

# iSeries

# Integrated File System Technology

**Tom McBride**  
**mcbride@us.ibm.com**

*8 Copyright IBM Corporation, 2003. All Rights Reserved.  
This publication may refer to products that are not currently  
available in your country. IBM makes no commitment to make  
available any products referred to herein.*

# ***Integrated File System Technology***

## ***Contents***

**Overview**

**File Systems**

**Ways to Access Data**

**Useful Features**

**\*TYPE2 Directories**

**V5R1 Goodies**

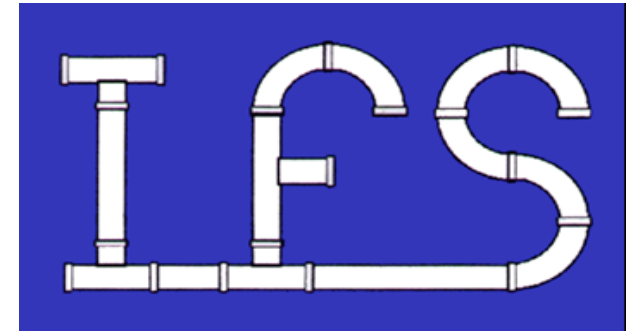
**V5R2 Goodies**

# Overview

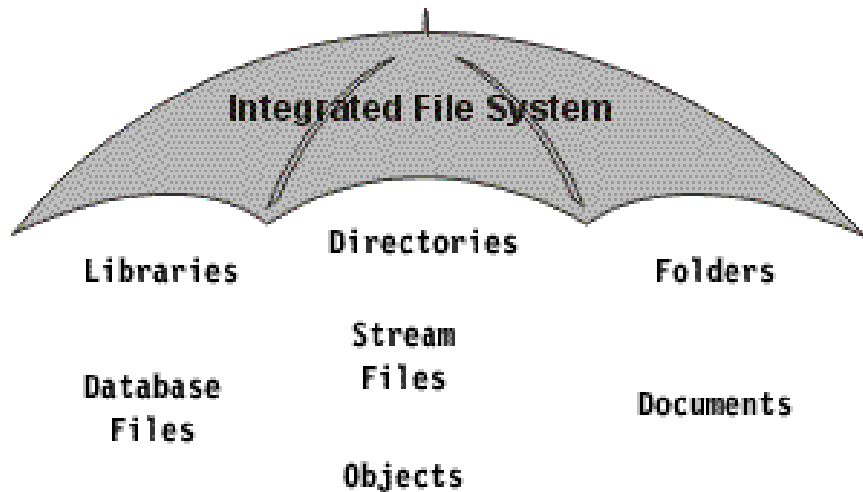
# The Integrated File System

What is it?

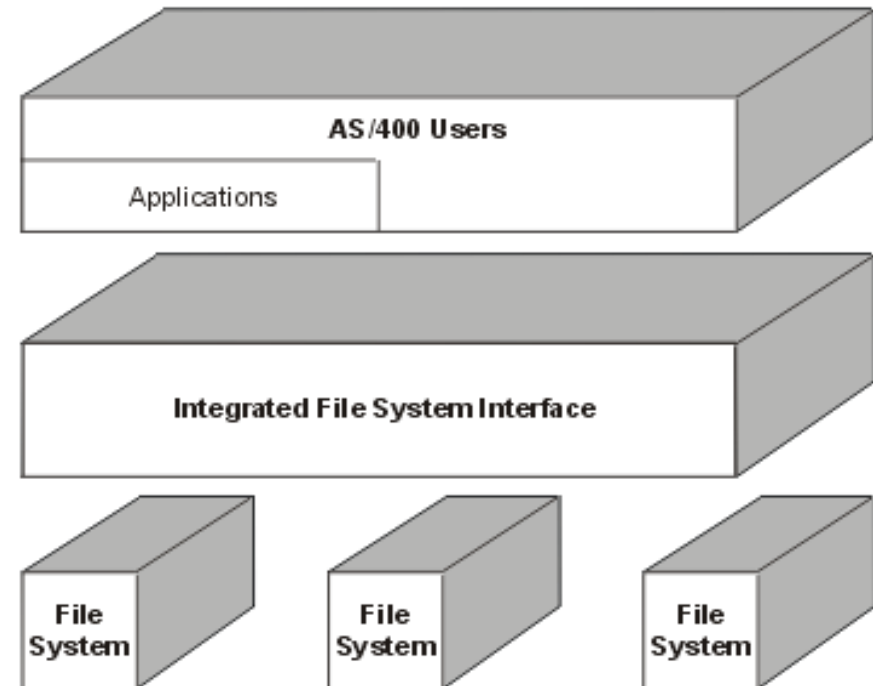
Think **"Plumbing"** ...  
**Industrial Strength Plumbing!!!**



Common interface to data on iSeries

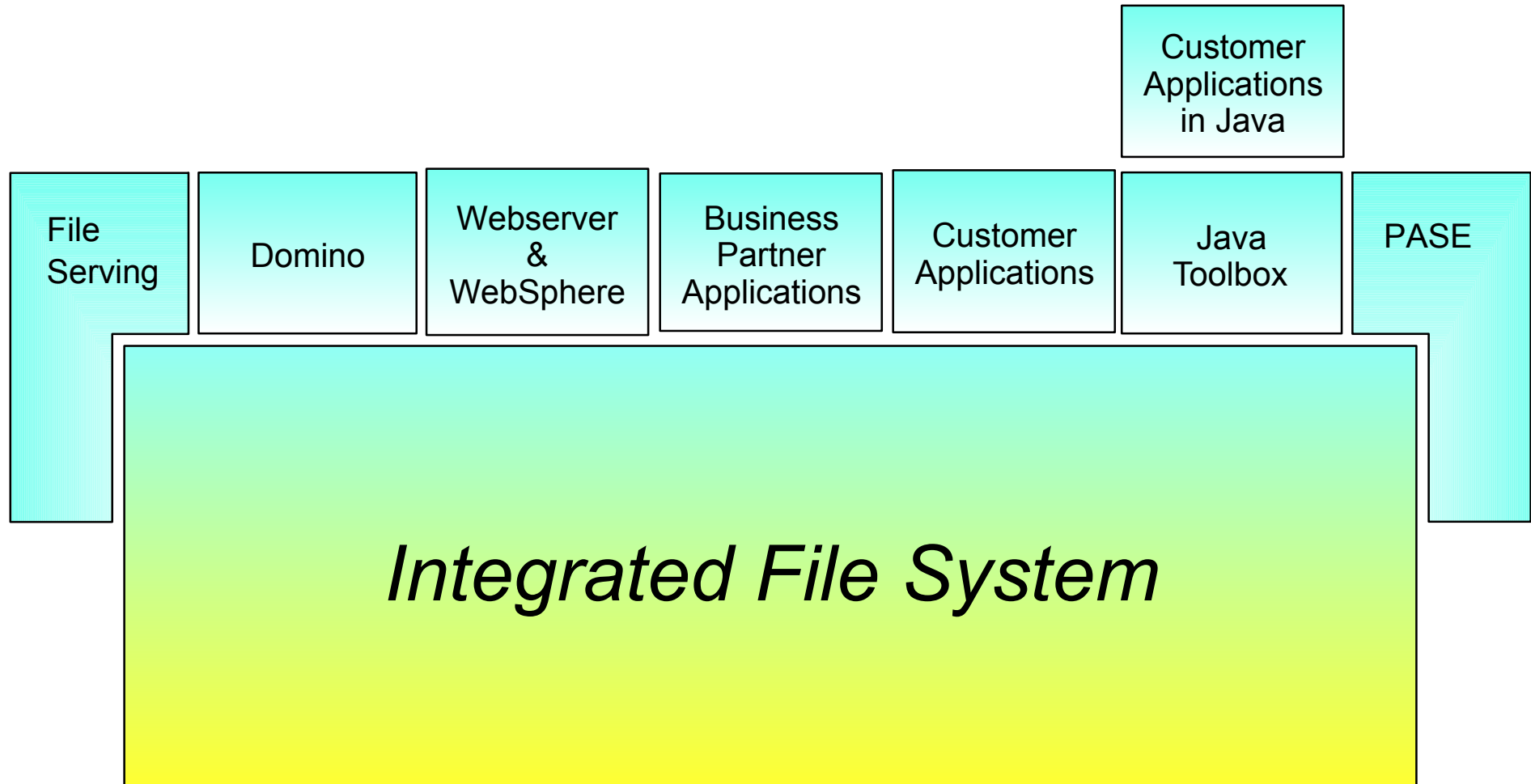


Integrates File Systems



# The Integrated File System

Who / What Uses It?

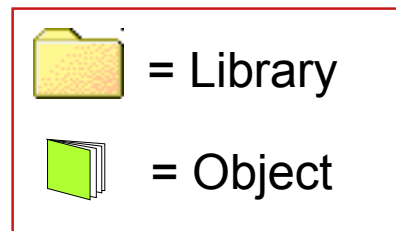
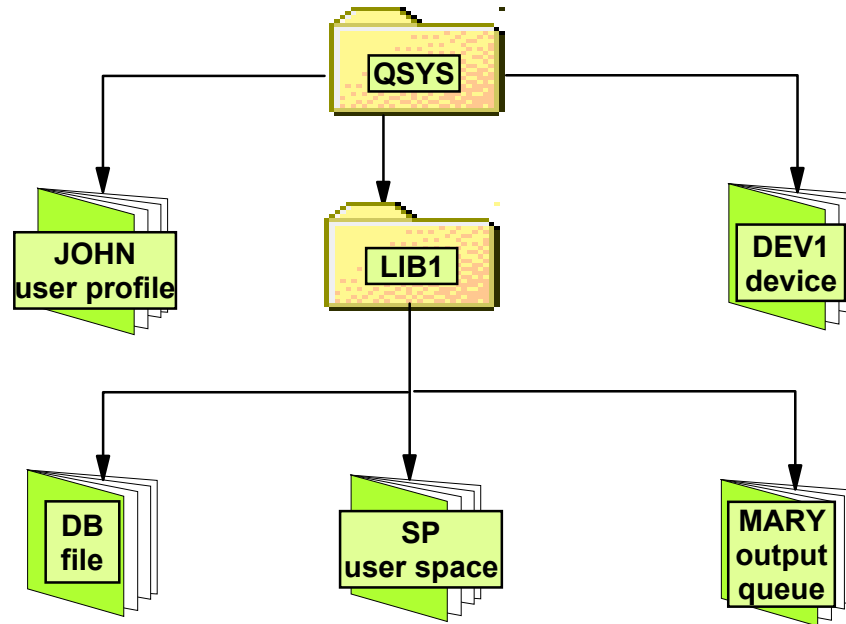


# *File Systems*

# File Systems

In the beginning, before the Integrated File System, there were...

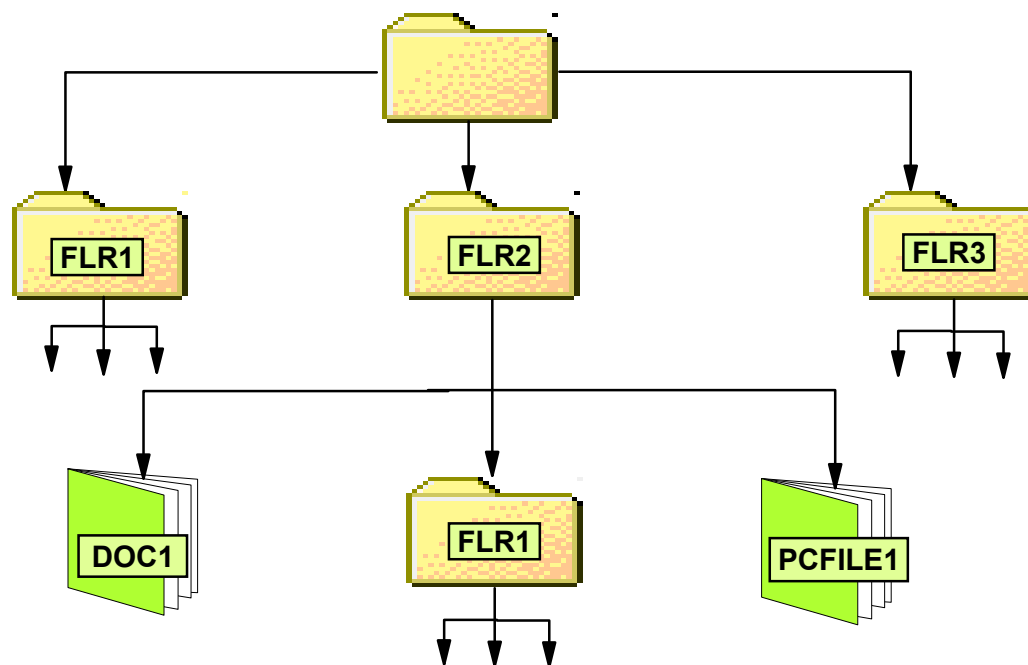
## Libraries and Objects





# File Systems

In the beginning, before the Integrated File System, there were...

## Folders and Documents

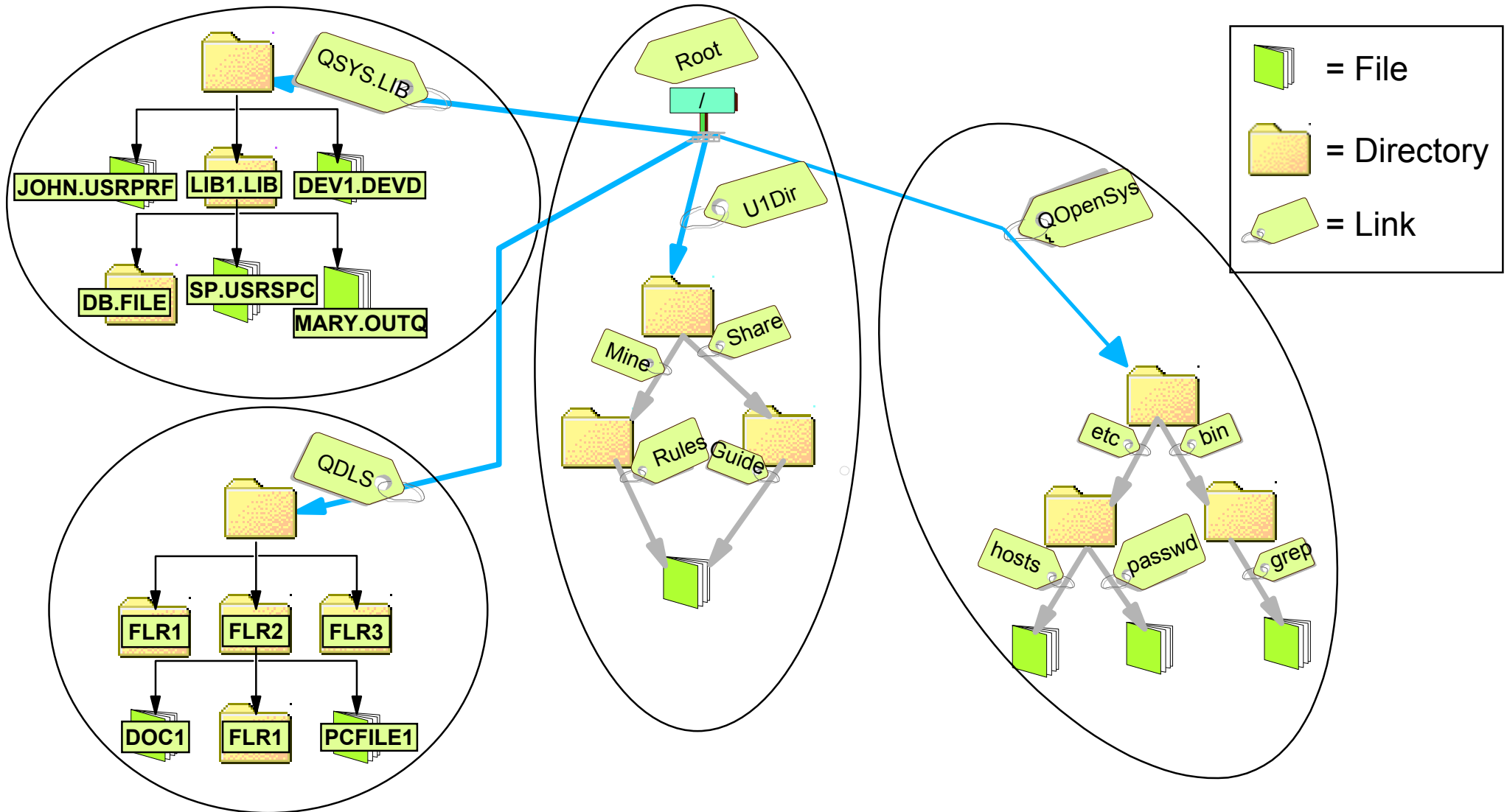


 = Folder  
 = Document



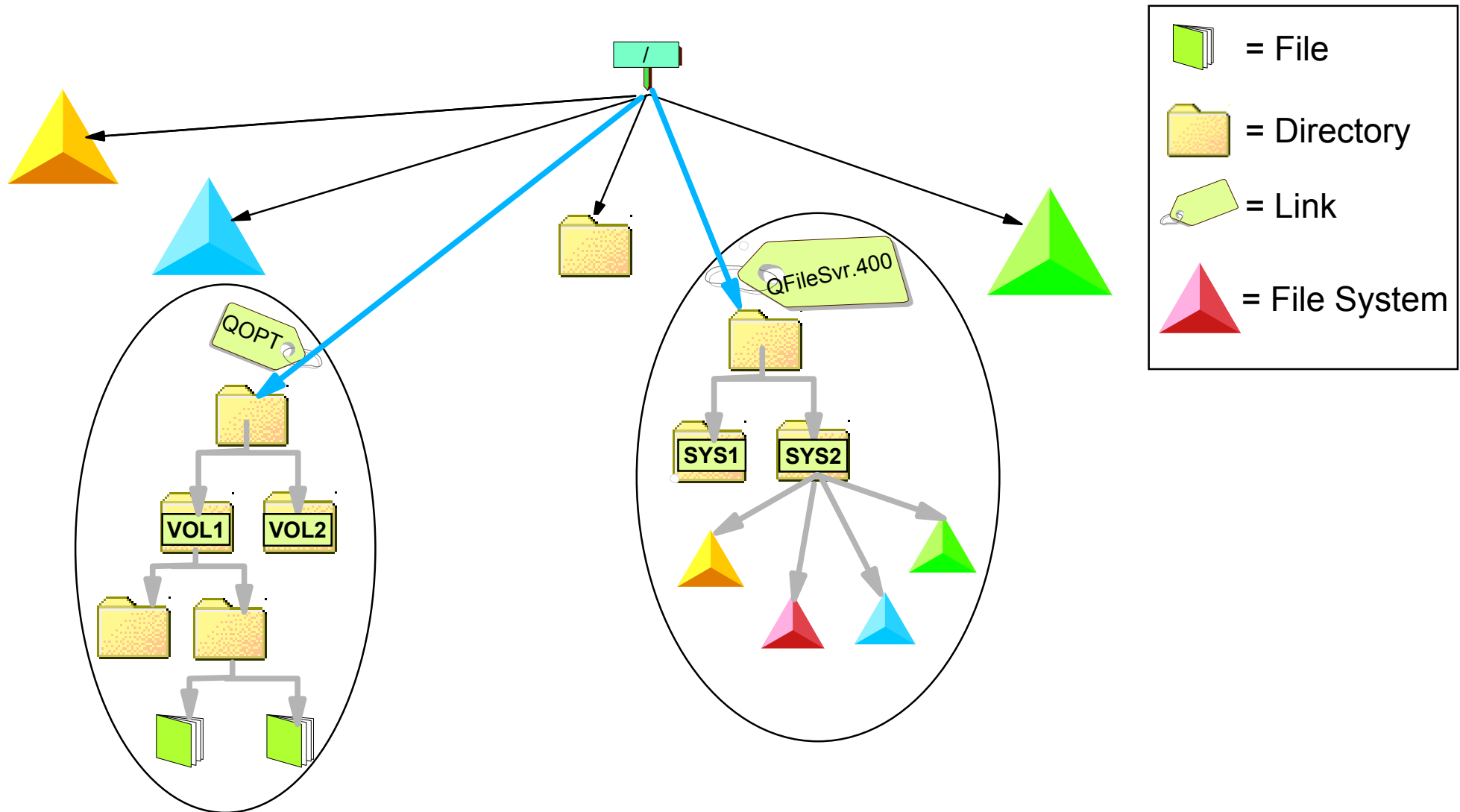
# Then, the Integrated File System was born

Root & QOpenSys file systems integrated with QSYS.LIB & QDLS file systems



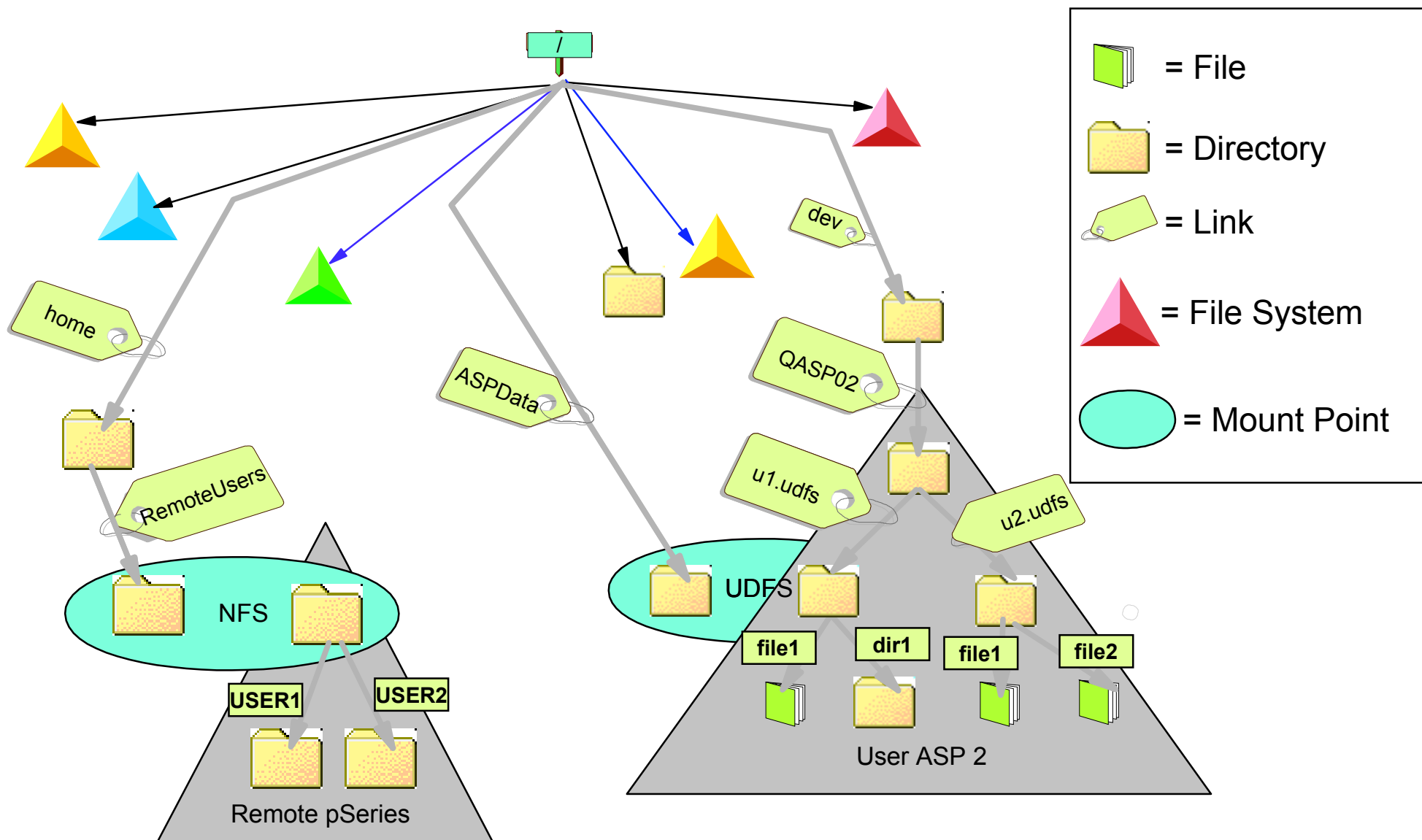
# And, more file systems were added...

Optical data access (QOPT) and Remote iSeries access (QFileSvr.400)



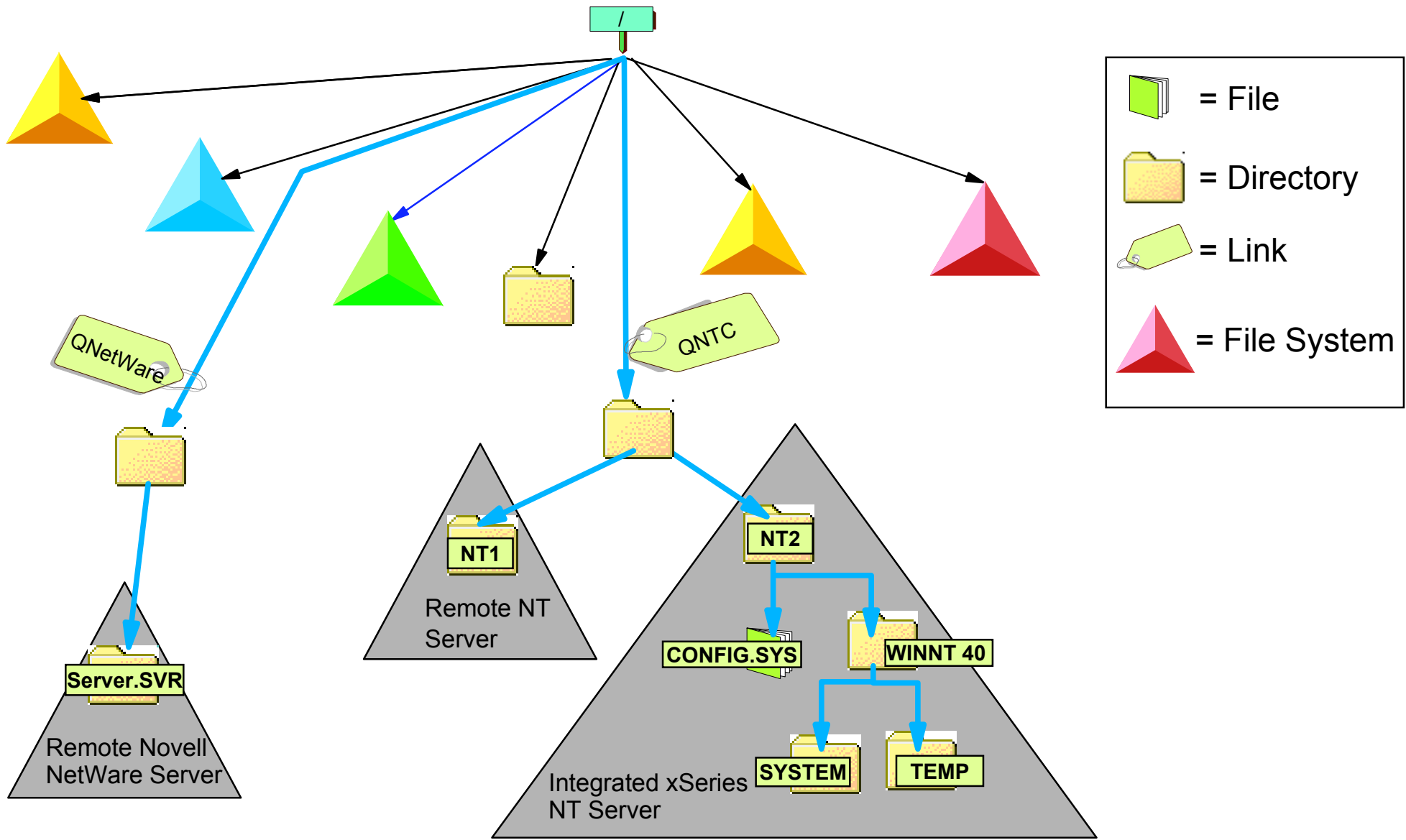
# And, mountable file systems were added...

Network File System (NFS) and User-defined File Systems (UDFS)



# And, more remote server access was added...

## Novell NetWare (QNetWare) and NT Client File Systems





# *Ways to Access Data*

## Ways to Access Data Using the Integrated File System

- **PC client**
  - iSeries NetServer
  - iSeries Access
  - iSeries Navigator
- **PASE, JAVA Toolbox applications**
- **Traditional OS/400 applications (ILE C/C++, RPG, COBOL, CL)**
- **Remote systems**
  - OS/400 File Server (QFileSvr.400)
  - QNetWare
  - Network File System (NFS)
  - QNTC



*All ways come through the IFS*

## Ways to Access Data Using the Integrated File System

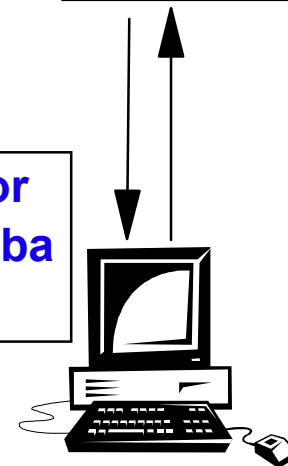
### PC File Sharing using iSeries NetServer\*

- Built into base OS/400 server and Microsoft Windows 98, NT, 2000, Me, XP (V5R2), and Linux/Samba (V5R1 w/PTFs) clients
- A TCP/IP server
  - Found in the InfoCenter at *Networking > TCP/IP*
- Selectively shares integrated file system directories and OS/400 output queues with network clients
  - Read/write or read-only access
  - More secure
- Configurable text data conversion
- A Domain logon controller
- Single sign-on data access (Kerberos v5 authentication) (V5R2)
- Can specify subsystems for server jobs based on client (V5R2)



iSeries  
NetServer

Windows or  
Linux/Samba  
Client



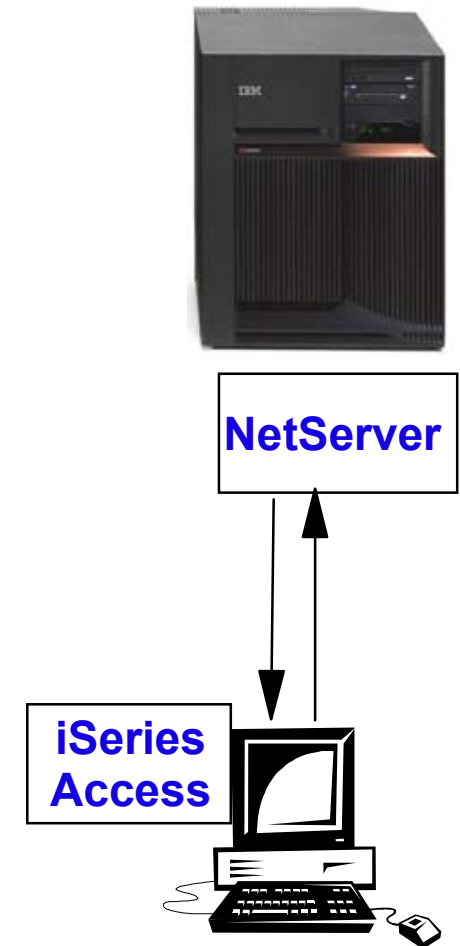
\* iSeries Support for Windows Network Neighborhood



# Ways to Access Data Using the Integrated File System

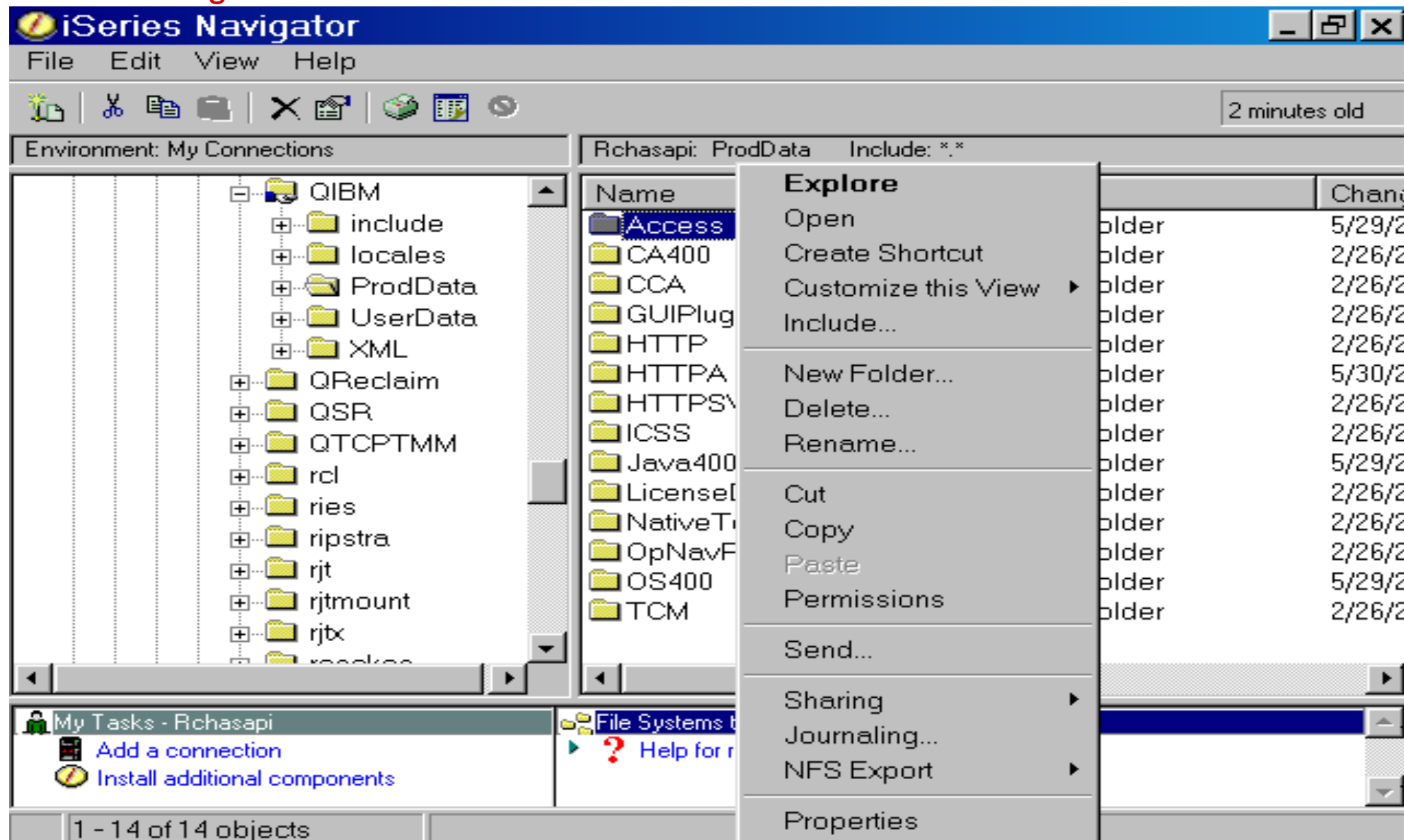
## PC File Sharing using iSeries Access

- THE solution for PC, Web browser, or wireless connectivity to iSeries server
- Provides THE primary interface for managing the integrated file system through iSeries Navigator
  - **iSeries Navigator** uses the OS/400 File Server for management access
- **iSeries Access** is required on PC client
- Uses iSeries NetServer for install, service, file serving and print sharing
- Also provides terminal emulation, Data Transfer, Management Central, Operations Console, Programmer's Toolkit, ODBC, and more
- Found in the InfoCenter at *Connecting to iSeries > What to connect with > iSeries Access*



# Ways to Access Data Using the Integrated File System

## iSeries Navigator - Your interface to the IFS



# Ways to Access Data Using the Integrated File System

## The "Green Screen" (WRKLNK)

```

Work with Object Links

Directory . . . . : /QIBM/ProdData

Type options, press Enter.
  2=Edit   3=Copy   4=Remove   5=Display   7=Rename   8=Display attributes
 11=Change current directory ...

Opt  Object link      Type      Attribute      Text
---  -
  1  Access           DIR
  2  CA400            DIR
  3  CCA              DIR
  4  GUIPlugin       DIR
  5  HTTP             DIR
  6  HTTPPA          DIR
  7  HTTPSVR        DIR
  8  ICSS            DIR
  9  Java400         DIR

More...

Parameters or command
===>
F3=Exit   F4=Prompt   F5=Refresh   F9=Retrieve   F12=Cancel   F17=Position to
F22=Display entire field   F23=More options
    
```



# Ways to Access Data Using the Integrated File System

## Portable Applications Solutions Environment (PASE)

- Allows you to port AIX applications to the iSeries server with minimal effort
- Provides an integrated runtime environment that allows you to run UNIX applications without the complexity of managing a UNIX system
- Uses the **integrated file system** for data access
- Found in the InfoCenter at  
*Integrated Operating Environments > OS/400 PASE*

# Ways to Access Data Using the Integrated File System

## IBM Toolbox for Java

- Shipped with iSeries Access for Windows
- Provides Java classes for accessing iSeries resources
  - ▶ including the **integrated file system**
- Uses the iSeries Access for Windows Host Servers as access points to the system
- Found in the InfoCenter at  
*Programming > Java > IBM Toolbox for Java*

# Ways to Access Data Using the Integrated File System

## Traditional OS/400 Applications

### ILE APIs

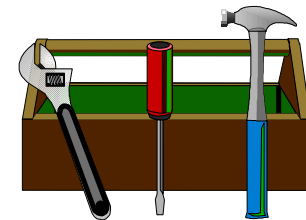
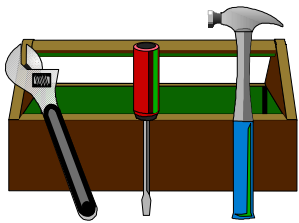
- Integrated file system APIs
  - ▶ open(), read(), write(), close() ...
- C / C++ runtime functions
  - ▶ fopen(), fread(), fwrite(), fclose() ...
- Available to ILE languages
  - ▶ C / C++
  - ▶ COBOL
  - ▶ RPG

### CL Commands

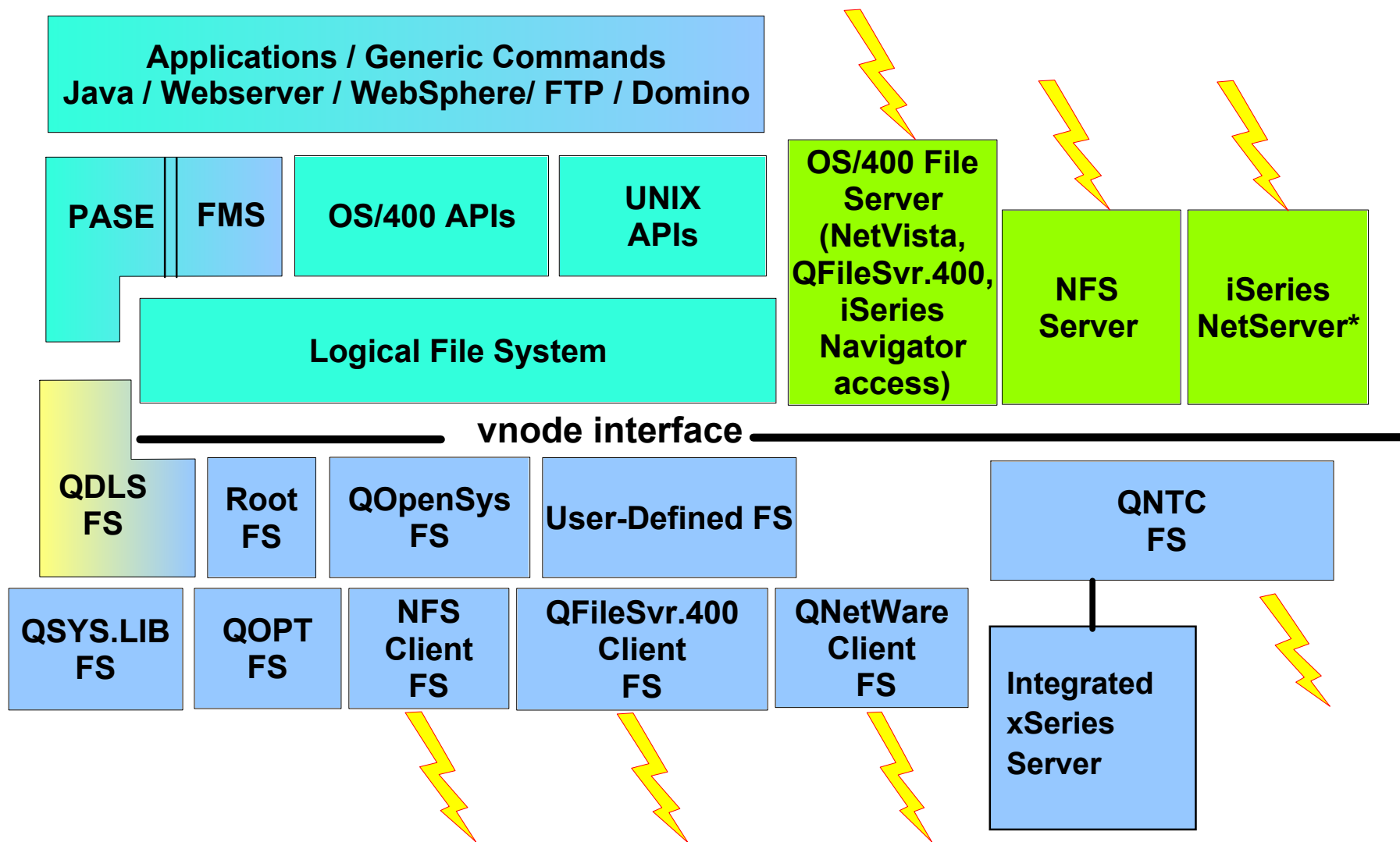
- WRKLNK / DSPLNK
- EDTF / DSPF
- CRTDIR / RMVDIR
- ADDLNK / RMVLNK
- CHGATR / CHGAUT / CHGOWN
- CPY / MOV
- Wildcard support

### More Information...

- ▶ Information Center >
  - File Systems and Management >
  - Integrated File System >
  - Tasks >
  - Access the Integrated File System >
  - Using CL Commands or Using APIs



# Under Your Kitchen Sink: The Plumbing



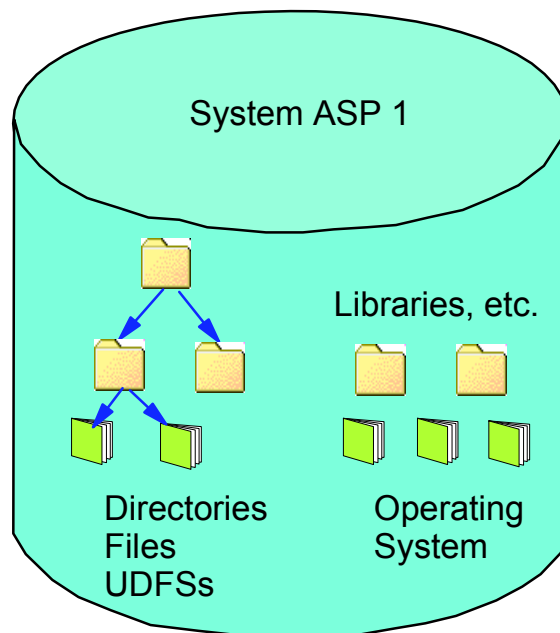
\*iSeries Support for Windows Network Neighborhood

# *Useful Features*



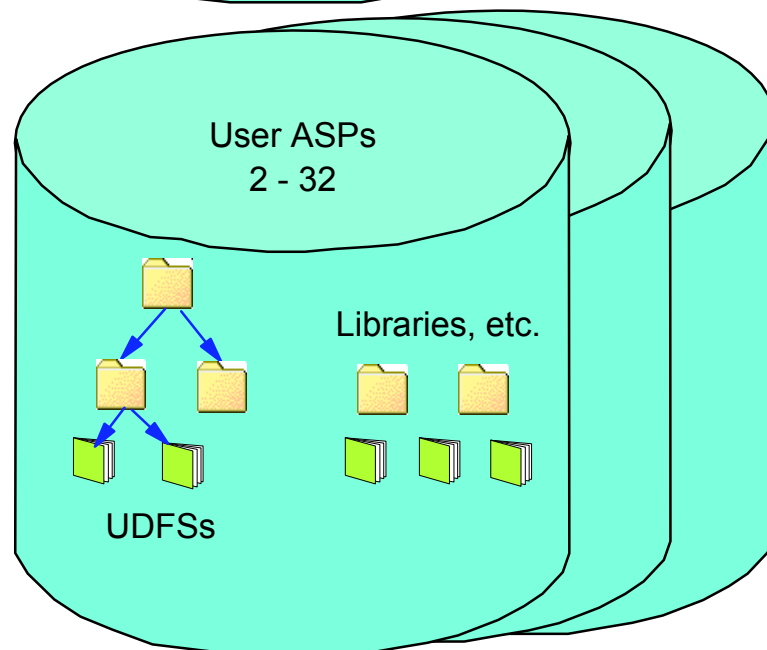
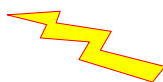
# Useful Features

## User ASPs



## System ASP

- Number 1
- Multiple disk units
- Always exists
- Contains operating system and user data

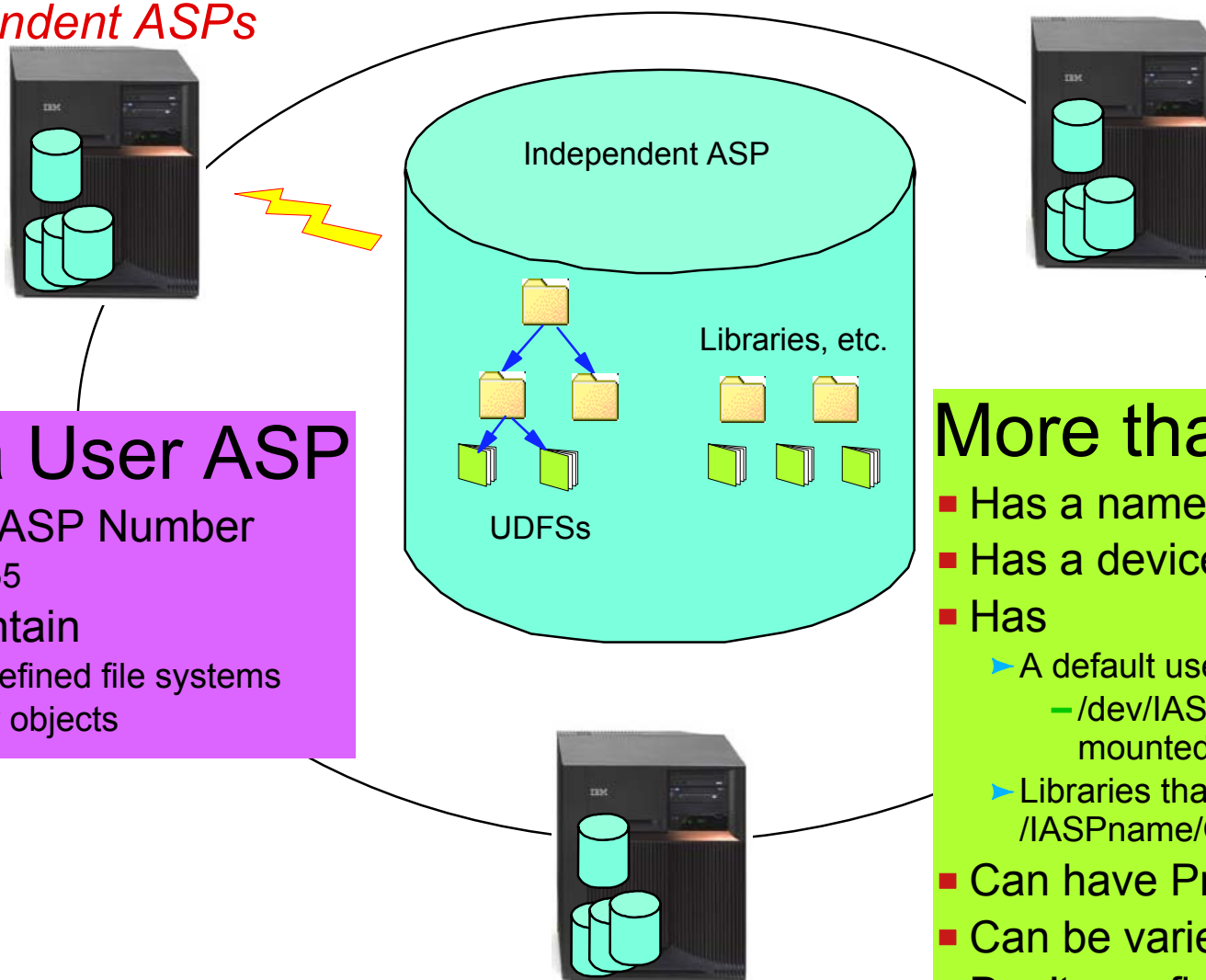


## User ASPs

- Numbers 2 - 32
- One or more disk units
- Optional
- Contains Libraries and UDFSs
- Can overflow into system ASP

# Useful Features

## Independent ASPs



### Like a User ASP

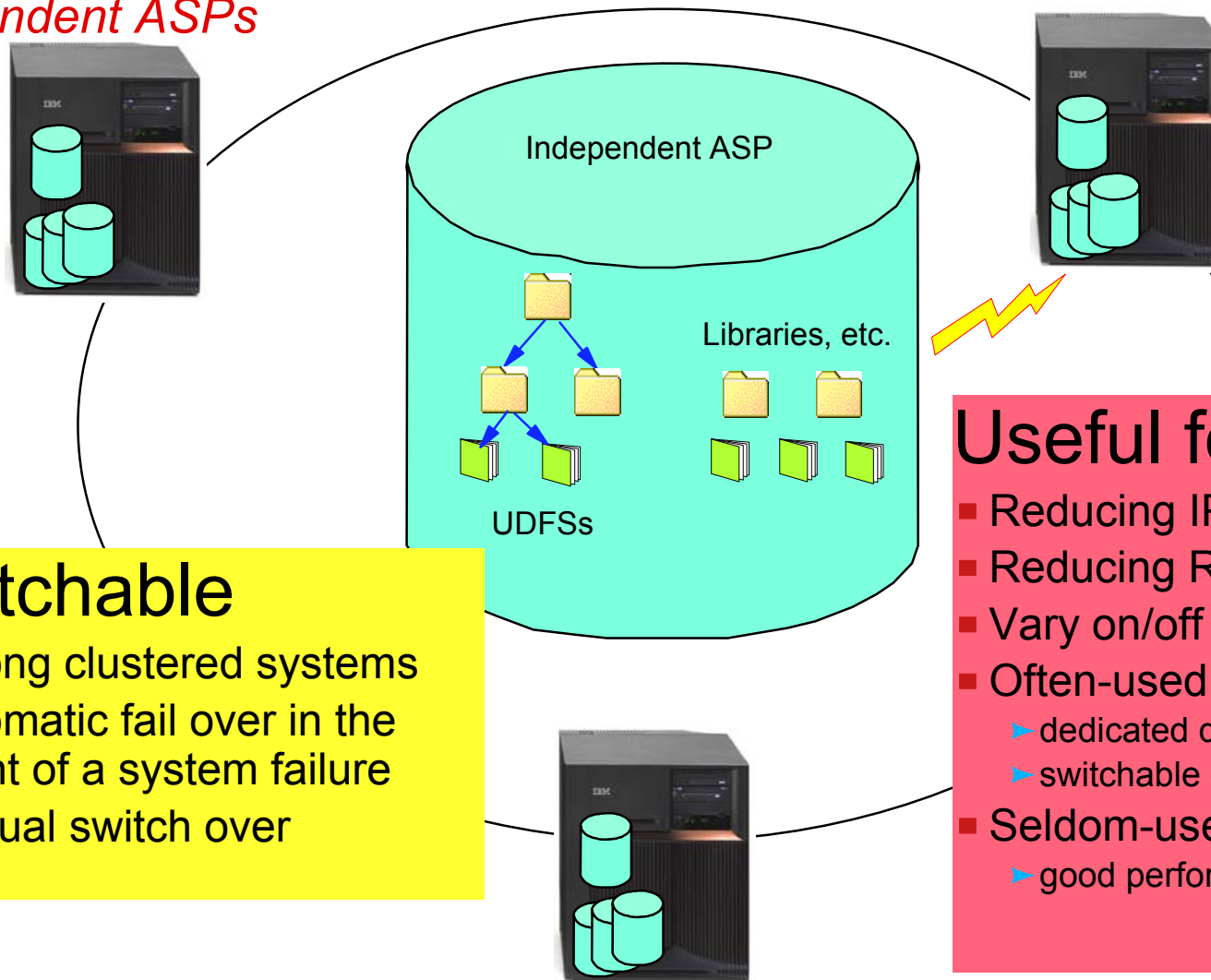
- Has an ASP Number
  - ▶ 33 - 255
- Can contain
  - ▶ User-defined file systems
  - ▶ Library objects

### More than a User ASP

- Has a name
- Has a device description
- Has
  - ▶ A default user-defined file system
    - /dev/IASPname/QDEFAULT.UDFS is mounted at /IASPname
  - ▶ Libraries that are mounted at /IASPname/QSYS.LIB
- Can have Primary & Secondary
- Can be varied on and off
- Don't overflow to system ASP
- Can be reclaimed in parallel (RCLSTG) without restricted state

# Useful Features

## Independent ASPs



### Switchable

- Among clustered systems
- Automatic fail over in the event of a system failure
- Manual switch over

### Useful for

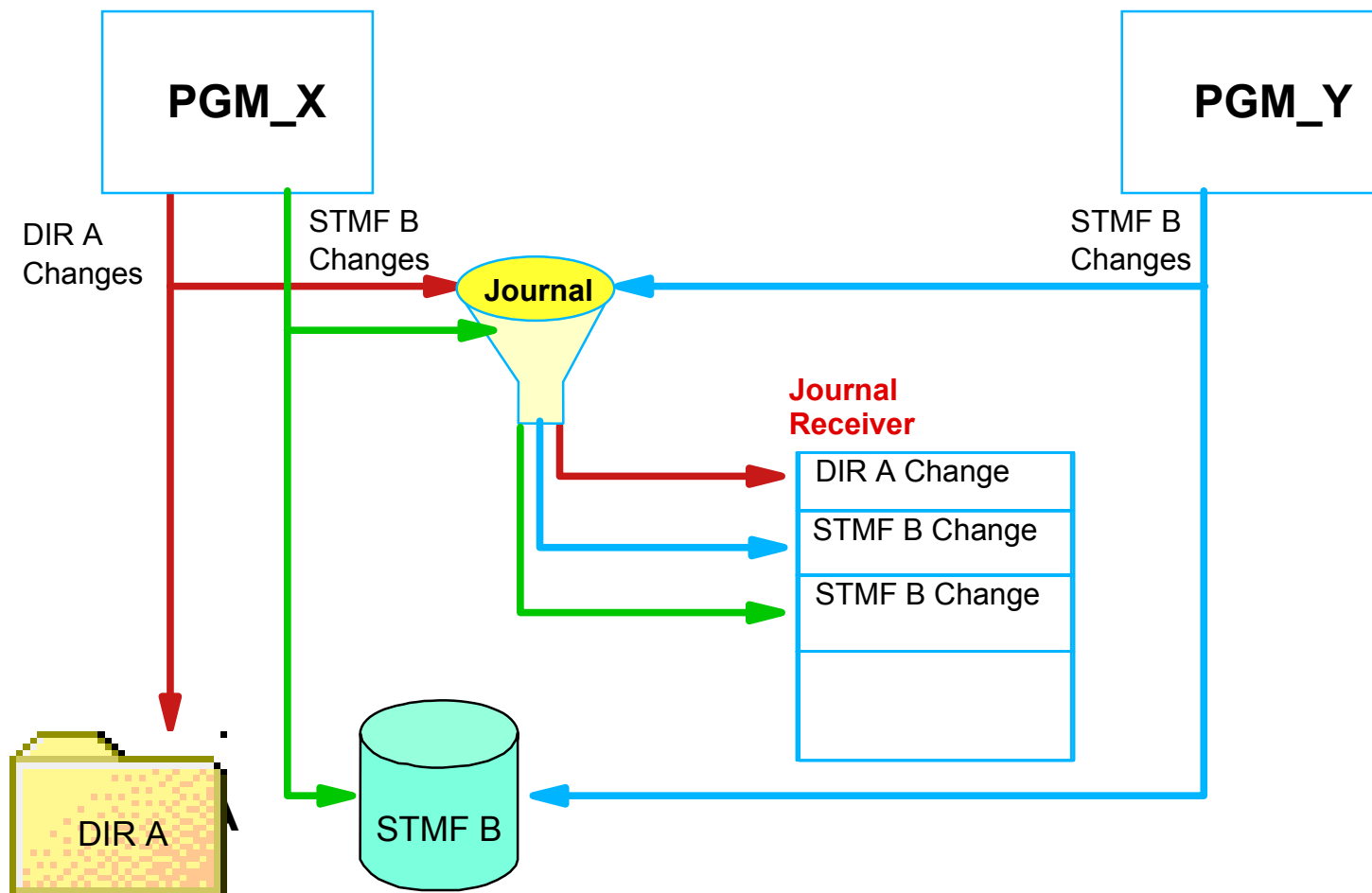
- Reducing IPL time
- Reducing RCLSTG time
- Vary on/off as needed
- Often-used data
  - ▶ dedicated disks - better performance
  - ▶ switchable - high availability
- Seldom-used data
  - ▶ good performance compared to tape

Found in the InfoCenter at *Systems Management > Disk Management > Independent Disk Pools*

## Useful Features

### Journaling

- Works in the Root, QOpenSys, User-defined file systems
- Works on directories, stream files, symbolic links (plus database files, data areas, and data queues)



## Useful Features

### Journaling - Advantages

## Crash Recovery

- Automatic recovery after system crash
- In-flight changes are completed or backed out
- No need to restore last saved version after the crash

## Single Object Recovery

- Recover a saved object to a known state
- Recovers from application or disk failure, or site disaster

## Reduce Backup Time and Volume

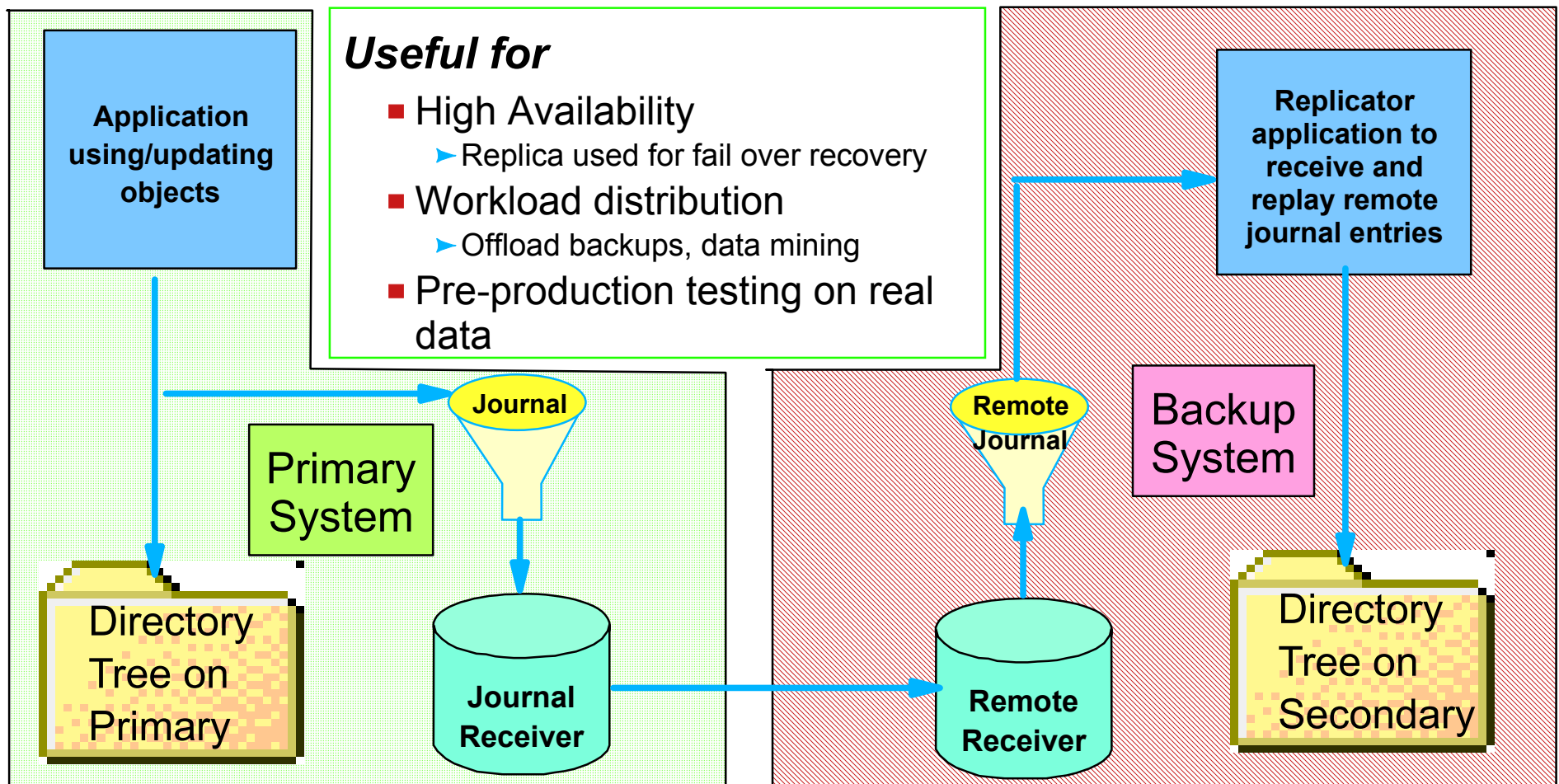
- Save objects weekly
- Save journal receivers daily
- Less data to save

Found in InfoCenter at *File Systems and Management > Integrated File System > Concepts > Journaling support for integrated file system objects*

# Useful Features

## Journaling - Replication

- Transfer journal entries to the replica system's journal receiver
- Replicator application receives journal entries and applies them on the replica
- Replica can be in "standby mode" for quick startup after a fail over (V5R2)



## **Useful Features**

### ***National Language Support***

#### ***Multi-language support for IFS APIs***

- Can specify pathnames in any CCSID, language, and country

#### ***Name continuity***

- Object names can be specified or retrieved in any CCSID
- Stored in normalized form (UCS2 Level 1 or UTF-16)
- Preserves the name when accessed from systems having different CCSIDs

#### ***Automatic data conversion using IFS APIs***

- Files are tagged with CCSIDs
- Conversion occurs to and from the job CCSID or the specified CCSID

#### ***Automatic data conversion using iSeries NetServer File Shares***

- Files are tagged with CCSIDs
- Conversion occurs to and from the specified CCSID for files with specific extensions

# Useful Features

## Powerful IFS APIs

### Large-File

- Regular APIs support files up to 2 gigabytes
- Large-file APIs expand that to 256 gigabytes
- Can map existing APIs to large-file APIs, or can use large-file APIs directly
- Controlled by compile flags
- C-runtime large-file support is controlled by SYSIFCOPT(\*IFS64IO)

### Memory Mapping

- Obtain a process-local pointer to the file...access it directly for reading or writing
- Private or shared mapping
- System value QSHRMEMCTL limits write access

### Process Subtree

- Sweeps a tree, selects objects, and passes them to a user-exit function for processing
- It handles object selection and sweeping the tree...you just do your thing



## Useful Features

### Powerful IFS APIs...continued

#### *pread(), pwrite() (V5R2)*

- Most efficient way to perform random I/O
- Combines lseek() with read()/write()

#### *accessx(), faccessx(), QlgAccessx() (V5R2)*

- Determines whether an object can be accessed by a class of users in a particular way
- Classes of users include: current thread, others besides the owner, or everyone

#### *O\_SYNC, D\_SYNC, R\_SYNC (V5R2)*

- open()-specified controls over the integrity of your file's data and/or attributes
- Sync's data and attributes (O\_SYNC) or just data (D\_SYNC) on write()
- On read() too, when R\_SYNC is also specified

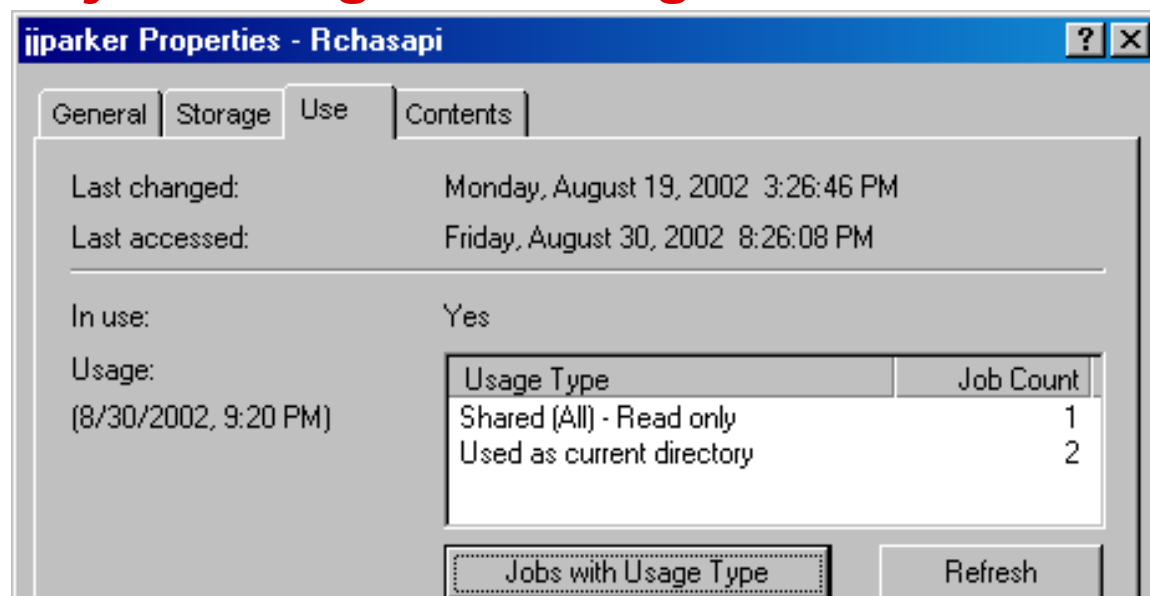
#### *Retrieve Object References (V5R2)*

- Find and show references (how many, type, jobs) to an object
- Available on iSeries Navigator Properties/Usage tab

#### *Dump Job References (V5R2)*

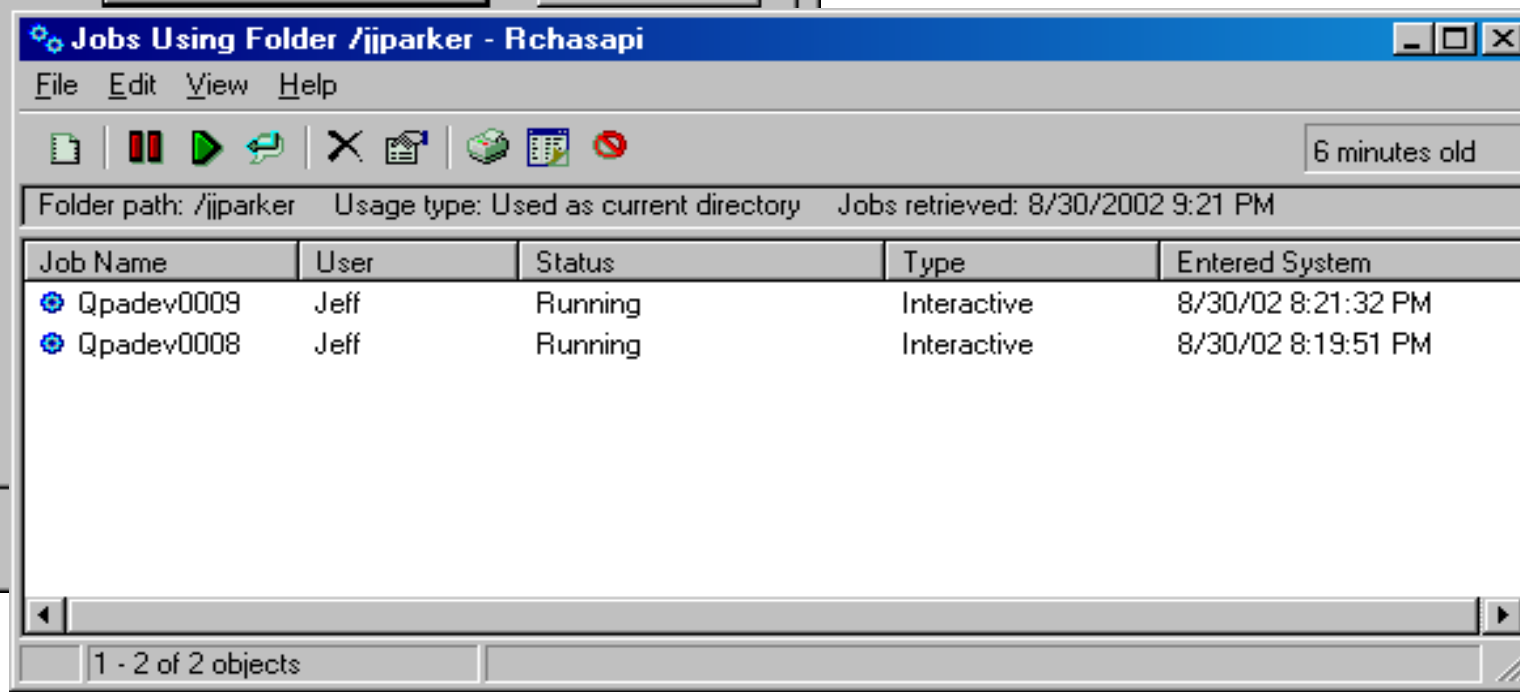
- Primitive spool file dump of IFS objects being used by a particular job
- CALL QP0FPTOS (\*DUMPLFS 'nnnnnn')

## Object Usage Tracking in iSeries Navigator (V5R2)



Shows individual object usage

- how many
- type
- jobs



# Dump Job References (V5R2)

```

api - V5R2dev
File Edit View Communication Actions Window Help

Display Spooled File
File . . . . . : QSYSPT                               Page/Line 38/31
Control . . . . : +1                               Columns 1 - 13
Find . . . . . : VNODE
*...+...1...+...2...+...3...+...4...+...5...+...6...+...7...+...8...+...9...+...0...+...1...+...2...
*** Descriptor table and File Table Data ***
Descriptor Table Address          0x0159C39B21000020
Max Number of Descriptors Allowed (size) 200
Max Number of Descriptors Allocated 13
Min Deallocated Descriptor 9
====Descriptor 0
/QIBM/UserData/OS400/MGTC/config/McConfig.properties
file EC2CB09D01 0167A0 d_tag 0x00000036 d_flags 0x08 LockScope 0x0000000F infoFlags 0x00000FA4
File table entry:
f_valid 0x00 f_type VNODE f_seekCnt 0x00000000 f_refCnt 0x00000001 f_refCntLIC 0x00000000
f_offset 0x0000000000000072 f_openFlags 0x0200080001040001 f_tag 0x00000036 f_int_flags 0x00000000
f_fops DBEB3365FE 0023F0 f_object CF294BD57A 00EC00 f_ccsid 37 underlyingObject 0xEC2CB09D010168F0
====Descriptor 1
/QIBM/UserData/OS400/MGTC/config/McConfig.properties
file EC2CB09D01 016580 d_tag 0x00000037 d_flags 0x08 LockScope 0x00000010 infoFlags 0x00000FA4
File table entry:
f_valid 0x00 f_type VNODE f_seekCnt 0x00000000 f_refCnt 0x00000001 f_refCntLIC 0x00000000
f_offset 0x0000000000000072 f_openFlags 0x0200080001040001 f_tag 0x00000037 f_int_flags 0x00000000
f_fops DBEB3365FE 0023F0 f_object CF294BD57A 00EC00 f_ccsid 37 underlyingObject 0xEC2CB09D010166D0

F3=Exit F12=Cancel F19=Left F20=Right F24=More keys
a HV 03/022
Connected to remote server/host rchasapi using port 23

```

## **Useful Features**

### **Performance Tuning (V5R2)**

#### **Disk Storage Allocation**

- Determines how disk storage is allocated for a stream file
- Normal
  - ▶ Extend the file in increasingly larger blocks to reduce I/O. May take up more disk storage than is actually used.
- Minimize
  - ▶ Allocate what is needed. Conserves disk storage, but may cause more I/O and disk fragmentation.
- Dynamic
  - ▶ Determine how to allocate disk storage based on how the file is being used.

#### **Main Storage Allocation**

- Determines how main storage is allocated as a stream file is being accessed
- Normal
  - ▶ Use as much main storage as is needed to cache what is being used to reduce I/Os.
- Minimize
  - ▶ Allocate what is needed. Conserves main storage, but may cause more I/O because less data is cached.
- Dynamic
  - ▶ Determine how to allocate main storage based on system activity and main storage contention.

#### **Changeable attributes on...**

- iSeries Navigator *Properties* > *Storage tab*
- Qp0ISetAttr() API and CHGATR command

# Useful Features

## Performance Analysis using Performance Explorer See how your application uses the IFS

### ■ Add a Performance Explorer Definition

- ▶ ADDPEXDFN DFN(IFS2) TYPE(\*TRACE) INTERVAL(200) TRCTYPE(\*SLTEVT) SLTEVT(\*YES) BASEVT((\*PMCO)) OSEVT((\*IFSOPEN) (\*IFSIO))
- ▶ Trace operating system events
- ▶ \*IFSOPEN (open, creat, close)
- ▶ \*IFSIO (read, write, dup, dup2, lseek, fcntl byte locking, ftruncate, fsync)

### ■ Start collecting data

- ▶ STRPEX SSNID(yyyyyyyy)
- ▶ Select your definition created previously

### ■ Run your application

### ■ Stop collecting data

- ▶ ENDPEX SSNID(yyyyyyyy)

### ■ Print the collected data

- ▶ PRTPEXRPT MBR(yyyyyyyy) TYPE(\*TRACE)

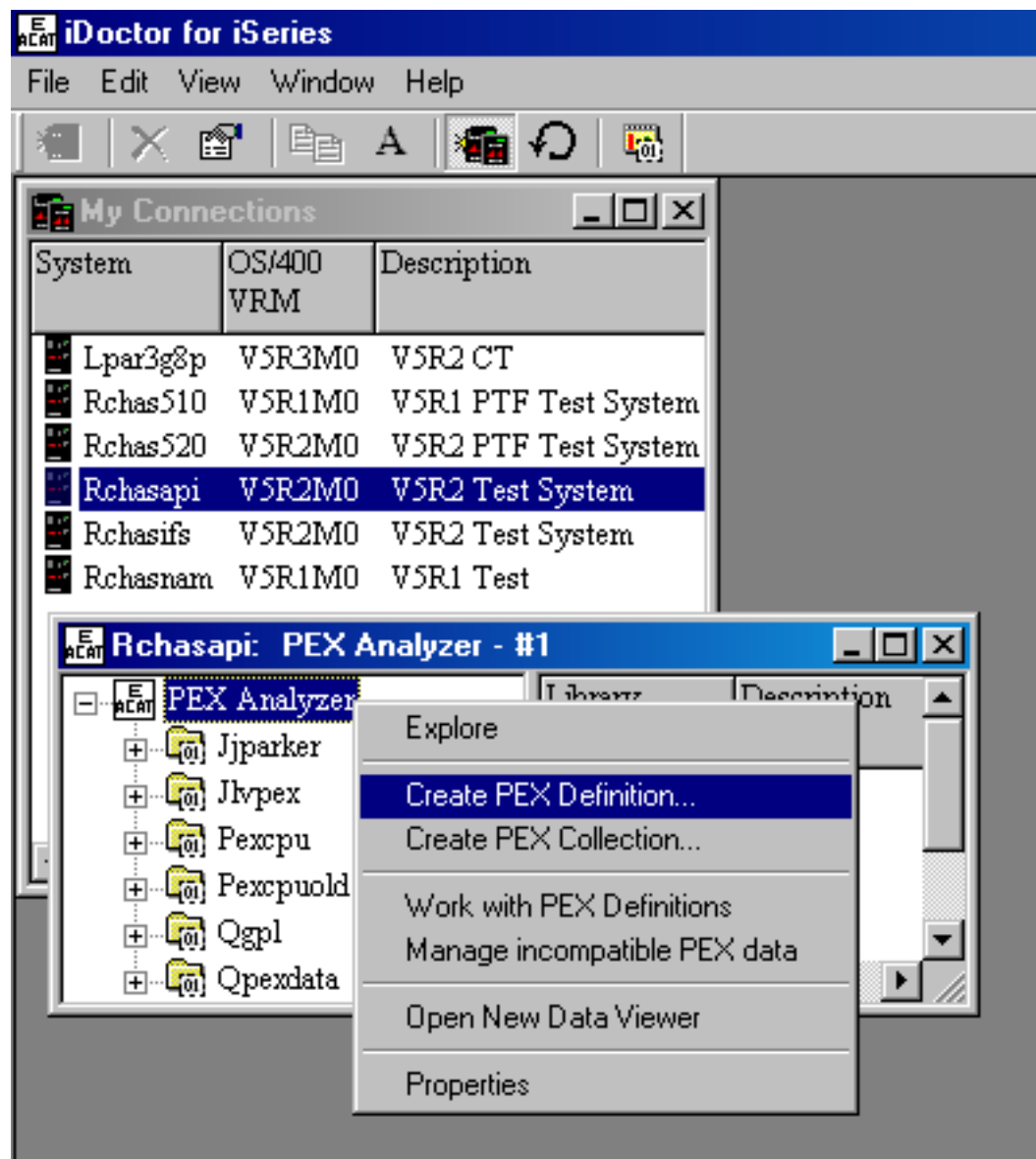
```
Event
IFSOP IFS open .....{.....ENUUS/jjparker/file3
IFSIO IFS write .....Ä...Ä.....
IFSOP IFS close .....
```

### ■ Found in the InfoCenter at Systems Management > Performance > Applications for Performance Management > Performance Explorer

## Useful Features

### Performance Analysis using iDoctor for iSeries

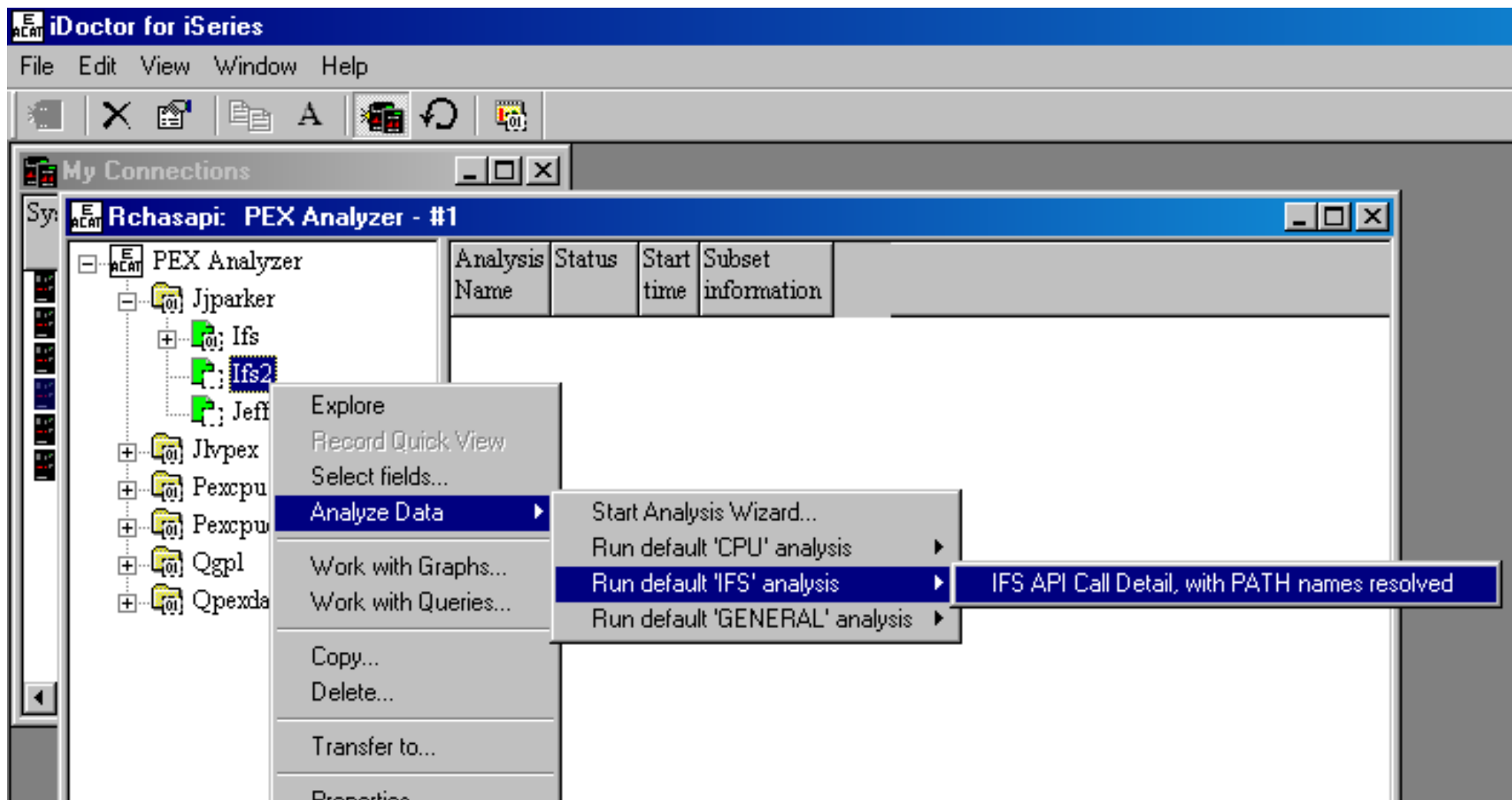
- **Found in the InfoCenter at** *Systems Management > Performance > Applications for Performance Management > iDoctor for iSeries*
- **Add a Performance Explorer Definition**
  - ▶ *Create PEX Definition*, specifying to trace IFS events
- **Start collecting data**
  - ▶ *Create PEX Collection* associated with the PEX definition
  - ▶ Automatically starts collecting
- **Run your application**
- **Stop collecting data**
  - ▶ Automatically stops after the time specified in the collection
  - ▶ Can be manually stopped by right-clicking on the collection and selecting *Stop > Create DB Files*



# Useful Features

## Performance Analysis using iDoctor for iSeries

### Run Analysis of Data



# Useful Features

## Performance Analysis using iDoctor for iSeries

### ■ Examine Results

The screenshot displays the iDoctor for iSeries interface. The 'My Connections' pane shows a tree view with 'Rchasaki: PEX Analyzer - #1' expanded to 'Jjparker', which contains sub-items 'Ifs', 'Ifs2', and 'Ifs api call detail, with pe'. The 'Data Viewer [Rchasaki] - #1' pane shows a table of 'Ifs API Call Detail' with 9 records. The table columns include IFS API File Descriptor, IFS API New File Descriptor, IFS API Requested New File Descriptor, IFS API Name, Error Number, IFS Path Name, IFS Path CCSID, IFS Path Language, IFS Path Country, Conversion Id, Number of Bytes Requested, Number of Bytes Received, and Inp Off.

IFS API File Descriptor	IFS API New File Descriptor	IFS API Requested New File Descriptor	IFS API Name	Error Number	IFS Path Name	IFS Path CCSID	IFS Path Language	IFS Path Country	Conversion Id	Number of Bytes Requested	Number of Bytes Received	Inp Off
0	0	0	open	0	/jjparker/pexfile	37	ENU	US	0	0	0	
0	0	0	write	0	/jjparker/pexfile	0			0	100	100	
0	0	0	write	0	/jjparker/pexfile	0			0	50	50	
0	0	0	lseek	0	/jjparker/pexfile	0			0	0	0	1
0	0	0	read	0	/jjparker/pexfile	0			0	100	50	
1	0	0	open	0	/jjparker/pexfile2	37	ENU	US	0	0	0	
1	0	0	write	0	/jjparker/pexfile2	0			0	200	200	
1	0	0	close	0	/jjparker/pexfile2	0			0	0	0	
0	0	0	close	0	/jjparker/pexfile	0			0	0	0	



# Useful Features

## Object Signing and Signature Verification (V5R1)

- **You can add a *digital signature* to an integrated file system stream file (\*STMF)**
  - ▶ An encrypted mathematical summary of the data in the stream file
  - ▶ Enables you to verify the integrity of the object
  - ▶ Shows proof of origin and helps detect tampering
- **Methods of signing a stream file**
  - ▶ Use Digital Certificate Manager
  - ▶ Use the Sign Object (QYDOSGNO, QydoSignObject) API
  - ▶ Use Management Central's Product and Package function
- **Methods of verifying a stream file**
  - ▶ Use Digital Certificate Manager
  - ▶ Use the Verify Object (QYDOVFYO, QydoVerifyObject) API
  - ▶ Use the Check Object Integrity (CHKOBJITG) command
- **Stream files you may want to sign include:**
  - ▶ Java jar and class files
  - ▶ PC exe, dll, and cab files
  - ▶ AIX shared object (so) files
- **Found in the InfoCenter at *Security > Object Signing and Signature Verification***

***\*TYPE2 Directories  
V5R1 and V5R2***

## \*TYPE2 Directories - Boost Your IFS Performance

*What are they?*

- **A new implementation of the directory object in the following integrated file systems:**

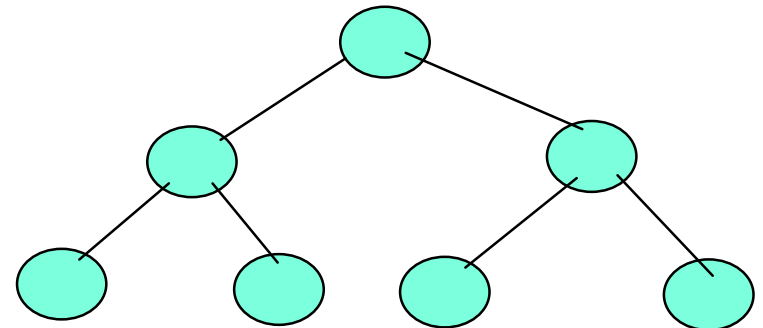
- ▶ Root
- ▶ QOpenSys
- ▶ UDFSs in basic and independent ASPs

- **Built for improved**

- ▶ Performance
- ▶ Reliability
- ▶ Functionality
- ▶ Size and Capacity

- **Base function in V5R2**

- **Available with PTFs in V5R1**



## \*TYPE2 Directories

### Potential Benefits

	Operation	Improvement Factor*
■ Performance	Create directory	up to 12 - 13 x
	Delete directory	up to 3 - 4 x
	Read directory	up to 4 x
	Open directory	up to 2 x
■ Reliability	Reclaim Storage (RCLSTG)	up to 1.5 - 2 x

- ▶ Superior recovery from system crashes reduces the need for reclaim storage and support calls

### ■ Functionality

- ▶ iSeries Navigator automatic name sorting

### ■ Size / Capacity

- ▶ Small directories (< 350 objects) are significantly smaller
- ▶ Large directories (> 350 objects) are 10 percent larger on average
- ▶ Increased capacity to store more object attributes
- ▶ Supports up to 1 million links (subdirectories in a single directory) (vs. 32765)

### ■ Compatibility

- ▶ Still a \*DIR object - Properties & WRKLNK option 8 show the directory format
- ▶ SAV / RST to and from \*TYPE1 works with no conversion needed

\*Measured in lab environments. Actual improvements in customer environments may differ

## **\*TYPE2 Directories**

### *How can you get \*TYPE2 directories?*

- **New systems preloaded with V5R2 or installing V5R2 from scratch already have \*TYPE2 directories**
  - ▶ Nothing more for you to do
- **If you are upgrading from V4R4 or V4R5**
  - ▶ You still have \*TYPE1 directories
  - ▶ You need to run a conversion utility to get \*TYPE2 directories
  - ▶ An estimator will tell you
    - how long it will take, single-threaded (multiply by 0.3 to 0.5 to get the actual expected time with multiple threads )
    - how much free disk space is needed during the conversion
    - how much disk space your directories consume before and after conversion
  - ▶ Can convert Root, QOpenSys, and User ASPs separately
    - Root and QOpenSys conversion requires restricted state
    - UDFS conversion only requires the ASP to be in restricted state
  - ▶ Independent ASPs are converted when varied on to V5R2
  - ▶ Conversion performance is dependent on the number of objects and the system configuration
    - Small number of objects (< 50,000) should be measured in minutes
    - Large number of objects could be measured in hours

## ***\*TYPE2 Directories***

### ***Converting To \*TYPE2 Directories in V5R1***

#### **■ Read Informational APAR II13161**

- ▶ Contains the list of PTFs needed
- ▶ Contains a pointer to the documentation in the InfoCenter
  - Go to [www.ibm.com/eserver/series/support](http://www.ibm.com/eserver/series/support)
  - Click on Search Technical Databases
  - Select "Search Software Problems (APARS)" in the drop-down box
  - Enter II13161 and click on Search
  - Click on the APAR number to see its contents

#### **■ Apply the required PTFs**

#### **■ Read the InfoCenter documentation and follow the process for converting**

## \*TYPE2 Directories

### Converting To \*TYPE2 Directories in V5R1...an example

#### ■ Preparations

- ▶ Run the Estimator (recommended)
  - CALL QP0FCVT2 (\*ESTIMATE \*ALL)  
or run it on individual file systems
    - CALL QP0FCVT2 (\*ESTIMATE \*ROOT)
    - CALL QP0FCVT2 (\*ESTIMATE \*QOpenSys)
    - CALL QP0FCVT2 (\*ESTIMATE \*QASP01)
    - CALL QP0FCVT2 (\*ESTIMATE \*QASPxx) (for each basic user ASP)
  - The actual time for the conversion should be about 30 to 50 percent of the estimated time because the conversion utility runs multiple threads
  - Make sure you have enough free disk space
- ▶ Save all IFS objects (a recommended precaution)

#### ■ Do the conversion

- ▶ Put the system in restricted state (required for Root and QOpenSys conversion)
- ▶ Run the Conversion Utility
  - CALL QP0FCVT2 (\*CONVERT \*ALL)  
or run it on individual file systems
    - CALL QP0FCVT2 (\*CONVERT \*ROOT)
    - CALL QP0FCVT2 (\*CONVERT \*QOpenSys)
    - CALL QP0FCVT2 (\*CONVERT \*QASP01)
    - CALL QP0FCVT2 (\*CONVERT \*QASPxx) (for each basic user ASP)

## ***\*TYPE2 Directories***

### ***Converting To \*TYPE2 Directories in V5R2***

- **Read the InfoCenter and follow the process for converting**
  - ▶ File Systems and Management >  
Integrated File System >  
Concepts >  
Directory >  
\*TYPE2 Directories
  
- **Independent ASPs are automatically converted when they are varied on for the first time in V5R2**



## \*TYPE2 Directories

### Converting To \*TYPE2 Directories in V5R2...an example

#### ■ Preparations

- ▶ Run the Estimator (recommended)
  - CVTDIR OPTION(\*ESTIMATE) FILESYS(\*ALL)  
or run it on individual file systems
    - CVTDIR OPTION(\*ESTIMATE) FILESYS(\*ROOT)
    - CVTDIR OPTION(\*ESTIMATE) FILESYS(\*QOPENSYS)
    - CVTDIR OPTION(\*ESTIMATE) FILESYS(\*UDFS) ASP(1)
    - CVTDIR OPTION(\*ESTIMATE) FILESYS(\*UDFS) ASP(xx) (for each basic user ASP)
  - The actual time for the conversion should be about 30 to 50 percent of the estimated time because the conversion utility runs multiple threads
  - Make sure you have enough free disk space
- ▶ Save all IFS objects (a recommended precaution)

#### ■ Do the conversion

- ▶ Put the system in restricted state (required for Root and QOpenSys conversion)
- ▶ Run the Conversion Utility
  - CVTDIR OPTION(\*CONVERT) FILESYS(\*ALL)
    - Respond to the message indicating which file systems are to be converted
  - or run it on individual file systems
    - CVTDIR OPTION(\*CONVERT) FILESYS(\*ROOT)
    - CVTDIR OPTION(\*CONVERT) FILESYS(\*QOPENSYS)
    - CVTDIR OPTION(\*CONVERT) FILESYS(\*UDFS) ASP(1)
    - CVTDIR OPTION(\*CONVERT) FILESYS(\*UDFS) ASP(xx) (for each basic user ASP)

## \*TYPE2 Handout

**Performance**  
**Reliability**  
**Functionality**

iSeries<sup>(TM)</sup> OS/400<sup>(R)</sup> Integrated File System

**\*TYPE2**  
**Directories**

**Size**  
**Capacity**  
**Compatibility**

**"Get Ready to Boost Your IFS Performance with V5R2"**

www.midrangeserver.com, The Four Hundred, Special Edition, August 29,2002

**V5R1:** PTF SI06153 [www.ibm.com/eserver/iseriess/infocenter](http://www.ibm.com/eserver/iseriess/infocenter)  
Database and file systems > File systems and management >  
What's new for V5R1 > \*TYPE2 Directories

**V5R2:** [www.ibm.com/eserver/iseriess/infocenter](http://www.ibm.com/eserver/iseriess/infocenter)  
File systems and management > Integrated file system >  
Concepts > Directory > \*TYPE2 Directories

# *Goodies*

## **Summary of V5R1 Goodies**

- **Journaling** (described earlier)
- **National Language Support** (described earlier)
- **Memory mapped stream files** (described earlier)
- **Object signing for stream files** (described earlier)
- **Independent ASP support** (described earlier)
- **\*TYPE2 Directories** (described earlier)
- **/dev/null character special file**
- **pipe() and \*FIFOs**
- **Save file I/O in QSYS.LIB** (improved transportability)
- **Change Attributes (CHGATR) command**
- **Subtree support for CPY, CHGATR, STRJRN, ENDJRN, APYJRNCHG**
- **SAV/RST performance improvement: PTF 5722SS1 SI05856**

## Summary of V5R2 Goodies

### ■ Journaling

- ▶ standby mode (described earlier)
- ▶ \*FIFO and \*CHRSF object "creates" are now journaled

### ■ \*TYPE2 Directories (described earlier)

### ■ Independent ASP support (described earlier)

- ▶ QSYS.LIB file system
- ▶ Groups
- ▶ Journaling of independent ASP objects

### ■ Object Reference Information (described earlier)

### ■ API additions / options

- ▶ Added pread, pwrite, pread64, pwrite64 (described earlier)
- ▶ Added accessx, faccessx, QlgAccessx (described earlier)
- ▶ Added fchdir
- ▶ O\_SYNC, D\_SYNC, R\_SYNC (described earlier)
- ▶ open API creation option - specifies the CCSID for text conversion when creating a file
- ▶ Qp0IGetAttr - new options for getting more attributes
- ▶ S\_ISGID support - primary group of created object is inherited from parent or thread, depending on flag's setting on the parent directory

### ■ Performance

- ▶ Reclaim Storage - systems with many objects in directories should see significant improvement  
Measured in the laboratory up to 2.3x for \*TYPE1 directories; 3.8x for \*TYPE2 directories
- ▶ Parallel create and delete of stream files - faster handling of large objects
- ▶ Disk storage and Main storage allocation options for stream files (described earlier)
- ▶ Stream file parallel create and delete - faster uploads and deletes of large files
- ▶ SAV/RST performance improvement - PTF 5722SS1 SI05599

## **IFS Tools**

### **Unsupported Tools**

<b>ATTRIB</b>	- Similar to DOS's attrib command
<b>CHGAUTALL</b>	- Change authority with subtree
<b>CHGOWNALL</b>	- Change owner with subtree
<b>CHGCCSID</b>	- Changes the CCSID of files in a subtree
<b>DELTREE</b>	- Deletes a subtree
<b>DLTIFSF</b>	- Deletes an object whose name contains invalid characters
<b>DSPLINK</b>	- Displays the location that a symbolic link references
<b>QRYIFSLIB</b>	- Dumps information about IFS objects to an outfile
<b>RNMIFSF</b>	- Renames an object whose name contains invalid characters

Available for download as a save file at

<ftp://testcase.boulder.ibm.com/as400/fromibm/ApiSamples/ifstool.savf>

For more information, see the following article:

"IFS Tools", by Tom McBride, from IGNITe/400, July 2002

<http://www.ignite400.org/html/News/pdf/news2002070402.pdf>

## References

### The iSeries Information Center

- Your iSeries source for hardware, software, programming and planning information.
- <http://www.ibm.com/series/infocenter>

### iSeries Nation

- The essential destination for the iSeries community. Become a citizen today! Registration is quick and easy, and gives you access to valuable offers and a wealth of information to help you improve your IT department and your business.
- <http://www.ibm.com/eserver/nation1>

### "Get Ready to Boost Your IFS Performance With V5R2"

- <http://www.midrangeserver.com>, The Four Hundred, Special Edition, August 29, 2002

### "IFS Tools", by Tom McBride, from IGNITE/400, July 2002

- <http://www.ignite400.org/html/News/pdf/news2002070402.pdf>

# Trademarks and Disclaimers

8 IBM Corporation 1994-2003. All rights reserved.

References in this document to IBM products or services do not imply that IBM intends to make them available in every country.

The following terms are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both:

AS/400	IBM(logo)
AS/400e	iSeries
e (logo) business	OS/400
IBM	xSeries
AIX	

Lotus, Freelance Graphics, and Word Pro are registered trademarks of Lotus Development Corporation and/or IBM Corporation. Domino is a trademark of Lotus Development Corporation and/or IBM Corporation.

C-bus is a trademark of Corollary, Inc. in the United States, other countries, or both.

Java and all Java-based trademarks are trademarks of Sun Microsystems, Inc. in the United States, other countries, or both.

Microsoft, Windows, Windows NT, and the Windows logo are trademarks of Microsoft Corporation in the United States, other countries, or both.

ActionMedia, LANDesk, MMX, Pentium and ProShare are trademarks of Intel Corporation in the United States, other countries, or both.

UNIX is a registered trademark of The Open Group in the United States and other countries.

SET and the SET Logo are trademarks owned by SET Secure Electronic Transaction LLC.

Other company, product and service names may be trademarks or service marks of others.

Information is provided "AS IS" without warranty of any kind.

All customer examples described are presented as illustrations of how those customers have used IBM products and the results they may have achieved. Actual environmental costs and performance characteristics may vary by customer.

Information in this presentation concerning non-IBM products was obtained from a supplier of these products, published announcement material, or other publicly available sources and does not constitute an endorsement of such products by IBM. Sources for non-IBM list prices and performance numbers are taken from publicly available information, including vendor announcements and vendor worldwide homepages. IBM has not tested these products and cannot confirm the accuracy of performance, capability, or any other claims related to non-IBM products. Questions on the capability of non-IBM products should be addressed to the supplier of those products.

All statements regarding IBM future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only. Contact your local IBM office or IBM authorized reseller for the full text of the specific Statement of Direction.

Some information in this presentation addresses anticipated future capabilities. Such information is not intended as a definitive statement of a commitment to specific levels of performance, function or delivery schedules with respect to any future products. Such commitments are only made in IBM product announcements. The information is presented here to communicate IBM's current investment and development activities as a good faith effort to help with our customers' future planning.

Performance is based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput or performance that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput or performance improvements equivalent to the ratios stated here.

Photographs shown are of engineering prototypes. Changes may be incorporated in production models.