MACH CSK 10-32 UNF .625	PAGZ	2
- 7	MS35206-245	SCREW, MACH, PAN HEAD #8-32 UNC .500	PAGZ	20
- 8	AN960C8	WASHER, FLAT #8	PAGZ	20
- 9	M28748/10G0N02A	CONNECTOR, ELEC, RCPT, 158 SKT (J16)	PAGZ	1
- 10	M28748/10G0V02A	CONNECTOR, ELEC, RCPT, 158 SKT (J15)	PAGZ	1
- 11	M28748/10R0Z02A	CONNECTOR, ELEC, RCPT, 158 SKT (J14)	PAGZ	1
- 12	M28748/10E0N02A	CONNECTOR, ELEC, RCPT, 80 SKT (J13)	PAGZ	1
- 13	J1577-158-12	COVER, PROTECTOR, PIN (07418)	PAGZ	3
- 14	J1577-80-12	COVER, PROTECTOR, PIN (07418)	PAGZ	1
- 15	MS35265-32	SCREW, MACH FILLISTER HEAD #6-32 UNC .750	PAGZ	4
- 16	MS15795-805	WASHER, FLAT #6	PAGZ	4
- 17	MS21042L06	NUT, SELF-LOCKING #6-32 UNJF	PAGZ	4

Figure 7. Housing Assembly, Panel Interface Device, P/N 002CH001-01 (Sheet 1 of 11)

Figure 1. Example of ATI Illustrated Parts Breakdown

```

[h]\
[h]\NAVAIR XX XX XXX XXX          WP002 02
[h]\
[h]\          MAINTENANCE W/IPB AND WIRE LIST
[h]\
[h]\          CABLE SET, INTERFACE DEVICE
[h]\          P/N 002CT001-01
[h]\
[h]\          TITLE
[h]\
[e]\ASSEMBLY\NA0200202002.GRA
[e]\CLEANING\NA0200202002.GRA
[e]\DISASSEMBLY\NA0200202002.GRA
[e]\END PREP LIST\NA0200202006.GRA
[e]\GENERAL MAINT PROCEDURES & PRECAUTIONS\NA0200202002.GRA
[e]\INSPECTION\NA0200202002.GRA
[e]\IPB CABLE SET, ID 002CT001-01\NA0200202007.GRA
[e]\IPB CABLE ASSY W1 002CA001-01\NA0200202008.GRA
[e]\IPB CABLE ASSY W2 002CA002-01\NA0200202010.GRA
[e]\IPB CABLE ASSY W3 002CA003-01\NA0200202012.GRA
[e]\IPB CABLE ASSY W4 002CA004-01\NA0200202014.GRA
[e]\MATERIALS REQUIRED\NA0200202002.GRA
[e]\REFERENCE MATERIAL\NA0200202001.GRA
[e]\REMOVAL AND INSTALLATION\NA0200202002.GRA
[e]\REPAIR\NA0200202002.GRA
[e]\SUPPORT EQUIPMENT REQUIRED\NA0200202001.GRA
[e]\TOOLS REQUIRED\NA0200202003.GRA
[e]\WIRE LIST INSTRUCTION\NA02002020003.GRA
[e]\WIRE TYPE LIST\NA0200202005.GRA
[e]\
[e]\GO TO WIRE LIST MENU, CABLE SET\NA0200202WL.INX
[e]\GO TO REFERENCE DESIGNATION INDEX\NA0200202REFDES.INX
[e]\GO TO PART NUMBER INDEX\NA0200202PL.INX
[e]\GO TO MAIN INDEX\NA02MAIN.INX
[EOB]

```

Figure 2. Example of ASCII Index

[h]\
[h]\NAVAIR 16-45-2020-2-17
[h]\
[h]\ INTERMEDIATE MAINTENANCE
[h]\ WITH
[h]\ ILLUSTRATED PARTS BREAKDOWN
[h]\
[h]\ DATED: 1 NOV 1993
[h]\
[h]\PUBLISHED BY DIRECTION OF COMMANDER
[h]\ NAVAL AIR COMMAND
[e]\
[e]\001 00 INTRODUCTION\NA0200100002.INX
[e]\
[e]\002 00 PANEL ID, MAINT W/IPB 0002PD001-01\NA0200200002.INX
[e]\
[e]\002 01 PANEL ID, WIRE LIST 002PD001-01\NA0200201002.INX
[e]\
[e]\002 02 CABLE SET, MAINT W/IPB & WL 002CT001-01\NA0200203002.INX
[e]\
[e]\002 03 FIXTURE ASSY, MAINT W/IPB 002HF001-01\NA0200202002.INX
[e]\
[e]\DISTRIBUTION STATEMENT\DISTRIB.INX
[e]\
[e]\DESTRUCTION NOTICE\DESTRUCT.INX
[EOB]

Figure 3. Example of ASCII Index


```

[h]\
[h]\NAVAIR 16-45-2020-2-17          WP002 00
[h]\
[h]\      MAINTENANCE WITH ILLUSTRATED PARTS BREAKDOWN
[h]\
[h]\          PANEL ID, MDIG CPS
[h]\          P/N 002PD001-01
[h]\
[h]\          TITLE
[h]\
[e]\ASSEMBLY\NA0200200009.GRA
[e]\A1 SCHEMATIC\NA0200200010.GRA
[e]\A2 SCHEMATIC\NA0200200011.GRA
[e]\CLEANING\NA0200200003.GRA
[e]\DISASSEMBLY\NA0200200003.GRA
[e]\GENERAL MAINT PROCEDURES & PRECAUTIONS\NA0200200003.GRA
[e]\INSPECTION\NA0200200004.GRA
[e]\IPB PANEL ID 002PD001-01\NA0200200014.GRA
[e]\IPB PANEL ASSY, TOP/BOTTOM 000PA001-01\NA0200200016.GRA
[e]\IPB PANEL ASSY, LEFT 000PA007-01\NA0200200017.GRA
[e]\IPB PANEL ASSY, RIGHT 000PA008-01\NA0200200018.GRA
[e]\IPB HOUSING ASSY, ID 002CH001-01\NA0200200019.GRA
[e]\IPB ELECTRONIC COMPONENT ASSY, LEFT 002CH006-01\NA0200200030.GRA
[e]\IPB HOLDER ASSY, CRKT CARD ASSY 000CC002-01\NA0200200032.GRA
[e]\IPB A1 CRKT CARD ASSY 002PB001-01\NA0200200033.GRA
[e]\IPB A2 CRKT CARD ASSY 002PB003-01\NA0200200035.GRA
[e]\MATERIALS REQUIRED\NA0200200002.GRA
[e]\REFERENCE MATERIAL\NA0200200001.GRA
[e]\REMOVAL AND INSTALLATION\NA0200200003.GRA
[e]\REPAIR\NA0200200004.GRA
[e]\SUPPORT EQUIPMENT REQUIRED\NA0200200001.GRA
[e]\TOOLS REQUIRED\NA0200200005.GRA
[e]\
[e]\GO TO REFERENCE DESIGNATION INDEX\NA0200200REFDES.INX
[e]\GO TO PART NUMBER INDEX\NA0200200PL.INX
[e]\GO TO MAIN INDEX\NA02MAIN.INX
[EOB]

```

Figure 4. Example of ASCII Index

[h]\
[h]\NAVAIR 16-45-2020-2-17 WP002 00
[h]\
[h]\WIRE LIST MENU
[e]\
[e]\A4TB1-1A\NA0200200009.INX
[e]\A4TB1-1A\NA0200200010.INX
[e]\A4TB1-2A\NA0200200011.INX
[e]\A4TB1-2B\NA0200200003.INX
[e]\J1\NA02002J1.INX
[e]\J2\NA02002J2.INX
[e]\J3\NA02002J3.INX
[e]\J4\NA02002J4.INX
[e]\P1\NA02002P1.INX
[e]\
[e]\GO TO WORK PACKAGE INDEX \NA02002WP.INX
[e]\GO TO MAIN INDEX\NA02MAIN.INX
[EOB]

Figure 5. Example of ASCII Wire List Menu Index (Sheet 1 of 2)

```

[h]\
[h]\NAVAIR 16-45-2020-2-17
[h]\
[h]\WIRE LIST A4TB1-1A
[h]\
[h]\FROM
[h]\REF DES      PIN      END      WIRE      TO
[h]\              PREP      CODE      REF DES
[h]\
[h]\A4TB1-1A      A        11B      CTS        J101
[h]\A4TB1-1A      B        11B      B2         J101
[h]\A4TB1-1A      C        11B      CTS        J101
[h]\A4TB1-1A      E        1F
[h]\A4TB1-1A      F        1F
[h]\              SPARE
[h]\              SPARE
[e]\
[e]\GO TO WIRE MENU\NA02002WIREMENU.INX
[e]\GO TO WORK PACKAGE INDEX \NA02002WP.INX
[e]\GO TO MAIN INDEX\NA02MAIN.INX
[EOB]

```

Figure 5. Example of ASCII Wire List Index (Sheet 2 of 2)