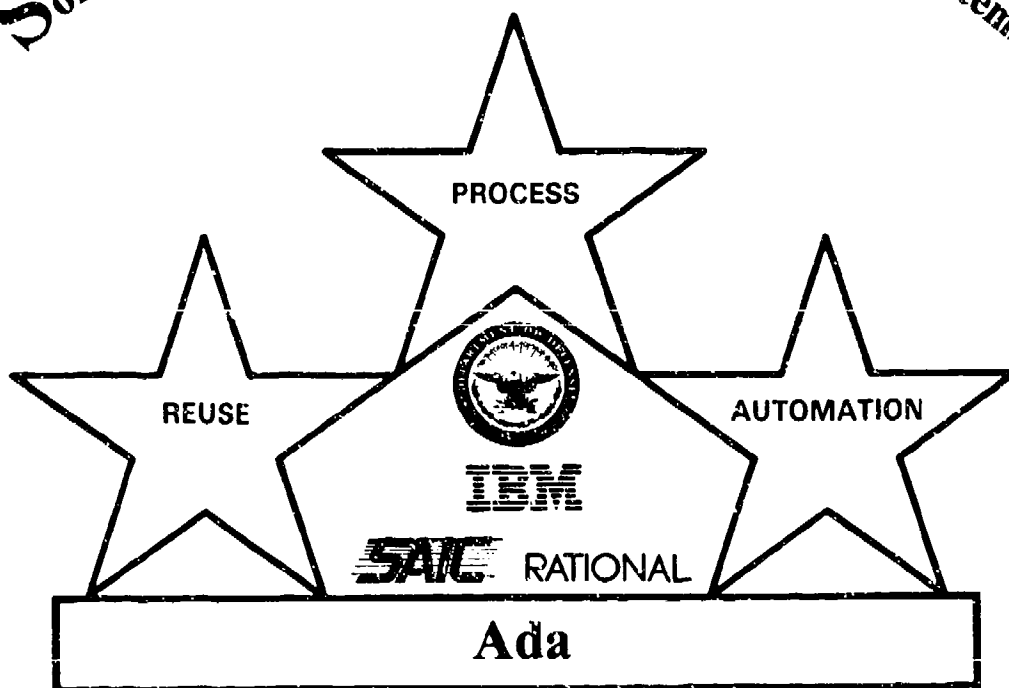


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# Practical Aspects of Repository Operations for the

Software Technology for **A**daptable **R**eliable **S**ystems



Contract No. F19628-88-D-0032

Task IR10 — Repository Operation

CDRL Sequence No. 1440

10 January 1990

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**Practical Aspects of Repository Operations  
for the  
Software Technology for Adaptable, Reliable Systems  
(STARS) Program**

**Contract No: F19628-88-D-0032**

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Prepared for:

Electronic Systems Division  
Air Force Systems Command, USAF  
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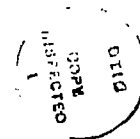
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## 1. Introduction

The Software Technology for Adaptable Reliable Systems (STARS) has contracted for the operation of a repository of all deliverable software and technical reports. The repository also operates as medium of interchange between the prime contractors, the subcontractors, the consultants, and the contracting agency. Electronic mail is interchanged, other electronic documents are shared, software is developed, and software is shared and reused by the STARS contract participants with the STARS repository computer.

Thus the repository acts as a focal point of the STARS program which facilitates many of the activities of the program. The IBM Team STARS repository has been operated for 14 months, during which time the repository itself has grown and matured from a simple electronic file storage medium to a relational database of reusable software components. The maturation of the repository continues, but is dependent on the reliable operation of the STARS computer. This report describes the operation of the STARS repository computer and describes the basis for the policies under which it operates.

## 2. The Repository Computer System

### 2.1 Hardware

#### 2.1.1 Central Processor

The Repository computer system is a Digital Equipment Corporation (DEC) microVAX model 3600 with 32 megabytes of main memory. The VAX line of computers from DEC offers extended virtual memory addressing and software compatibility across a wide performance range of CPU platforms from approximately one MIPS up to 30 MIPS. The VAX central processing unit is a complex instructions set computer (CISC) architecture, as opposed to reduced instruction set computer. The model 3600 is rated at 2.7 MIPS, it may be upgraded to a performance level of 3.8 MIPS with a change of CPU boards.

#### 2.1.2 Disk Storage

The repository computer is equipped with four DEC RA82 disk drives, each of 625 megabyte capacity. One RA82 is used exclusively for the operating system and its software support. This disk also contains the page and swap files used by the virtual memory operation of the machine. The compilers, debuggers, editors, database, and documentation software reside on this disk.

A separate RA82 is used to house the user files and working storage for software development. Each user is allocated a unique working area for their own files. A task area, such as IR40, may also be allocated a unique working area on this disk for the files and programs associated with the task.

The remaining two RA82 disk drives are used to house the Ada software repository. The two physically separate disk drives have been bound as one volume set giving the repository the equivalent capacity of a single 1.25 Gigabyte disk drive. When this capacity is exhausted additional disk drives can be bound into the multi-volume set; however, a better alternative might be to logically divide the repository into multiple volumes divided by content.

The Ada software repository is represented by both a database and a hierarchical directory of the collected Ada source code and deliverables from the STARS program and other sources. Thus there are two views of the repository, an organized view represented by the database and the collection of files represented by the directory tree. The database view provides for imposing organization and reuse technology to the collected raw materials.

#### 2.1.3 Communication

The only serial communication device connected to the VAX 3600 is the console terminal used for system control. All serial devices such as user terminals, modems, and printers are connected to the VAX 3600 via a DECServer 500 terminal server. The DECServer is a computer and communication interface system which concentrates the serial data and communicates to the VAX 3600 via an Ethernet local area network (LAN). The DECserver is programmed upon startup by one of the computers in the VAX cluster to which it is connected. The programming configures the DECServer ports and sets preferred services for each port. The ports which are connected to the STARS modems have a preferred service to connect to the STARS computer.

The modems for the STARS system are all supplied by Multitech. There are eighteen 2400 baud MNP level 5.0 modem cards in two Multitech CC216 Modem Rack chassis. These modems

are available by dialing (813)791-7222, the pilot number for the eighteen line rotary connection. The STARS computer can also be reached by dialing 1-800-STAR10 (1-800-782-7710). Additionally, there are two Multitech V.32 modems capable of dial-up speeds to 9600 baud. These two modems are operated in place of two of the 2400 baud modems, they are accessed by the phone numbers (813)791-0535 and (813)791-9530, the highest two numbers on the eighteen line rotary.

STARS users may dial (813)791-9437 for assistance with accounts, logging onto the computer, or for help in locating products.

The STARS computer local Ethernet is bridged to an Ethernet at IBM in Gaithersburg, Maryland using a leased telephone line and high speed modem. Each end of the bridge uses a Paradyne Challenger 19200 modem and Advanced Computer Communications ACS4030 Ethernet bridge interface.

#### 2.1.4 Peripherals

The STARS VAX 3600 also has a DEC model TU81-Plus 9-track industry compatible tape drive capable of 1600 bpi and 6250 bpi operation, a DEC LN03R Postscript Laser printer, and a DEC proprietary cartridge tape unit for loading software called a TK70. The TU81-Plus is used for backup and file exchange with the other prime contractors.

#### 2.2 Software

The STARS computer runs under DEC's proprietary operating system, VMS. VMS supports asynchronous terminals and workstations operating as VAX Cluster members, there are no workstations supported by the STARS computer at this time. VAX/VMS offers a number of features that make it suitable for use as a repository: account management is straightforward, there are a large number of commercial products available for VAX/VMS, it is compatible with a wide range of communication products, and it is easy to work with for a large number of users as many of its commands are similar to those found on PCs.

##### 2.2.1 Commercial Off the Shelf Software (COTS)

The STARS computer is currently licensed for the following products:

- o VAX VMS operating system for up to 40 users,
- o DEC VAX Ada compiler, version 1.5,
- o DEC VAX Configuration Management System,
- o DEC VAX Language Sensitive Editor,
- o DEC VAXNotes,
- o Oracle Corporation Relational Database Management System,
- o Dynamics Research Corporation AdaMAT.

##### 2.2.2 Ada Software Tools

The following products are compiled versions of software developed in Ada as part of various STARS contracts. Source code is available in the repository for these products:

- o Browser (file browser)

- o CAS (Count Ada Statements)
- o Check\_Standards
- o COCOMO (COConstructive COst MOdel)
- o Compile\_Order
- o Eat\_Tab
- o Page
- o Pretty\_Print
- o SE (STARS Editor)
- o SGML (Standard Generalized Markup Language, ISO 8879:1986)
- o Statement\_Profile
- o Unpage

### 2.3 System Availability

The system is considered available when a local or remote user may logon to the computer and perform repository activities. The system is considered to be "down" at all other times for any reason, including routine maintenance and backup. The STARS computer should be available at least 98% of the time, this allows for no more than 14.6 hours downtime per month on a yearly average.

### 2.4 Response Time

With the exception of commands that invoke time consuming activities, STARS users see little or no delay in the computers response to their commands. The actual response time to commands has not been objectively measured; however, subjective measurement generally indicates that the STARS computer is performing well. There are times when response is noticeably longer than desired, primarily due to heavy program development or database activity. Should this become a problem there are several solutions: operating system tuning or the installation of a faster CPU board. Tuning the operating system may include adjustment of system parameters or the purchase of additional software, such as a disk file defragmentation product to improve performance. There is no evidence that a performance problem currently exists.

### 3. STARS Users

The STARS computer system serves the STARS community of prime contractors, subcontractors, and consultants. Only persons directly involved with the STARS program may have access to the STARS computer and only for work directly in support of STARS. Software and files available on the STARS computer are for support of the STARS program and may not be used on any program without permission from the program office. Authorized STARS users are not charged for access to the computer, use of the computer is an expense covered by task IR10.

There is no typical STARS user. Many have little experience with DEC VAX computers, but are very experienced PC users. Others are experienced with UNIX in a workstation environment, but have little PC or VAX experience. Others are experienced on a number of different platforms and have little difficulty with the VAX/VMS operating system.

The importance of the user profile cannot be understated. The goal of repository operation is to design and provide a system which can be understood, used, and accessed by an average user while at the same time encouraging the advanced user to utilize the full suite of available software development tools and facilities. The typical user profile to which the STARS repository is targeted is:

- o Using a PC with a VT100 terminal emulator package such as PROCOMM,
- o Has a 1200 or 2400 baud modem,
- o Prefers a menu access to the repository database over VMS commands, and
- o Is more interested in the STARS products than software development.

Given this user profile it is important that developers be sensitive to the limitations this imposes on software developed for repository access. One of the more important limitations is the lack of graphics or user interface devices other than the keyboard and a character display. VAX/VMS can support a number of different terminal types, among which VT100 is the common denominator with the widest support by PC based terminal emulators; however, VT100 support does not provide for more than four special function keys, a problem when converting software from the PC environment to the VAX environment. Users may report problems with their equipment as problems with the STARS computer or they may have misunderstanding on the differences between operation of programs under VAX/VMS compared to MS-DOS.

The menus and tools provided to users need to be consistent with the use they expect of the repository. Some of the uses for the repository are:

- o Peer review of contract deliverables,
- o Search for reusable components,
- o Access to development tools, and
- o Electronic mail to other users.

Since users are typically accessing the system by dial-up phone lines and at 1200 or 2400 baud, the time required to display full screen forms can be tedious.

Users will want to customize their access to the repository system. Such customization is easily performed by those experienced with VAX/VMS. For the novice user of VAX/VMS, the command structure is rather obscure and arcane. Manuals, such as "Introduction to VAX/VMS" by DEC, are not readily available to remote users. A user guide for the repository is in preparation and will become a routine distribution to all repository users.

For reviewing text files, users need an easy to work with text editor that handles the minimal needs for examining files. The Boeing repository provides user selectable access to a variety of editors as one means of customization. This approach has some advantages; however, the typical user may not have a reason to prefer TPU, EDT, VI, or EMACS if they have no experience with any of them. The IBM Team repository instead standardizes on a file editor known as the File Browser, a derivation of the STARS Foundation Text Editor prepared for the Naval Research Laboratory under contract N00014-87-C-2386. This approach allows for smoother integration of the edit function into the other software products, but imposes a choice upon users. Such decisions and trade-offs are common in repository design.

Each user is provided with a unique working area for files they create and use. Such an area is a directory on the user disk, known by the logical name DISK\$USER:. The name of the user's directory is the same as their username. On the STARS computer each user has access to as much storage area as they need, up to the space remaining on the disk assigned to users. VAX/VMS allows disk quotas to be established to regulate the amount of disk space a user may consume. Disk quotas will be enabled on the user disk when there is insufficient space to allow users unlimited access.

## 4. Security

### 4.1 User Access

Systems accessible from dial-up phone lines are vulnerable to penetration by hackers. The primary defense against unauthorized access is the combination of usernames and passwords assigned to each user. Users not familiar with password protection schemes may select passwords that are easy to break, such as their username or a simple first name.

VAX/VMS offers a number of features that facilitate the management of users and passwords. Under VMS, system managers can change passwords for users; however, they may not determine a user's password. The program used to manage user accounts is called AUTHORIZE. The AUTHORIZE program has a number of parameters that control user passwords, these parameters are explained and typical values are shown below.

- o minimum length (PWDMINIMUM=6 characters),
- o lifetime (PWLIFETIME=90 days), and
- o expiration date (PWDEXPIRES).

VMS also maintains information on the last login and the number of logins failures by a user. The following is an account profile for the system manager:

```

Username: KUTOROFF                               Owner: STEVE KUTOROFF
Account: STARS                                   UIC: [100,26] ([SALC,KUTOROFF])
CLI: DCL                                         Tables: DCLTABLES
Default: DISK$USER:[KUTOROFF]
LGICMD: LOGIN
Login Flags:
Primary days: Mon Tue Wed Thu Fri
Secondary days:                               Sat Sun
No access restrictions
Expiration: (none) Pwdminimum: 8 Login Fails: 0
Pwdlifetime: 30 00:00 Pwdchange: 25-OCT-1989 08:13
Last Login: 15-NOV-1989 09:55 (interactive), 19-OCT-1989 11:17
Maxjobs: 0 Fillm: 100 Bytlim: 20480
Maxacctjobs: 0 Shrfillm: 0 Pbytlim: 0
Maxdetach: 0 BIOlm: 18 JTquota: 1024
Prcilm: 10 DIOlm: 18 WSdef: 1024
Prio: 4 ASTlm: 24 WSquo: 2048
Queprio: 0 TQElm: 10 WSextent: 4096
CPU: (none) Enqlm: 300 Pgflquo: 20000
Authorized Privileges:
CMKRNL CMEXEC SYSNAM GRPNAM ALLSPOOL DETACH DIAGNOSE LOG_IO
GROUP ACNT PRMCEB PRMMBX PSWAPM ALTPRI SETPRV TMPMBX WORLD
OPER EXQUOTA NETMBX VOLPRO PHY_IO BUGCHK PRMGBL SYSGBL MOUNT
PFNMAP SHMEM SYSPRV BYPASS SYSLCK SHARE GRPPRV READALL
SECURITY
Default Privileges:
TMPMBX NETMBX
Identifier Value Attributes
NEWSMANAGER %X80010006 NORESOURCE NODYNAMIC
REPOSITORY %X8001002C NORESOURCE NODYNAMIC
STARSR40 %X80010081 RESOURCE NODYNAMIC

```

|             |            |                      |
|-------------|------------|----------------------|
| STARSR20    | %X8001007B | RESOURCE NODYNAMIC   |
| STARSR20_QA | %X8001007E | NORESOURCE NODYNAMIC |
| STARSR20_CM | %X8001007D | NORESOURCE NODYNAMIC |
| STARSR40_CM | %X80010083 | NORESOURCE NODYNAMIC |
| STARSR40_QA | %X80010084 | NORESOURCE NODYNAMIC |

The system manager and operations staff are privileged users, they may use resources and examine files not accessible to others. It should be noted that privileged users have a password lifetime of 30 days instead of the 90 days assigned to normal users. In addition, privileged users receive the same privileges as normal users upon login, any special privileges must be requested as needed. Identifiers as listed above, may be used for controlling file ownership or in file access control lists (ACLs) to control user access to files.

The following is an account profile for more typical STARS user:

|                                              |                               |
|----------------------------------------------|-------------------------------|
| Username: WARDT                              | Owner: TOM WARD               |
| Account: STARS                               | UIC: [201,76] ([STARS,WARDT]) |
| CLI: DCL                                     | Tables: DCLTABLES             |
| Default: DISK\$USER:[WARDT]                  |                               |
| LGICMD: LOGIN                                |                               |
| Login Flags:                                 |                               |
| Primary days: Mon Tue Wed Thu Fri            |                               |
| Secondary days: Sat Sun                      |                               |
| No access restrictions                       |                               |
| Expiration: (none)                           | Pwdminimum: 6 Login Fails: 0  |
| Pwdlifetime: 90 00:00                        | Pwdchange: 31-OCT-1989 16:51  |
| Last Login: 15-NOV-1989 06:53 (interactive), | (none)                        |
| Maxjobs: 0 Fillm: 100 Bytlim: 20480          |                               |
| Maxacctjobs: 0 Shrfillm: 0 Pbytlim: 0        |                               |
| Maxdetach: 0 BIOlm: 18 JTquota: 1024         |                               |
| Prclm: 10 DIOlm: 18 WSdef: 1024              |                               |
| Prio: 4 ASTlm: 24 WSquo: 2048                |                               |
| Queprio: 0 TQElm: 10 WSextent: 4096          |                               |
| CPU: (none) Enqim: 300 Pgflquo: 20000        |                               |
| Authorized Privileges:                       |                               |
| TMPMBX NETMBX                                |                               |
| Default Privileges:                          |                               |
| TMPMBX NETMBX                                |                               |

VMS has other system parameters that control the maximum number of times a login failure may occur before evasive action is taken. When the number of login fails is exceeded, the system will disconnect the terminal. For local users, this has minimal impact, for dial-up users, it requires the user to re-dial the number in order to try again. VMS allows for an account to be disabled for a period of time after a break-in attempt is detected. This and other related parameters are controlled by the VAX system generation program, but they may be changed at any time. These parameters can be set to make break-in nearly impossible. For example, an account can be disabled for a period of time ranging from seconds to days after a failed login attempt is detected. Restrictive settings are a hardship on users who forget their passwords or have trouble connecting to the system; therefore, the system manager for a VAX/VMS computer needs determine the optimum trade off between system security and ease of user access.

An additional security feature has been incorporated into the STARS computer to disconnect a user who is inactive but remains logged on to the system. A "watch-dog" timer program named TIMEOUT monitors activity by each user and terminates the user session if there has been no activity for a period of time, currently set at 35 minutes. Warnings are issued to the user once each minute for the five minute period before the inactivity limit is reached. This program helps prevent unauthorized use of the computer when a terminal is left unattended. The duration of the timeout can be changed by the system manager.

#### 4.2 Network Access

The STARS computer is connected to a corporate network operated by Science Applications International Corporation (SAIC) and to a network operated by International Business Machines (IBM).

The STARS computer is linked via an Ethernet Local Area Network (LAN) to several computers located at the Clearwater, Florida facility. The STARS computer is connected to the SAIC network through a Wide Area Network (WAN) synchronous leased line through a DEC model 3100 computer. The SAIC network is connected to other computers used by SAIC. Message interchange with the Boeing repository is handled through the internet via an SAIC computer located in San Diego, California. The network mail address for the Boeing computer is SDSC::"username%BONNIE@ATC.BOEING.COM". The STARS computer address for the Boeing computer is ARPA%"username%STARS.SPAN@SDS.SDSC.EDU".

The IBM network connection is via an Ethernet bridge and modem to IBM's Gaithersburg office. This connection allows access by IBM personnel to the repository computer without using slower dial-up lines (see 2.1.3).

Each of these connections adds a new risk element to the STARS computer. The need to be connected to a network must be weighed against the risk. For example, an unknown person released a worm on 16 October 1989 to the internet which targeted DEC VAX computers running the VMS operating system. The worm would attempt entry via an internal list of accounts and a password guessing scheme as well as exploiting sites which had inadequate protection of certain critical files. Network managers on the internet shared information about the worm's operation and information on protecting computers from attack. Such attacks are becoming more frequent; however, there is no evidence that the STARS computer was ever targeted. The system managers prevent such access by restricting access to critical files and protecting network accounts from unauthorized use.

#### 4.3 Physical Security

The STARS computer is housed in a locked room within the offices of Science Applications International. Keys are provided only to the systems staff (Steven Kutoroff and Leonard Turton) and the building management. Visitors are escorted to the room for service and repair.

Power to the STARS computer is provided through a Liebert 30 KVA Uninterruptable Power Supply (UPS). The UPS provides filtered and clean power in spite of any service interruptions to the building. All electrical grounds are also through the UPS. All STARS communications equipment is powered through the same UPS as the computer itself. The UPS can provide for continuous operation for up to one hour on its internal batteries.

The STARS computer room is air conditioned by two physically separate air conditioners, one of 2 ton capacity and the other of 6 ton capacity. At all times one air conditioner is set for continuous air circulation and controls the room temperature. The second unit is adjusted to a higher temperature with its air handler set to automatic as a backup to the primary unit. The roles of the two units are periodically exchanged by adjusting the thermostat and changing the fan control, this ensures that the backup unit is functional. At this time, neither air conditioner has a backup power source.

The risk of fire is controlled by the buildings sprinkler system. At this time there are no interlocks between the building sprinkler system and the UPS. This is a known risk which will be corrected in the future.

Magnetic tapes used for backup purposes are stored both on site and in off site secure storage. On site storage is used for incremental (short term) backup tapes and for backups waiting for delivery to the off site location. The on site storage facility is a tape rack in the room adjacent to the computer which has the same lock as the computer room.

Off site tape storage is at:

Archive Corporation  
3901 W. Osborne  
Tampa, FL, 33614  
(813) 874-1577

The Archive Corporation provides for secure storage of magnetic media. They will pick up and deliver tapes upon request. This facility ensures survivability of the IBM Repository in case of disaster on site.

## 5. System Asset Management

System asset management not only includes the physical asset of the computer itself, but also the information contained within it. The hardware items are tracked using a database of all items purchased for the contract along with a property identification system for each item purchased.

The less tangible assets can be managed by considering the following questions:

1. Are all the users that have access to the system known?
2. Should any of these users be deleted?
3. Is all data on the system related to the supporting contract?
4. Are all network paths documented and controlled?
5. Are failed accesses reviewed for security breaks?
6. Are users periodically informed of their responsibilities?
7. Are system critical files protected from general access?
8. Are limited access areas protected from unauthorized access?

These topics will be covered individually.

### 5.1 Are all the users that have access to the system known?

The AUTHORIZE program allows system managers to review, add, delete, and modify accounts and attributes for each account on the system. The user list is reviewed periodically to ensure that each user account is known and has appropriate privileges. A separate database is maintained with information about users mail address, phone number, and affiliation. This database includes all past STARS participants.

### 5.2 Should any of these users be deleted?

A report from AUTHORIZE is periodically reviewed for users no longer associated with the STARS program and users whose accounts are inactive. Inactive accounts are those for which the user has not logged in for a period of 90 days, the current value for password lifetime. The system announcement message (see 6.1.1) warns users that this may occur and lets them know the STARS help phone number should they have a problem. At the discretion of the system manager, files belonging to users no longer active in the STARS program are either deleted immediately or saved for six months (to allow the user time to rejoin the program).

### 5.3 Is all data on the system related to the supporting contract?

It is not possible to check all user files for relationship to the STARS program, users can upload and download files at will from personal computers to STARS. Since access to the STARS system is controlled, abuse of the system is believed to be unlikely.

### 5.4 Are all network paths documented and controlled?

See the section titled "Security".

### 5.5 Are failed accesses reviewed for security breaks?

Each break-in detection or failed access produces a warning on the system console and an

entry in the operator log file. Procedures for searching the operator log file and reporting break in attempts are under development.

**5.6 Are users periodically informed of their responsibilities?**

Through the message printed at login users are occasionally reminded of the need to change passwords. No formal statement of responsibilities is currently sent to all active STARS users.

**5.7 Are system critical files protected from general access?**

All system critical files are protected from general access by controlling file ownership and file access. System files are owned by the system account, as opposed to the privileged users who maintain them. These files have protection codes which restrict access to those with special privileges (controlled by AUTHORIZE) and by the system itself. The files belonging to the AUTHORIZE program itself are critical.

**5.8 Are limited access areas protected from unauthorized access?**

VAX/VMS provides a mechanism called the Access Control List (ACL) which may be used to limit access to files. Projects such as Common Ada Missile Packages (CAMP) are given a unique identifier which is granted on an individual and temporary basis to users needing access to such files. Access to limited access files is granted on a special request basis.

## 6. User Interface Considerations

### 6.1 Getting logged onto the computer

It is important that users have access to information needed for the support of their work that pertains to the function being performed. For example, a help message on logging into the computer is not useful to a user having trouble logging in.

#### 6.1.1 SYSS\$ANNOUNCE

The message known by the logical name SYSS\$ANNOUNCE is displayed for users prior to the USERNAME prompt at login time. It is used on the STARS computer to provide the help phone line number should a user have difficulty in logging in to the computer. The message warns users that passwords will expire every 90 days.

IBM TEAM STARS REPOSITORY

For system security, passwords are expired after 90 days of inactivity.

If you experience any problems, please call the help line.  
(813) 791-9437

Username: \_

#### 6.1.2 SYSS\$WELCOME

The welcome message, known by the logical name SYSS\$WELCOME, is displayed after the username and password are verified. The message is typically a welcome to the computer system in use. The message shown is displayed below:

IBM STARS Team VAX 3600, VMS V4.7A

After this message the system informs the user of the last date and time of interactive and batch logins. The purpose of this information is to allow users to verify that this information is consistent with their use as it provides a means for users to check that no unauthorized user is logging in under their account. If the user has unread mail, the number of unread messages is displayed at this time.

#### 6.1.3 NOTICE.TXT

Notice is the message displayed to the user after successful logon that conveys information about the system's latest capabilities and informs the user of new tools or scheduled downtime. The notice file is also displayed in response to the command NOTICE at the DCL (Digital Command Language) prompt. A typical NOTICE.TXT file is shown below:

```
===== Last Edited 13 November 1989 at 1520 EST =====
The IBM STARS Team Repository may be accessed via the following commands at
the command prompt:
```

```
$ repos2_2
-- for version 2.2 of the interface
```

```

-- NOTE: this version requires full VT220 emulation.
$ repos windows | nonwindows
-- for version 2.0 of the interface (obsolete).
-- default is to use windows mode unless terminal data rate is low
-- windows mode requires VT100 or VT220 emulation.
$ repos1
-- for version 1.0 of the interface (obsolete).

===== IBM STARS Team Help phone line (913)791-9437 =====
AdaMAT has been installed. Type ADAMAT for an introduction.
===== For assistance call Len Turton or Steve Kutoroff =====
===== Problem Reports may be mailed to 'REPOS' =====

```

The notice must be changed in response to new software, system changes, user interface changes, and to provide warnings about downtime. The date entered into the top line lets users know when the file has been updated. Another approach used for such information is to display the notice file only once after it has been updated. The STARS system currently displays the notice on each login.

In the above example, the notice is informing users that the common repository interface software is available in three current versions. Since each of the versions has certain requirements, such as terminal emulation requirement, these are noted. The software used for database access to the repository is developed under task IR40 and is managed by task IR10. Development and maintenance of the repository database is the responsibility of task IR40, IR10 provides for support, backup, and maintenance of the commercial and systems software used by IR40.

## 6.2 Using the STARS Computer

### 6.2.1 VAX/VMS Services

The VAX/VMS operating system has a number of features to assist users, such as a complete on-line help system. Users may type help on a topic or command from the VMS prompt and get information including examples at the lowest level. Many commands may be entered directly at the command line or the user may elect to enter a layered product such as the Ada compiler's library management system, known as ACS, or the Configuration Management System (CMS) and work within the product's own command shell and help environment. Help is entered by typing HELP or HELP followed by topic or subject.

STARS users are given open access to system resources such as the processor and creating disk files. Should capacity management become a problem, the system has facilities to manage resource usage either through accounting or through allocation of quotas and limits. For capacity management VMS allows the assignment of disk quotas to a project or to a user. VMS also allows for setting limits on total processor usage. Disk quotas are enabled by volume, this would allow the management of the disk space used on the user files disk (Disk\$User:) without impact on the system or the repository disk drives. At the current time, there is no need to manage disk use on the STARS computer.

### 6.2.2 Using the Repository

The philosophy of the IBM Team repository is to develop a customizable shell between the computer operating system and the repository contents. This has been done in a stepwise fashion, learning from the early prototypes and using the experience to develop an improved interface.

The earliest interface consisted of a single level menu programmed using the VAX computers command language, Digital Command Language (DCL). This interface is available by using the command REPOS1, as noted in the text of the file NOTICE.TXT, described above. This interface merely provided a means to access some of the data and tools on the repository during the Q increment.

The next step in repository development was to create an interface to an Oracle database of the repository contents. This interface was coded in Ada using the Window\_Manager from the STARS Foundation contract as its basis. The menus for this interface were hard coded in the program. Later versions of the software were developed in which the menus are defined in a text file which is read into a more general menu driver program which provides the interface to the actions needed for each menu selection. The various versions of this interface are available by typing REPOS2\_2, REPOS2, or REPOS at the DCL command prompt, as noted in the logon message.

The goal of these interfaces is to provide a single access method into the repository and therefore allow the database to manage the contents independent of the host operating system.

## 7. Repository Operation

Operation of the STARS repository requires that products of the primes be obtained, stored, and distributed. Changed and new products from the Boeing repository are delivered monthly on VAX/VMS backup format 9 track magnetic tapes. Changed and new products from Unisys are delivered as needed on VAX/VMS backup format 9 track magnetic tapes. The tapes contents are loaded onto the repository when they are delivered.

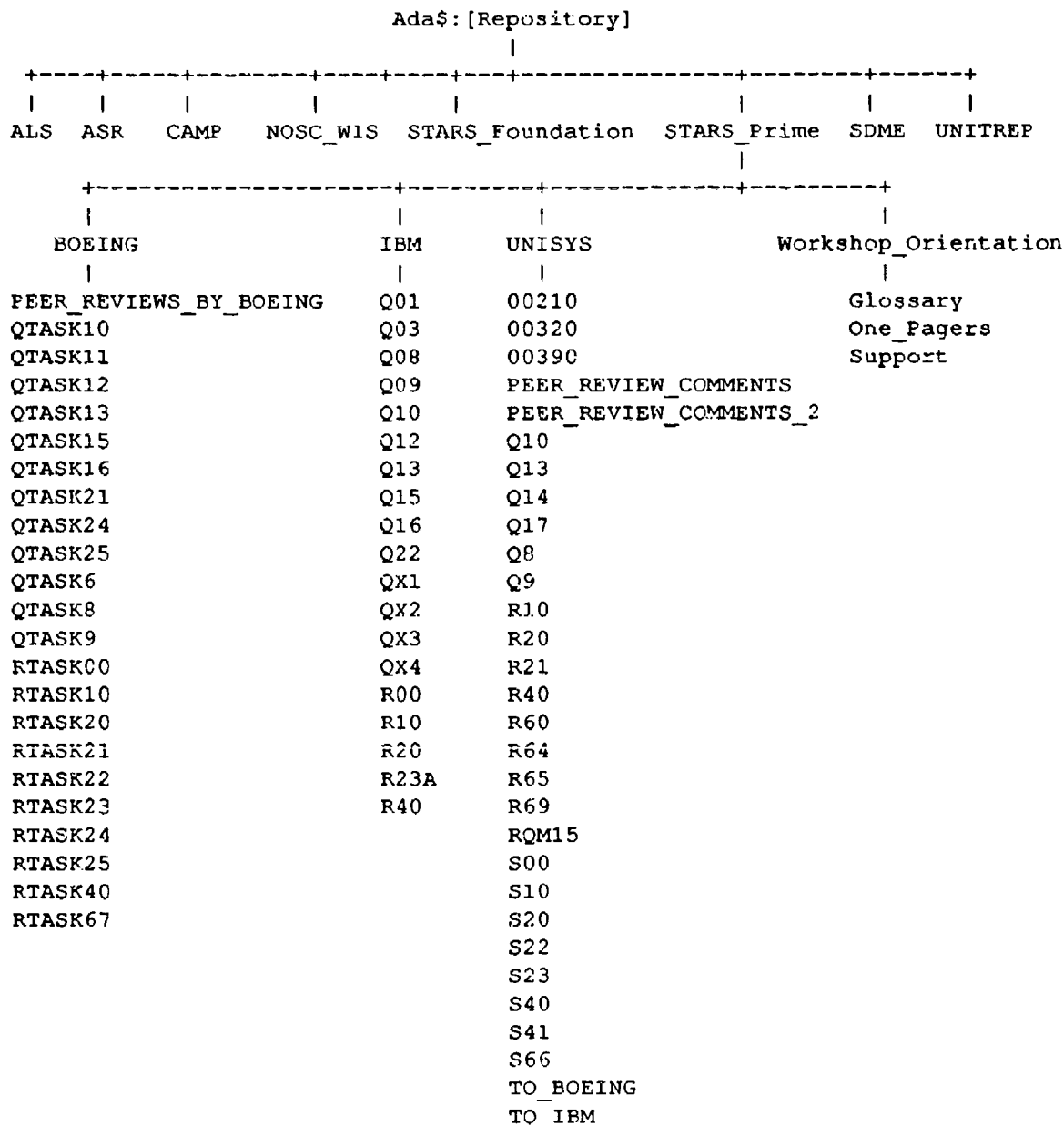
CDRL products from IBM and its subcontractors are delivered electronically by IBM to a holding area from which the files are transferred to the repository. This process has been largely automated.

There have been problems with the process, primarily with products prepared by UNIX host computers. There are a number of files in the repository which are in UNIX file format rather than VMS file format. These files cannot be read by VMS editors due to the inclusion of line feed characters at line breaks, a tool to convert these files is being prepared. Other files have been delivered to the VAX/VMS repository host which are in binary executable and object format. Such files are deleted when found as they cause unpredictable effects on attached terminals when they are viewed. These problems are being corrected with cooperation by all parties and by changing supplier procedures.

Aside from electronic mail, there are two other means of exchanging information, NOTES and NEWS. NOTES is a program from DEC which allows people to interact as if in conference with other users on a topic. As such, NOTES allows for an individual to control a topic under discussion and limit interaction to certain people. The program NEWS is more of an electronic bulletin board for sharing and posting information. NEWS has features which allow for multiple computers to exchange news items via network interconnections. NEWS is used to exchange items between the Boeing and IBM repositories.

## 8. Repository Organization

The repository organization scheme is important for users accessing the repository through VAX/VMS commands or the directory browser component of the repository software. The following diagram illustrates the gross structure of the directories in the repository. The CDRL items for each task are located in the directory for the task, the CDRLs are listed in a later chart.



The STARS Prime CDRLs are listed below by directory name in the repository. As can be seen below, each prime contractor uses a unique naming convention for the directories which

contain their CDRL items.

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.BOEING.QTASK10]

CDRL210  
CDRL220  
CDRL260  
CDRL270

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.BOEING.QTASK11]

CDRL300  
CDRL310

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.BOEING.QTASK12]

CDRL410

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.BOEING.QTASK13]

ARPS  
ARPS\_V1  
CDRL460  
CDRL470  
CDRL510  
CDRL520  
CDRL530  
CDRL540  
CDRL550

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.BOEING.QTASK15]

CDRL\_1420  
CDRL\_1430

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.BOEING.QTASK24]

CDRL600  
CDRL610  
CDRL620  
CDRL630  
CDRL650  
CDRL660

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.BOEING.QTASK8]

CDRL140  
CDRL170

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.BOEING.RTASK00]

CDRL710

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.BOEING.RTASK10]

CDRL\_810

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.BOEING.RTASK21]

CDRL\_890

CDRL\_910

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.BOEING.RTASK24]

CDRL\_980

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.BOEING.RTASK40]

CDRL\_820

CDRL\_840

CDRL\_860

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.BOEING.RTASK67]

CDRL\_1240

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.IBM.Q01]

C0080A

C0080B

PEER\_REVIEW

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.IBM.Q03]

C0090

C0100

C0110

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.IBM.Q08]

C0160

C0170

C0180

C0190

C0220

C0230

C0240

C0270

C0290

C0300

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.IBM.Q09]

C0310

C0320

C0330  
C0340  
C0350  
C0360  
C0370  
C0380  
C0390

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.IBM.Q10]

C0420  
C0430  
C0440  
C0450

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.IBM.Q12]

C0460  
C0470  
C0480  
C0490  
C0500  
C0510  
C0520  
C0530

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.IBM.Q13]

C0540  
C0550  
C0560  
C0570  
C0580  
C0590  
C0600

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.IBM.Q15]

C1230  
C1270A  
C1270B

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.IBM.Q16]

C0620  
C0630  
C0640  
C0650  
C0660  
C0670  
C0680  
C0690

C0700  
C0710  
C0730  
C0740  
C0750  
C0760  
C0770  
C0780  
C0790  
C080C  
C0810  
C0820

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.IBM.Q22]

C0830

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.IBM.QX1]

C0870

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.IBM.QX2]

C0880  
C0890  
C0900

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.IBM.QX3]

C0910  
C0920  
C0930  
C0940

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.IBM.QX4]

C1010  
C1020

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.IBM.R00]

C1280  
C1320  
C1392  
MONTHLY\_PROGRESS\_REPORT

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.IBM.R10]

C1430B  
C1430C

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.IBM.R20]

C1500A  
C1500B  
C1510A

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.IBM.R23A]

C2030  
C2040

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.IBM.R40]

C1540  
C1560B  
C1560C  
C1570A  
C1570B  
C1570C  
C1600A  
C1600B

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.UNISYS.Q10]

00380\_DOC  
00400\_ADA  
00410\_ADA

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.UNISYS.Q13]

00460\_ADA

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.UNISYS.Q14]

00490\_ADA  
02014\_001\_00  
02014\_002\_00

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.UNISYS.Q17]

00540\_ADA

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.UNISYS.Q8]

00190\_ADA  
00220\_ADA  
00240\_ADA  
00260\_ADA  
00280\_ADA

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.UNISYS.Q9]

00330\_ADA

Directory DISK\$REPOSITORY:[REPOSITORY.STARS\_PRIME.UNISYS.R20]

ACE  
CAIS\_A  
UI

## 9. Future

### 9.1 Software

#### 9.1.1 STARS Software

In the future the repository will continue to receive updated user access software from task IR40. This software will incorporate improved access and retrieval methods. In addition, new features for identifying STARS users and their addresses are planned as well as improvements in user feedback and problem reporting.

#### 9.1.2 Commercial Software

The repository will be updated from VMS 4.7A to VMS 5.2 as soon as feasible once the time, materials, and user impacts have been coordinated. There is always concern that a new version of the operating system will cause problems with other software, such as the Oracle RDBMS and AdaMAT. The upgrade may impact the STARS access software through changes in the runtime environment or the Oracle RDBMS interface software. The impact of this upgrade are under investigation at the present time.

Other software improvements planned include upgrading the DEC Ada compiler from version 1.5 to version 2.0. The extent of the changes to the compiler are currently unknown.

There is interest in adding a commercial SGML processing capability to the repository. Task IR65 is investigating the cost and benefits of products from DataLogics and Software Exoterica for SGML processing.

### 9.2 Tele-Communications

Improvements in remote access are being considered. Tymnet, Telenet, and expanded 800 number coverage are some of the options. "800" service is most economical at the lower range of use and use of a network service is more effective at the higher volumes. At the current rate of use, 800 service is the most cost effective route.

Additionally, the cost and utility of connecting the STARS computer to the regional networks is now being investigated.

## APPENDIX A.

### APPENDIX: Backup Procedures

Backup procedures are intended to ensure recovery of user and system files in the event of a system failure that results in loss of disk file system integrity. The STARS repository contains three disk volumes: system, user, and the repository. The system and repository disks are relatively static, i.e. significant changes occur periodically, not daily. The user disk has file changes on a daily basis.

#### A.1 System Disk - STARS\$DUA0:

The system disk has a STANDALONE backup performed every three months or more frequently in the event the system disk is modified, such as the installation or upgrade of a software product. A new standalone must be performed to insure an updated backup copy after any such additions to the system disk.

The concept of a STANDALONE backup is to boot the system to a running minimal operating system with no users. The minimal system files are loaded into memory such that no files are open on the system disk to ensure that an accurate image of the operating system is placed on the tape.

#### A.2 User Disk - STARS\$DUA1:

The user disk has a full backup performed every two weeks. The full backup procedure also performs the record function in which the date of the file backed up is recorded on disk. Between the full backups a daily incremental backup is performed at 2000 hours each night. The incremental procedure backs up any files that have been modified, created, or accessed since the last recorded full backup.

#### A.3 Repository - STARS\$DUA2: & STARS\$DUA3:

The repository disk is much like the system disk. The contents of the repository do not change on a daily basis. A full backup procedure is performed every 2 months or when any products have been changed. The record option is also used on the repository full backup. An incremental backup procedure is performed once a week to insure all modified, created, or accessed files have been saved to tape.

A full backup of the repository contents currently requires seven 12 inch magnetic tapes recorded at 6250 bits per inch.

## APPENDIX B.

### APPENDIX: Adding New Users

To add a new user to the STARS system, the following steps are performed:

1. Obtain following information about user: First Name, Last Name, Address, and Phone Number.
2. Execute the @ADDUSER command procedure. This is the procedure set up to assist in adding a new user to the system. An alternate method is to execute AUTHORIZE utility and perform the task manually. The ADDUSER command procedure performs all required steps while using a default account as reference. A new user is assigned a unique account name, a user identification code (UIC), a temporary password, and a working directory.
3. Add the new user information into the STARS repository users reference list.
4. Inform user by phone that his or her account is available. The new user will automatically be forced to change the temporary password that was initially assigned to them.

## APPENDIX C.

### APPENDIX: Expired User Account Management

A user account is expired due to inactivity or due to a change in status as a STARS user. The procedure to expire users is as follows:

1. First the user authorize file is checked for inactivity for a period of more than 90 days. This is done monthly; however, the chief programmer may use discretion in terminating access to accounts.
2. If the account has been inactive for more than 90 days the DISUSER, and DISMAIL flags are set on the account using the AUTHORIZE utility. These flags block the user from logging into the account or receiving mail. The DISUSER flag prevents the user from logging onto the computer even if the proper password is provided, this cannot be distinguished from using the wrong password on the account. At anytime the user account may be modified to allow the user access to the system by removing the flags from the authorize file. A user who has been expired and requires access to the system need merely call and the account can be enabled.

## APPENDIX D.

### APPENDIX: Terminated User Account Management

Access to the STARS computer is restricted to persons actively working on STARS projects through the program office, contractors, or subcontractors. STARS access is terminated when the user no longer qualifies and when such notification is provided to the chief programmer for task IR10. The procedure for a terminated user is as follows:

1. Remove the USERNAME from the system authorize file. This is performed by running the AUTHORIZE utility and entering "REMOVE username". This command removes the user from the AUTHORIZE database.
2. Archive the user account. This is done by using the BACKUP utility. The files associated with the user are copied onto tape and saved for 6 months. If the users total disk space is limited the files may be deleted entirely from the system or they may be kept on disk rather than placing them on tape. If the user is to be reinstated, the user's files can be restored.
3. Any VAXNotes discussions owned by the individual will need to have their ownership corrected.
4. The database of user information will have to be updated.