AIX/ESA Overview

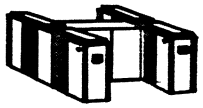
Steve Ouelette

IBM Corporation

November 18, 1992

IBM

AIX



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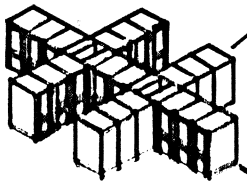
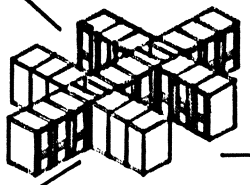
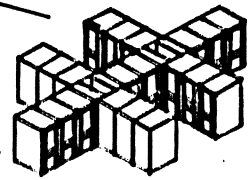
FOCUS AREAS



High Speed Data Path



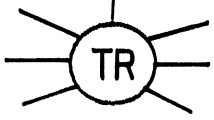


Compute Server

- Programs Requiring
  - Large Address Space
  - High MIPS
  - Large Memory (Real, Virtual)
- Programs Leveraging
  - Batch
  - Multiprocessing (Parallel)
  - Vector

High Speed Data Path

High Speed Network



Visualization

Data Server

- Large Data Capacity
- Fast Data Transfer Speed

Data = Files, DB, Graphics, Image, Case Repository

Interactive Campus Server

- High User Capacity
- Low Workstation Cost
- Low Staffing & Skills Costs

TCP/IP Ethernet

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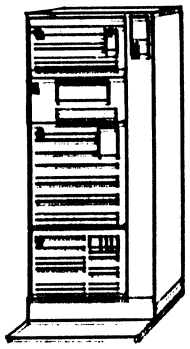
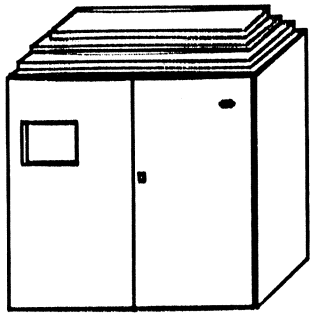
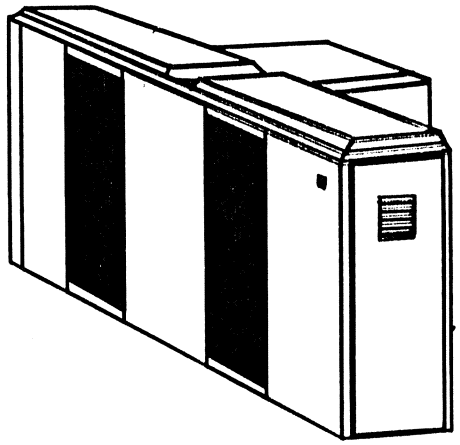
AIX/ESA







- Native S/390 operating system
- Based on OSF/1
- OSF/1.0 AES compliant
- Scaled to mainframe
- XPG/3 compliant
- C2 security – designed for B1

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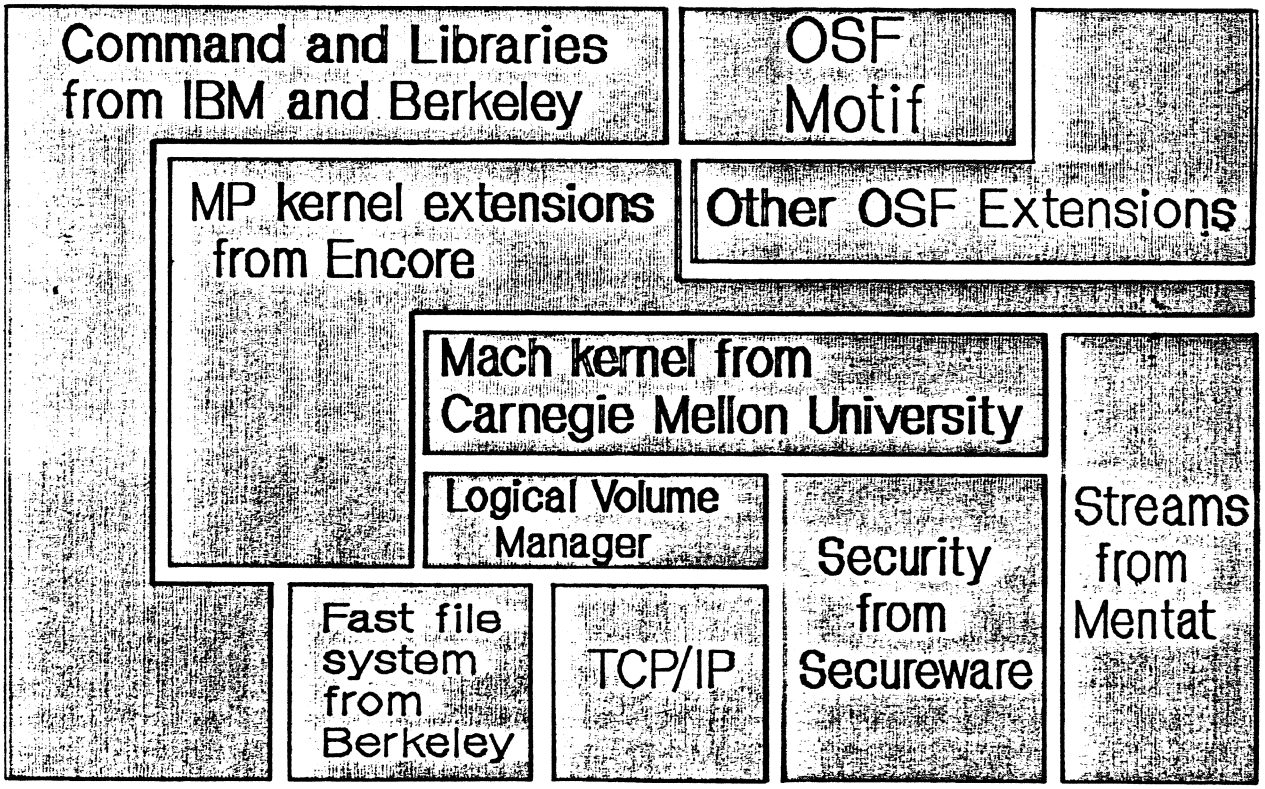
Based on OSF/



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AIX Extensions to OSF/1

Network Management	Performance Monitor	Availability Improvements
Enhanced Scheduler		Enhanced Kernel Recovery and Performance
Improved File System	Hardware Recovery & Device Drivers	Accounting Enhancements

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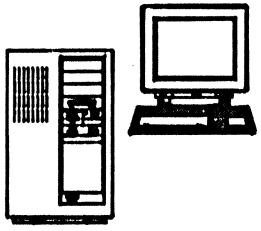
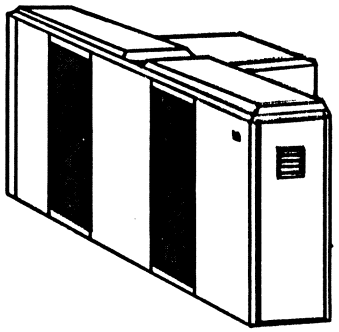
Application Environment Specification (AES)





OSF OEM RISC System/6000 System/390

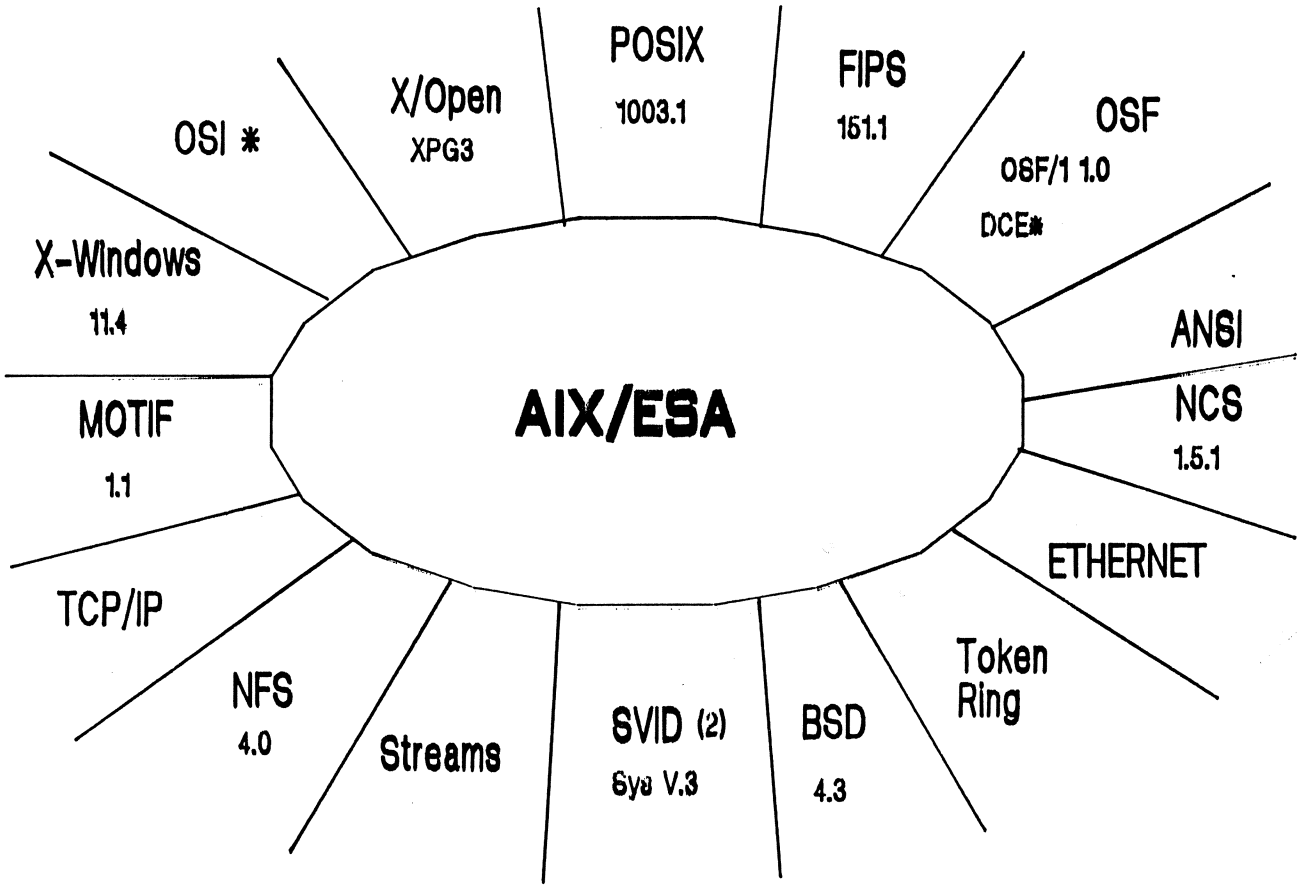
Common:

- Application programming interfaces
- User interface
- Network services
- Data base management services

Portability of applications, data and people

RF0501A

SUPPORTED INDUSTRY STANDARDS



* Statement of Intent

OPEN SYSTEMS

OSF 1.0 base
POSIX 1003.1-1988
XPG/3
UNIX System V Interface Definition (SVID) Issue 2
4.3 BSD
X-Windows 11.4
Motif 1.1
NCS 1.5.1
National Institute of Standards and Technology FIPS 151-1
ANSI X3.159-1989, C
OSF Application Environment Specification
- Operating System Programming Interfaces
- Volume Revision A
- User Environment Volume-Revision B

IEEE 802.3 and 802.5 (Ethernet and Token Ring)
ANSI X3T9.5 Fiber Distributed Data Interface
TCP(MIL-STD-1778) and IP (MIL-STD-1777)

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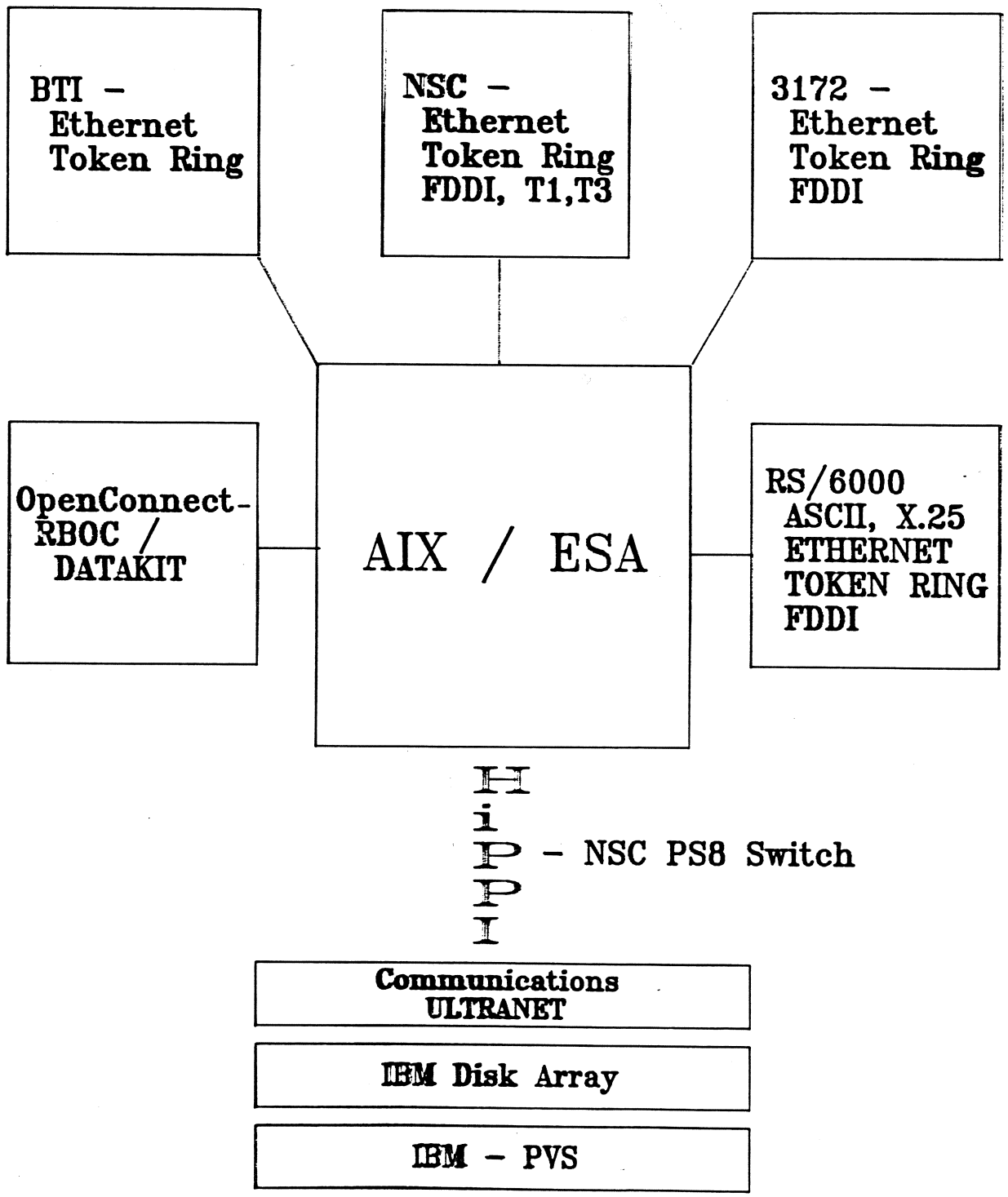
AIX/ESA CONNECTIVITY (OUTBOARD)



AIX

SYSTEMS MANAGEMENT

CONFIGURATION MANAGEMENT

* TUNEABLE KERNEL PARAMETERS
* SUBSYSTEMS (STREAMS, PHYSICAL DEVICES, OR PSEUDO DEVICES , DYNAMICALLY CONFIGURABLE
* DYNAMIC DEVICE DRIVER ADDITION

ACCOUNTING MANAGEMENT

* DISK USEAGE BY USER ID'S
* TAPE DRIVE MINUTES, COST OF THE DRIVE, NUMBER OF MOUNTS, COST OF MOUNTING, ETC.
* MICROSECOND TIMING
* VECTOR USE
* ELIMINATES WRITING TO OUTPUT FILES FOR EACH PROCESS TERMINATION

TAPE MANAGEMENT

* ENHANCED DEVICE DRIVER
* TAPE MANAGER VALIDATION LABELS & USER ACCESS, OFFERS TAPE CATALOGING, USES STANDARD SYSTEM CALLS FOR ACCESS TO DATA
* ACCESSES TO A TAPE VOLUME OR A SPECIFIC DATA SET
* TAKES RECOVERY ACTIONS PRIOR TO FAILURE NOTIFICATION

AIX

SYSTEMS MANAGEMENT

OTHER ENABLERS

* PERFORMANCE MONITORING
* STANDARD UNIX TIMER SCALED FOR MP
* INTERNATIONALIZATION LOCAL ENABLEMENT
* DCE (SOD)
* SNMP AGENT MODE

USER MANAGEMENT

* MASS ADD/DELETE OF USERS
* ADDITION/MODIFICATION OF USER ACCOUNTS VIA SINGLE COMMAND
* DELETING ACCOUNTS - DELETES HOME DIRECTORY AND FILES
* RETIRING ACCOUNTS - PROHIBITS ACCESS TO THE SYSTEM BUT KEEPS HOME DIRECTORY AND FILES INTACT

SECURITY

* ALLOWS SYSTEM ADMINISTRATOR TO DEFINE AND MANAGE ACCESS TO RESOURCES, AUTHORIZATIONS AND AUDITING
* USER/PROCESS HAS MINIMUM PRIVILEGE TO PERFORM ITS JOB
* AUDIT TRAIL OF ALL RELEVANT EVENTS

AIX

STORAGE MANAGEMENT STRATEGY

- FILE SYSTEM SERVICES

  On-Line Data Redundancy (Mirroring, RAID)

- HIERARCHICAL STORAGE MANAGER (HSM)
  - On-Line Data Requirements Greater Than DASD Capacity
  - Migration of Less Frequently Referenced Data Through Hierarchy of Optical and Tape Devices
  - Automatic Retrieval on Reference
  - Transparent to Applications
  - Integration With File Systems
- BACKUP/RECOVERY/ARCHIVE (BAR)
  - Data Redundancy
  - Integration With HSM
- DISTRIBUTED SUPPORT
  - Remote Data Access Via DCE
  - Workstation Storage Management Via Distributed HSM
  - Host-Driven Backup and User Driven Restore

TAPE MANAGEMENT SYSTEM

Enhanced REELlibrarian for AIX/ESA

REELlibrarian PROGRAM

REELlibrarian Program ported to AIX/370

Improvements by SCEPTRE and IBM

- Automated Resource Allocation
- Enhanced Security
  - Tape Label Validation
  - Prevent Multiple User Device Access
  - Standard label Processing
    - IBM/ANSI/No Label (NL)
    - TAR/CPIO Formats
    - Bypass Label Processing
  - Operator & Administrator Authorization Levels
  - Discretionary Access Control
  - User Privileges
  - Password Protection
  - Volume Fingerprints
- Accounting Information and Statistics
- On-line Tape Catalog
  - Foreign Catalog Interface Option
  - Can Operate without Catalog
- Ease of Use for End User
  - Command and functions for tape access
  - Transparent end of volume handling option
- Operator Domain Support
- Generation and Version Support
- Tape Pools
- Batch Environment Interface
- Improved Recoverability
- Site Exit Capability
- 3480/3490 Device "Sharing"

* Current REELlibrarian and REELbackup ported by YE92.

PS0312A2 K/D

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DATA MANAGEMENT

* VIRTUAL FILE SYSTEM
  - Allows several file systems to operate
    -- 4.3 BSD TAHOE
    -- NFS 4.0
    -- AIX/370

* LVM
  - File systems span multiple physical disks
  - Detect and relocate bad disk sectors dynamically
  - Disk mirroring (original +2 copies)

* VMM
  - Main memory divided into fixed length pages
  - Page Subsys. uses exp. storage
  - Improves performance by keeping only needed tasks

* DYNAMIC KERNEL EXTENSIONS
  - Device Drivers
  - File Systems (SOD)
  - Network Protocols (SOD)

* >2GB FILE SYSTEM (SOD)

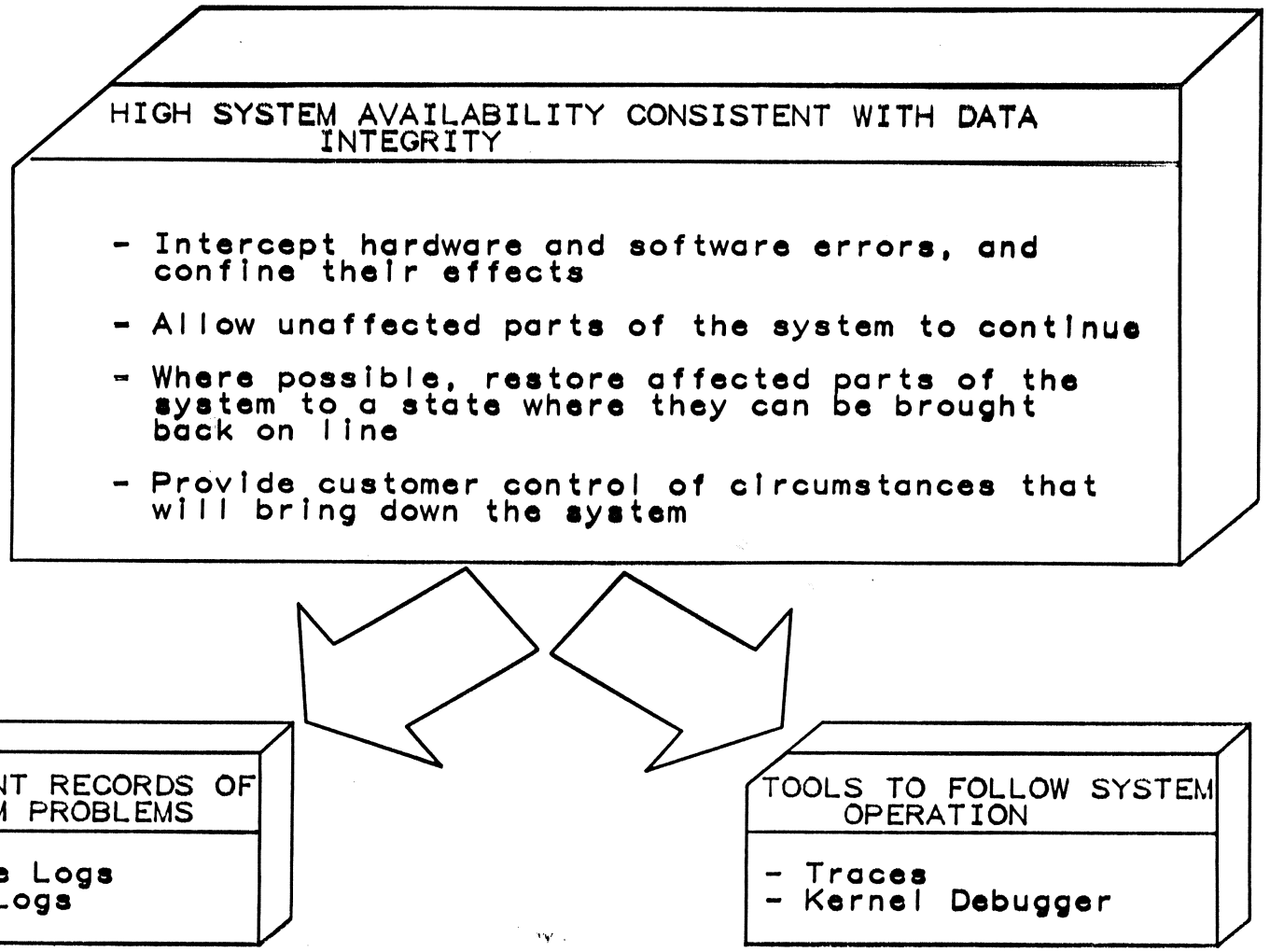
* 2GB PROCESS SIZE

* DATA STRIPING (SOD) ALLOWS FILES TO BE SPLIT OVER MULTIPLE CHANNEL PATHS TO SAME I/O

* ASYNCHRONOUS I/O (SOD) PROVIDES THE ABILITY TO OVERLAP APPLICATION PROCESSING AND I/O OPERATIONS INITIATED BY THE APPLICATION

AIX

RAS STRATEGY



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AIX

RAS

MESSAGES – IDENTIFYING FAILING HARDWARE OF SOFTWARE COMPONENTS

HARDWARE RECOVERY – MACHINE CHECKS AFFECTING ONLY THE RUNNING PROCESS, PROCESSOR KEEPS RUNNING UNTIL HARDWARE ERROR RECOVERY MUST BE INVOLVED

DUMPS – ALLOWS RELEVANT PORTION OF THE KERNEL'S ADDRESS SPACE TO BE CAPTURED FOR PROBLEM ANALYSIS WHILE THE SYSTEM CONTINUES OPERATION

STAND ALONE DUMP – USED WHEN SYSTEM RECOVERY NOT POSSIBLE. WRITES CONTENTS OF REAL MEMORY TO OPERATOR SPECIFIED TAPE AND ANALYSIS CAN BE DONE WHEN THE DATA IS MOVED INTO THE FILE SYSTEM

DYNAMIC CONFIGURATION OF ONE CONSOLE AT AT TIME IN AN MP ENVIRONMENT

BUILDABLE SOURCE - SOD

OBJECT CODE MAINTENANCE PROVIDED

DSF – DEVICE MEDIA MAINTENANCE AND ERROR DETECTION

TRACES – PROVIDES A RECORD OF THE FLOW OF SYSTEMS OPERATION (INTERNAL OPERATIONS, DATA AND COMMANDS TO I/O) TO BE IDENTIFIED

IOS-I/O SUPERVISOR ISOLATES CHANNEL SUBSYSTEM FROM AIX/ESA

KERNEL DEBUGGER – ALLOWS CUSTOMERS TO DEBUG DEVICE DRIVERS AND KERNEL EXTENSIONS THEY HAVE ADDED ON A RUNNING SYSTEM

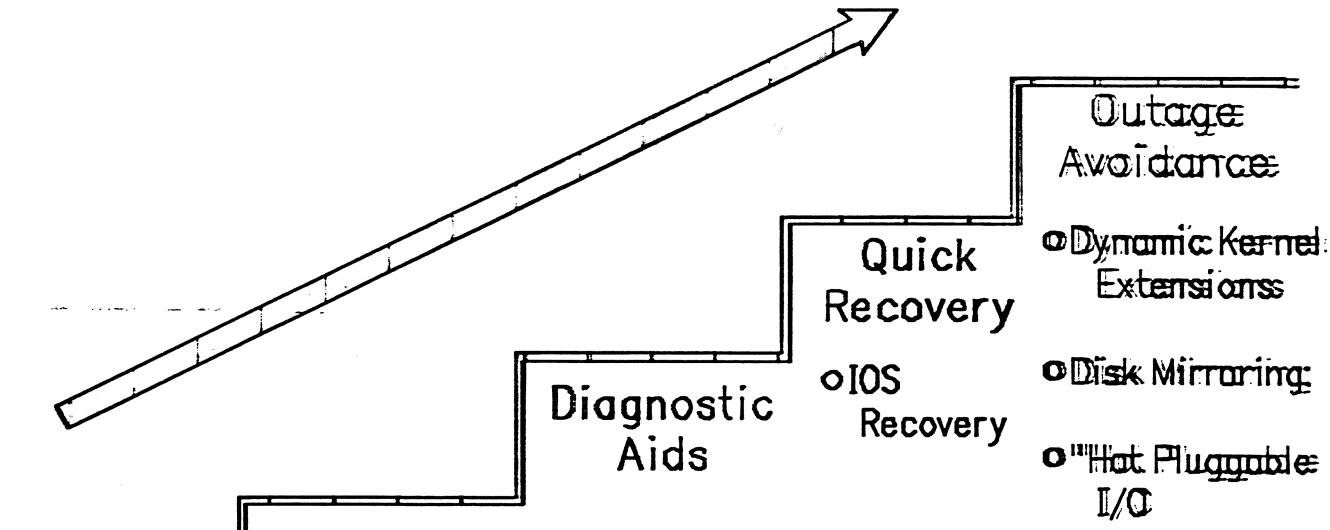
KERNEL RECOVERY – ABILITY OF THE KERNEL COMPONENT TO SPECIFY A RECOVERY ROUTINE WITHOUT TERMINATING THE SYSTEM

SELECTIVE FIX – TAKING A SPECIFIC FIX FROM THE TAPE TO CORRECT A SPECIFIC PROBLEM DOWN TO THE EXECUTABLE FILE OR SINGLE OBJECT LIBRARY

EREP – PROVIDES SYSTEM STATUS REPORTS AT I/O SUBSYSTEM LEVEL

AIX

Better UNIX System Availability



AIX

LICENSED PROGRAM PRODUCTS

* IBM AIX X-WINDOWS REALTIME MONITOR/ESA
  - Data collection (user-specified intervals)
    - Record/playback option for archiving
    - Remote monitoring option to offload graphic and data reduction functions
  - Statistical data reduction (avg. %,sd, r, R)
  - Graphic display interface (MOTIF/X11), various formats
    - Optional GIF format file for hardcopy output

* IBM AIX VS FORTRAN/ESA is based on VS FORTRAN Version 2 Release 5 and provides Vector Facility support for ESA capable processors and provides symbolic debug support (dbx). FORTRAN/ESA conforms to FORTRAN 77 and FORTRAN 66 standards. At the source language level FORTRAN/ESA is compatible with VS FORTRAN version 2 release 5 for AIX/370, MVS and CMS.

  Object and load modules are not the same for AIX/ESA and CMS. SOD=Intension for parallel processing capability equivalent to that provided by MVS and CMS

  FORTRAN 77 - ANSI X3.9-1978 ISO 1539-1980
  FORTRAN 66 - ANSI X3.9-1966 ISO 1539-1972

APPLICATION SUPPORT

XCOFF (EXPANDED COMMON OBJECT FILE FORMAT)

Object format supporting run time linking of object modules. Application can dynamically link to shared libraries at run time as well as dynamically loading executable modules.

DEBUGGERS - dbx, for application source code
XDE is provided as an X-windows interface for viewing process and provides windows for issuing dbx commands
kdbx, for kernel debug on a running system

LIBRARIES - Math which provides trigonometric, Bessel, hyperbolic and other miscellaneous floating point functions and arithmetic functions on integers of arbitrary length
ESSL (Engineering Scientific Subroutines Library)

EDITORS & UTILITIES - vi, sed ed
SGU (Software Generation Utilities) tools for building programs on the system

LANGUAGES - ANSI C & ASSEMBLER (shipped in product), VS FORTRAN, COBOL, AWK

ON LINE DOCUMENTATION - Pre-formatted information on system calls, user commands C library subroutines, file format, special files and system management commands

AIX/ESA VERSION 2 RELEASE 1 STATEMENTS OF DIRECTION (SOD)

- A SECOND RELEASE OF AIX/ESA BUILD UPON THE FIRST RELEASE WITH A
  - >2GB FILE SYSTEM
  - DATA STRIPING &
  - ASYNCHRONOUS I/O
- ENHANCED USABILITY AND PERFORMANCE FOR AIX/ESA USER CONNECTED THROUGH A CHANNEL OR LAN ATTACHED RS/6000

- OSF DISTRIBUTED COMPUTING ENVIRONMENT (DCE)
- IMPLEMENT OPEN SYSTEMS INTERCONNECT (OSI)
- INTENTION TO COMPLY WITH IEEE STANDARD 1003.1-1990 POSIX.1

- PROVIDE SUPPORT FOR THE IBM 3990 EXTENDED FUNCTIONS OF DUAL COPY AND DASD FAST WRITE
- PROVIDE ACCESS CONTROL LISTS (ACLs) FOR FILE SYSTEM AND SYSTEM V IPC OBJECTS
- DoD B1 LEVEL OF SECURITY IN A FUTURE RELEASE
- SUPPORT MULTIBYTE CHARACTER SET (MBCS) FOR ASIAN LANGUAGES
- SUPPORT OF THE IBM 9570 DISK ARRAY SUBSYSTEM IN A FUTURE RELEASE

AIX/ESA OSF/1 DIRECTIONS

APPLICATION ENABLERS

- Solutions Guide - ISV Applications
- High Perf. Build tool
- RDBM

PROGRAMMING INTERFACES

- ESSL
- FORTRAN
- Cobol
- Pascal
- Assembler
- ADA
- C++
- DWB
- C
- Debuggers: Kdbx, XDE

USER INTERFACE

- X-Window 11.4
- Motif 1.1
- International-ization
- NLS
- Shell Support
  - Bourne
  - C
  - Korn
- DXI Desktop

DISTRIBUTED PROCESS

- DCE
- SMS
- DME
- TMS
- NFS
- NCS
- MPP

COMMUNICATIONS SUPPORT

- IBM 3172
- BTI
- HYPERCHANNEL
- OPENCONNECT (MITEK)
- TCP/IP 4.3
- NFS 4.0
- ASCII TERM. SUPT
- X.25
- Internet Protocals
- FDDI
- Streams
- XTI
- Sockets
- Ethernet
- Token Ring
- SNMP
- OSI
- Ultranet
- Channel to Channel

BASE SYSTEM

- MP
- Large Print Capacity
- Native
- Virtual Mem.
- Scheduler
- IEEE 1003.1 (POSIX)
- XPG/3
- Hardware Exploitation (ES/9000, Vector, ESCON)
- Security (C2 --> B1)
- ASYNC I/O
- Device Support Facility
- Mach-IPC
- BSD 4.4
- HiPPI
- LVM
- X/Store
- Sys V.3
- AIX/370 FS
- VFS
- IOCP
- Kerberos
- EREP

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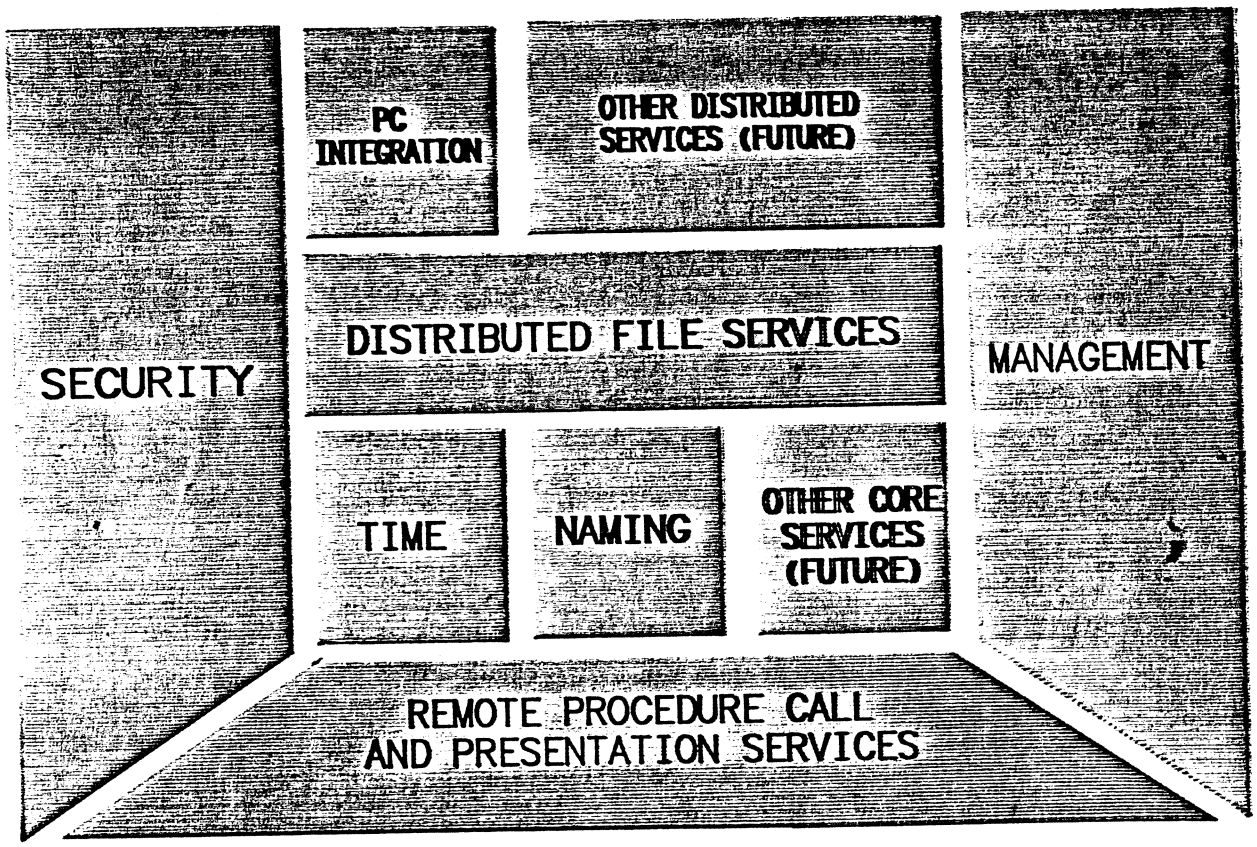
DCE ARCHITECTURE



AIX

AIX/ESA Summary

- Based on OSF/1 with IBM extensions
- Offers native S/390 UNIX capability
- Scaled for large systems
- Provides enhanced reliability and systems management
- Demonstrates IBM commitment to Open Systems standards

My experience porting MVS applications to AIX/ESA

Rich Ferri

IBM CORPORATION
Kingston NY

November / 1992

Contents

AGENDA

- Previous Ports
- Logistics of the ports
- Approach
- The LIST method
  - Linkage
  - Interface
  - Service call
  - Translation
- Wrinkles in the approach
- Cookbook
- Walk Through

- We've ported 3 major MVS applications to AIX/ESA
  - EREP (Environmental Record and Editing Program)
  - ICKDSF (ICK Device Support Facility)
  - IOCP (I/O Configuration Program)
- In total, we wrote 10 KLOC of C, Assembler and Assembler macros to port 700 KLOC of code
- ICKDSF required a new disk device driver, not included in the 10 KLOC

- All the porting work was done under VM/CMS

- The MVS code was moved over to CMS and assembled using HASMX

  - HASMX is an IBM internal program

  - This presentation does not constitute a commitment to provide HASMX outside of IBM

  - HASMX is HASM with XCOFF support added

  - XCOFF -- Extended Common Object File Format used by AIX/ESA object files

  - HASMX has an excellent track record to date

- The MVS application macros were moved from MVS to CMS and into maclibs

- We would wrap an overcoat of code around the MVS application
- The overcoat would insulate the MVS portion of the application from AIX
- The overcoat would intercept any requests for service from the application
- The overcoat would map requests for MVS services into requests for AIX services
- The idea of a "bi-modal" application was born -- an application that sometimes ran in MVS mode, other times in AIX mode

There are four major areas where an application becomes "operating system specific":

- Linkage (The AIX stack versus the MVS save area)
- Interface (MVS uses JCL, AIX has nothing similar)
- System services (MVS macro mapping into AIX services)
- Translation (The EBCDIC versus ASCII dilemma)

- The application via the user interface routine in AIX linkage mode
- The user interface invokes the "glue" routine (still in AIX mode)
- The glue routine provides an MVS style save area and invokes the MVS application
- Under MVS, the first save area is provided by MVS itself
- The MVS application continues using the MVS save area until a system service is required
- More glue to switch between MVS and AIX linkages, invoke the AIX service
- Upon exit of the MVS application, the MVS save area is replaced by the AIX stack

- MVS applications use JCL to select devices and files

- AIX has nothing similar to JCL

- A new interface application is written, in C, to direct the application to particular files, syntax check, etc.

- Example:

  under MVS:

```
// EXEC PGM IFCEREP1
//HISTORY DD DSN=HISTORY.FILE
//TOURIST DD DSN=TOURIST.FILE
```

  under AIX:

```
erep -h history.file -t tourist.file
```

- We wrote a maclib on CMS that had entries for all the MVS system macros that EREP called
- The CMS macros called AIX services in place of the MVS services
- The CMS macros mapped all MVS parameters into AIX style parameters
- Linkage had to be considered
- We assembled the MVS applications using the CMS maclib
- We simulated all necessary MVS control blocks (e.g. DCB)

- The MVS applications used EBCDIC strings
- HASMX can generate either EBCDIC or ASCII strings
- Generating ASCII strings would destroy data portability
- The MVS application could behave differently if ASCII strings were used
- We decided to generate EBCDIC strings. The READ and WRITE macros decided whether translation to ASCII was necessary when executing under AIX.

Wrinkles in the approach

- EREP is a 24 bit application running on AIX, a 31 bit operating system.
- EREP uses the leftmost 8 bits of a 32 bit address field for flags
- AIX uses the right 31 bits of an address field
- Bi-modal addressing in the application
  - Had to change address modes depending on whether the application was in MVS or AIX mode
  - Set the address mode via the BSM (Branch and Set Mode) instruction
  - In 24 bit mode, the application could not reference above the 16 megabyte boundary
  - Dynamically loaded modules are loaded above 16 meg
  - We statically bound all objects, even the dynamic ones
  - When a LOAD was invoked, we returned the address of the statically bound object

- Move the MVS application macros from MVS to CMS and create maclibs
- Move the MVS application source from MVS to CMS
- Search the MVS applications for references to MVS macros
- Write CMS macros for each MVS system macro
  - The CMS macros are stubs that invoke AIX service routines
- Write the AIX service routines that simulate MVS system calls
- Run the code through HASMX, referencing the new maclib and the MVS application maclib
- Move the .o (object or text files) over to AIX
- Write a new C user interface to replace JCL, and a "glue" routine to change linkage.
- Bind the User interface with the objects
- Execute the ported application

- The AIX application is invoked (31 bit mode, AIX linkage)
- The glue routine changes to 24 bit mode, MVS linkage
- The glue routine invokes the MVS application
- The MVS application remains in 24 bit mode, MVS linkage until exit or a service is required
- If a service is required:
  - The service routine changes to 31 bit mode, AIX linkage
  - The service routine maps MVS parms to AIX parms
  - The AIX service is invoked
  - The service routine returns to 24 bit mode, MVS linkage, and returns to the MVS application

- HASMX supports XCOFF objects (Extended Common Object File Format), used by AIX/ESA

- HASMX will optionally generate ASCII character codes

- Additional sections support
  - read-only sections
  - initialized data areas
  - uninitialized data areas

- HASMX, like HASM, provides OPSYN support to redefine op codes