Technical Challenges:

TIFF Image Scanning and Retrieval using Forms

Coleman Leviter

NYOUG

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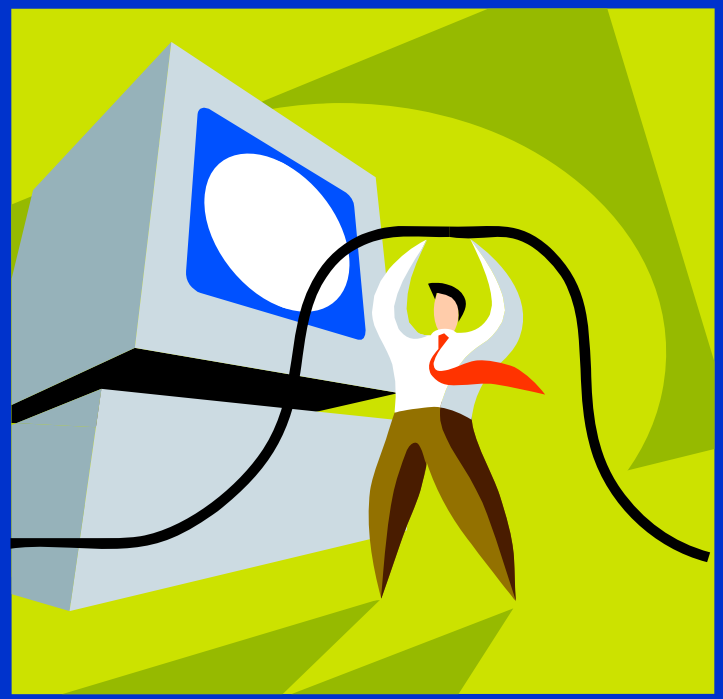
Presentation Goals

- Review TIFF Project
- Overcoming Obstacles outside Oracle
- Overcoming Obstacles within Oracle

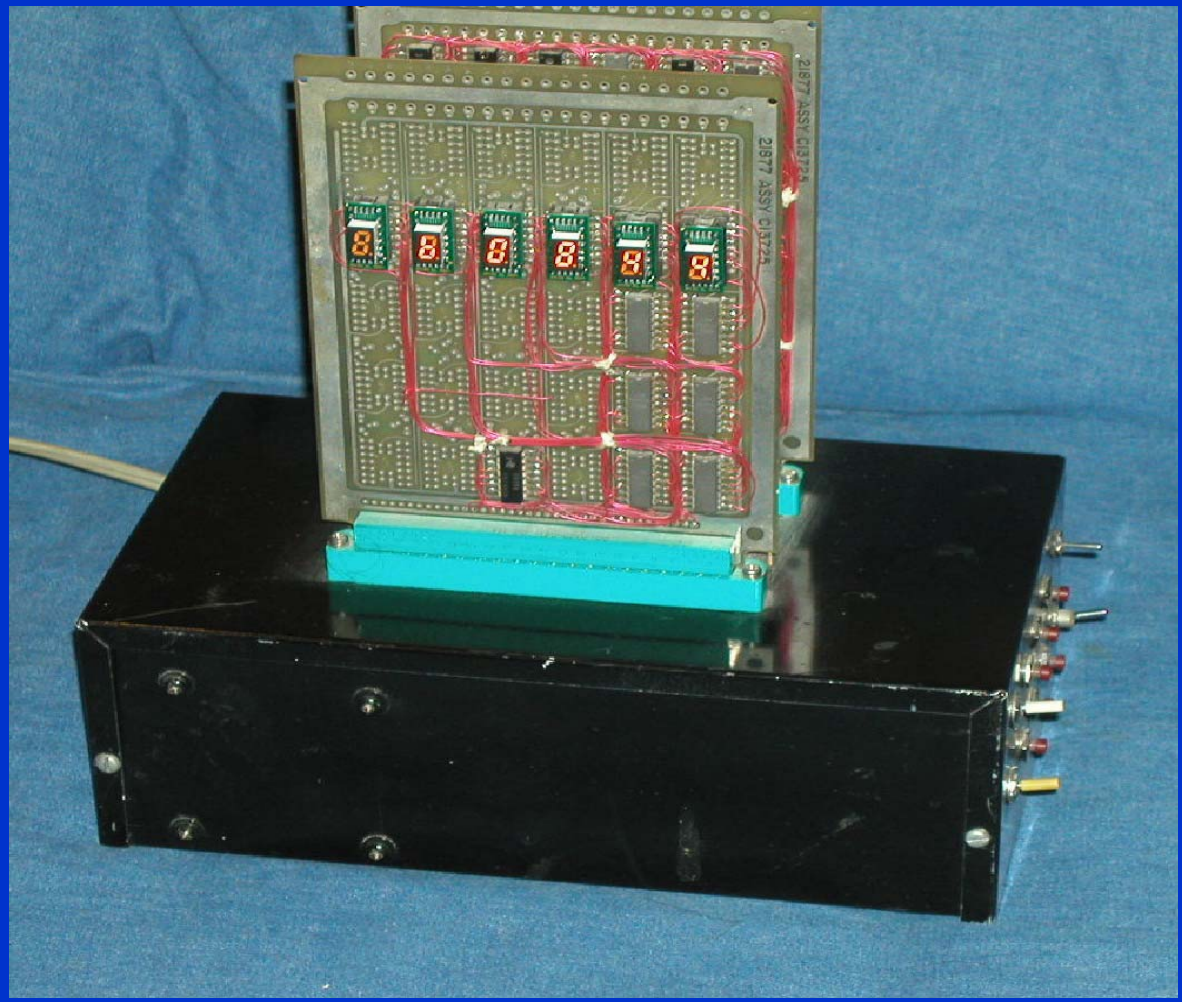


Project History

- Digital Designer – Norden Systems
- Software Engineer – Grumman F-14D Tomcat
- RWR Software Engineer – Litton Systems
- VAX Programmer –Financial District
- WMS Development – Arrow Electronics

Age of the hardware may not be an indicator of its functionality

Digital Alarm Clock – circa 1974
Still Works



Fujitsu Scanner M3096E – Circa 1988
Still Works

Lexmark T630 – Circa 2002
Has Bugs

Moral of System Integration

- It is not always software causing a problem
- Sometimes, it is indeed the hardware
- Break the system down into its constituent parts and test

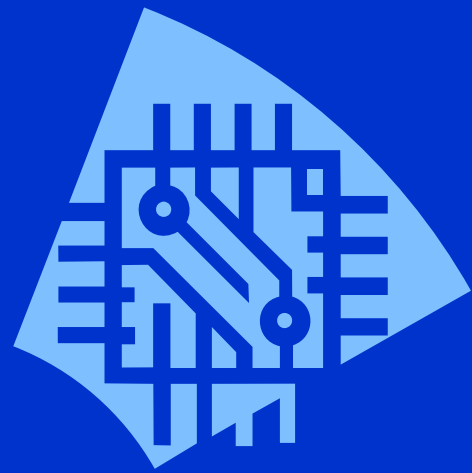
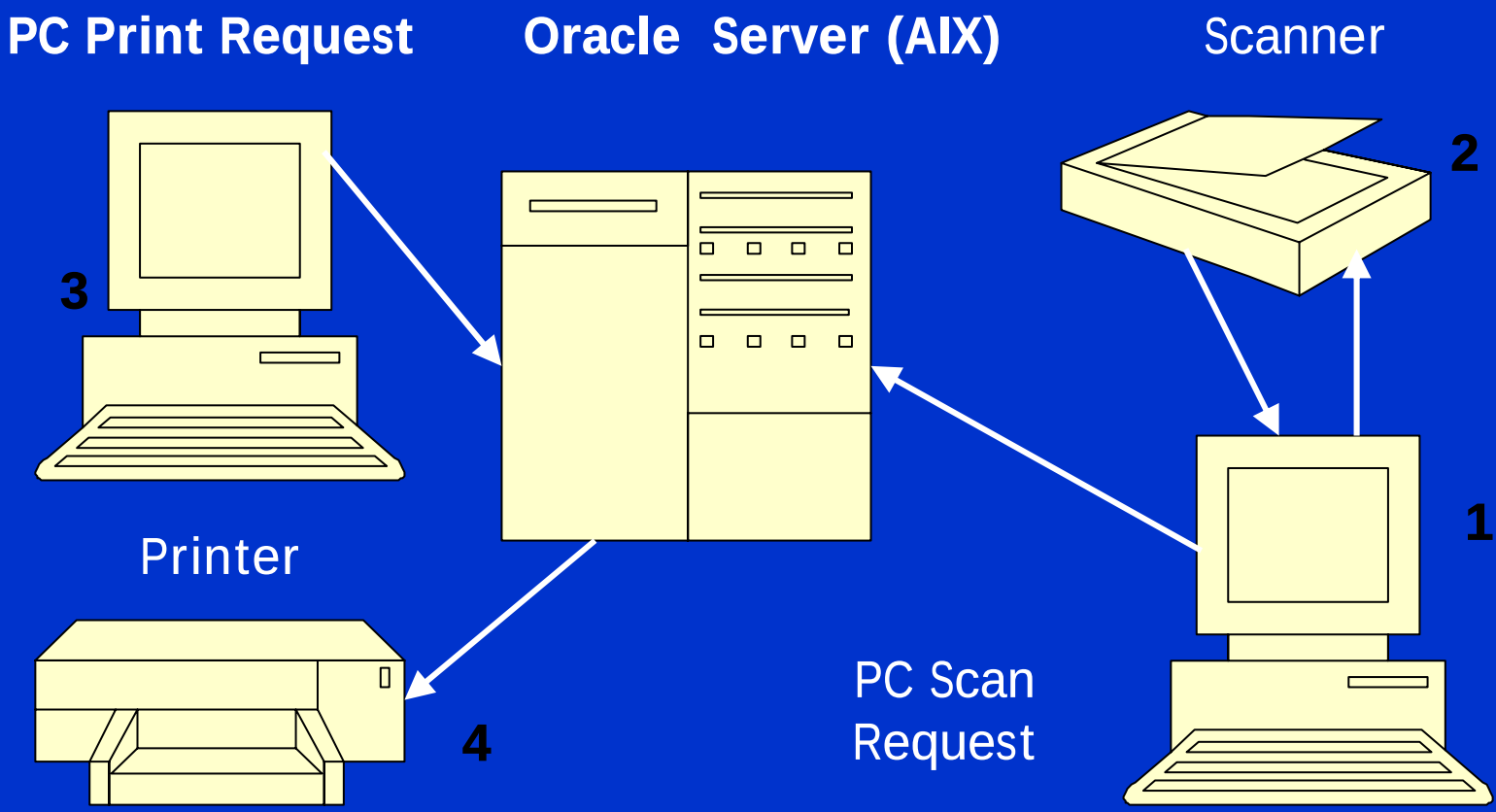


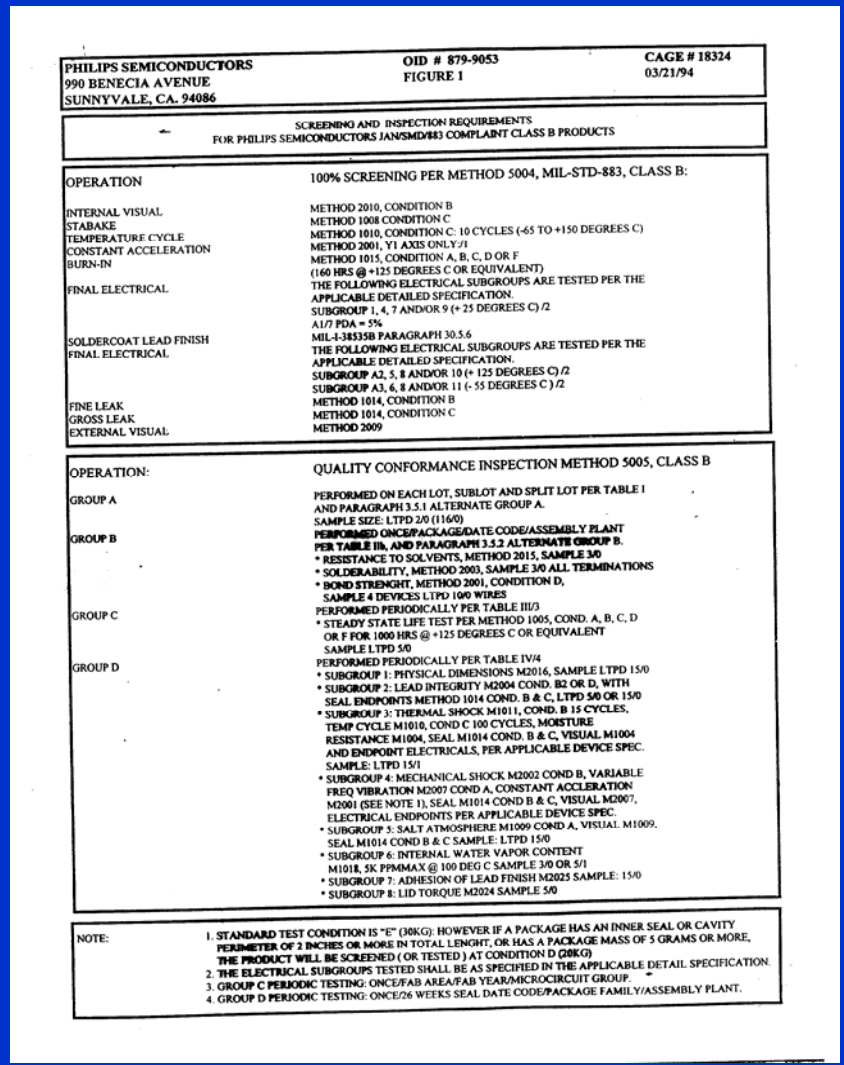
Image Scanning and Retrieval



Background

- Why TIFF Files?
  - Certificate of Compliance (paperwork) ships with special products
  - Images stored on host system, users do not have to retrieve hard copy
  - TIFF files print whenever product is shipped from warehouse

Typical TIFF Image



PHILIPS SEMICONDUCTORS
990 BENECIA AVENUE
SUNNYVALE, CA. 94086

OID # 879-9053
FIGURE 1

CAGE # 18324
03/21/94

SCREENING AND INSPECTION REQUIREMENTS
FOR PHILIPS SEMICONDUCTORS JAN/SMD/883 COMPLAINT CLASS B PRODUCTS

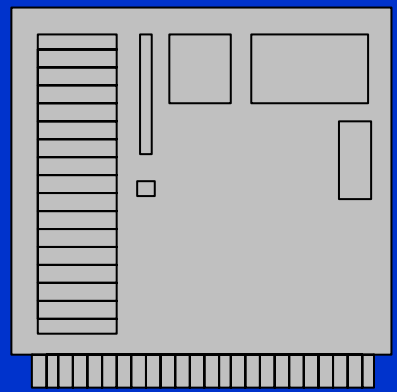
OPERATION	100% SCREENING PER METHOD 5004, MIL-STD-883, CLASS B:
INTERNAL VISUAL	METHOD 2010, CONDITION B
STABAKE	METHOD 1008 CONDITION C
TEMPERATURE CYCLE	METHOD 1010, CONDITION C: 10 CYCLES (-65 TO +150 DEGREES C)
CONSTANT ACCELERATION	METHOD 2001, Y1 AXIS ONLY /1
BURN-IN	METHOD 1015, CONDITION A, B, C, D OR F (160 HRS @ +125 DEGREES C OR EQUIVALENT)
FINAL ELECTRICAL	THE FOLLOWING ELECTRICAL SUBGROUPS ARE TESTED PER THE APPLICABLE DETAILED SPECIFICATION. SUBGROUP 1, 4, 7 AND/OR 9 (+ 25 DEGREES C) /2 A1/7 PDA = 5%
SOLDERCOAT LEAD FINISH	MIL-I-38535B PARAGRAPH 30.5.6
FINAL ELECTRICAL	THE FOLLOWING ELECTRICAL SUBGROUPS ARE TESTED PER THE APPLICABLE DETAILED SPECIFICATION. SUBGROUP A2, 5, 8 AND/OR 10 (+ 125 DEGREES C) /2 SUBGROUP A3, 6, 8 AND/OR 11 (- 55 DEGREES C) /2
FINE LEAK	METHOD 1014, CONDITION B
GROSS LEAK	METHOD 1014, CONDITION C
EXTERNAL VISUAL	METHOD 2009

OPERATION:	QUALITY CONFORMANCE INSPECTION METHOD 5005, CLASS B
GROUP A	PERFORMED ON EACH LOT, SUBLOT AND SPLIT LOT PER TABLE I AND PARAGRAPH 3.5.1 ALTERNATE GROUP A. SAMPLE SIZE: LTPD 2/0 (116/0)
GROUP B	PERFORMED ONCE/PACKAGE/DATE CODE/ASSEMBLY PLANT PER TABLE IIb, AND PARAGRAPH 3.5.2 ALTERNATE GROUP B. * RESISTANCE TO SOLVENTS, METHOD 2015, SAMPLE 3/0 * SOLDERABILITY, METHOD 2003, SAMPLE 3/0 ALL TERMINATIONS * BOND STRENGHT, METHOD 2001, CONDITION D, SAMPLE 4 DEVICES LTPD 10/0 WIRES
GROUP C	PERFORMED PERIODICALLY PER TABLE III/3 * STEADY STATE LIFE TEST PER METHOD 1005, COND. A, B, C, D OR F FOR 1000 HRS @ +125 DEGREES C OR EQUIVALENT SAMPLE LTPD 5/0
GROUP D	PERFORMED PERIODICALLY PER TABLE IV/4 * SUBGROUP 1: PHYSICAL DIMENSIONS M2016, SAMPLE LTPD 15/0 * SUBGROUP 2: LEAD INTEGRITY M2004 COND. B2 OR D, WITH SEAL ENDPOINTS METHOD 1014 COND. B & C, LTPD 5/0 OR 15/0 * SUBGROUP 3: THERMAL SHOCK M1011, COND. B 15 CYCLES, TEMP CYCLE M1010, COND C 100 CYCLES, MOISTURE RESISTANCE M1004, SEAL M1014 COND. B & C, VISUAL M1004 AND ENDPOINT ELECTRICALS, PER APPLICABLE DEVICE SPEC. SAMPLE: LTPD 15/1 * SUBGROUP 4: MECHANICAL SHOCK M2002 COND B, VARIABLE FREQ VIBRATION M2007 COND A, CONSTANT ACCLERATION M2001 (SEE NOTE 1), SEAL M1014 COND B & C, VISUAL M2007, ELECTRICAL ENDPOINTS PER APPLICABLE DEVICE SPEC. * SUBGROUP 5: SALT ATMOSPHERE M1009 COND A, VISUAL M1009, SEAL M1014 COND B & C SAMPLE: LTPD 15/0 * SUBGROUP 6: INTERNAL WATER VAPOR CONTENT M1018, 5K PPMMAX @ 100 DEG C SAMPLE 3/0 OR 5/1 * SUBGROUP 7: ADHESION OF LEAD FINISH M2025 SAMPLE: 15/0 * SUBGROUP 8: LID TORQUE M2024 SAMPLE 5/0

NOTE:
1. STANDARD TEST CONDITION IS "E" (30KG): HOWEVER IF A PACKAGE HAS AN INNER SEAL OR CAVITY PERIMETER OF 2 INCHES OR MORE IN TOTAL LENGHT, OR HAS A PACKAGE MASS OF 5 GRAMS OR MORE, THE PRODUCT WILL BE SCREENED (OR TESTED) AT CONDITION D (20KG)
2. THE ELECTRICAL SUBGROUPS TESTED SHALL BE AS SPECIFIED IN THE APPLICABLE DETAIL SPECIFICATION.
3. GROUP C PERIODIC TESTING: ONCE/FAB AREA/FAB YEAR/MICROCIRCUIT GROUP.
4. GROUP D PERIODIC TESTING: ONCE/26 WEEKS SEAL DATE CODE/PACKAGE FAMILY/ASSEMBLY PLANT.

Previous System

- ALPHA (DIGITAL/COMPAQ) hosted images on file system -
  - Images scanned using Fujitsu Scanner M3096E with Kofax Board (use on new system)
- Images stored with VMS file system - DECFORMS
- Indexed file contained image details
  - number of images, archived, tape information

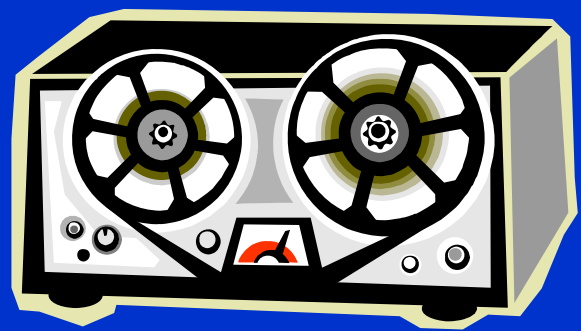


New Host System

- Forms 6.0 (Form Compiler) Version 6.0.8.25.2 (Production) Patch 16
- Patch 16 Required for reading TIFF files using Forms 6i – (Originally using Patch 10)
- AIX 5L Version 5.2
- Oracle9i Enterprise Edition Release 9.2.0.5.0 - 64bit Production

Migration Path

- Transfer almost 877,000 images from ALPHA to AIX
- File sizes range from 50k to 150k
  - 877k x 75k = 65.8 GB disk required
- Avg one sec file store time into ORACLE
- Retrieve images from 9 track tapes
  - 10 tapes, 3 hours average, 14,000 images



TIFF File Format - Background

- Motorola Format (4D4D) identification in first two bytes signify Big Endian
- Intel Format (4949) identification in first two bytes signify Little Endian
- All files on previous host system (ALPHA) stored as Intel Format
- Preserve format in ORACLE

TIFF File Storage on AIX

- Use ORACLE for TIFF File storage vs. AIX file system
  - Reliable and Proven
  - Backups reliable
  - Critical Application
- Remote Oracle Table
  - Isolate image backups and restoration from disaster recovery

Forms 6i Implementation

- Forms 6i on AIX implementation character mode
  - existing user base consisting of WYSE VT 420 (Dumb Terminals)
  - maintain existing form, fit and function with user community
- Existing Application
  - scan images with product, print images out

WYSE VT-420 Dumb Terminal

Forms Built Ins

- TIFF File management plan with Forms
  - Use built in read_image_file to store images to Oracle
  - Use built in write_image_file to retrieve images to AIX file system and queue to T630 Lexmark printer with ImageQuick Card
  - Goal – Rapid Application Development

LOBs and Remote Tables

- **Reading LOBs from Oracle using write_image_file**
- **Error Message**
  - ORA-22992 cannot use LOB locators selected from remote tables
  - Cause: **A remote LOB column cannot be referenced.**
  - Action: **Remove references to LOBs in remote tables.**
- **Solution**
  - **Global Temporary Tables**

LOBs and Remote Tables (cont'd)

- Writing LOBs to Oracle using read_image_file
- Remember TIFF File Format? MOTO vs. INTEL?
- Oracles's Built-in read_image_file converts 4949 to 4D4D
  - 4D4D002A0000DC MOTO
  - 49492A0008000000 INTEL

MOTO Problems in Forms

- **Some images stored in Oracle using MOTO format caused Forms to crash when using write_image_file. (Segmentation Fault)**
- **INTEL Format using utility TIFFDUMP**
  - Magic: 0x4949 <little-endian> Version: 0x2a
  - Directory 0: offset 8 (0x8) next 0 (0)
  - SubFileType (254) LONG (4) 1<0>
  - ImageWidth (256) LONG (4) 1<2544>
  - ImageLength (257) LONG (4) 1<3300>
  - BitsPerSample (258) SHORT (3) 1<1>
  - Compression (259) SHORT (3) 1<4>
  - Photometric (262) SHORT (3) 1<0>,)
  - **Software (305) ASCII (2) 56<Kofax standard Multi-Pag . NORMAL**

MOTO Problems in Forms

- MOTO Format using utility TIFFDUMP
  - Magic: 0x4d4d <big-endian> Version: 0x2a
  - Directory 0: offset 8 (0x8) next 0 (0)
  - SubFileType (254) LONG (4) 1<0>
  - ImageWidth (256) LONG (4) 1<2544>
  - ImageLength (257) LONG (4) 1<3300>
  - BitsPerSample (258) SHORT (3) 1<1>
  - Compression (259) SHORT (3) 1<5>
  - Photometric (262) SHORT (3) 1<1>
- Additionally: Software (305) ASCII (2) **30<Oracle Multimedia Toolki ...> CHANGED BY read_image_file**

Forms read_image_file

- Syntax
  - PROCEDURE READ_IMAGE_FILE (file_name VARCHAR2,
  - file_type VARCHAR2,
  - item_id ITEM);
- Problem: modifies TIFF file when storing to Oracle
- Solution: ???

Create Stored Procedure read_image_file_f

- Solution: create stored procedure that reads images and does not modify them
  - directly uses global temporary table
- Create Or Replace Function read_blob_file_f
  - INSERT INTO IMAGE_DETAIL_LOCAL_READ_GT (stoc_num, vndr_pord_num, vers_num,
  - date_code, lot_code, page_num, img_data)
  - VALUES (p_stoc_num, p_vndr_pord_num, p_vers_num, p_date_code, p_lot_code, p_page_num,
  - EMPTY_BLOB())
  - RETURNING img_data INTO dest_loc;
  - INSERT INTO image_detail SELECT * FROM image_detail_local_read_gt;
  - DELETE FROM image_detail_local_read_gt;
  - RETURN lcl_success;

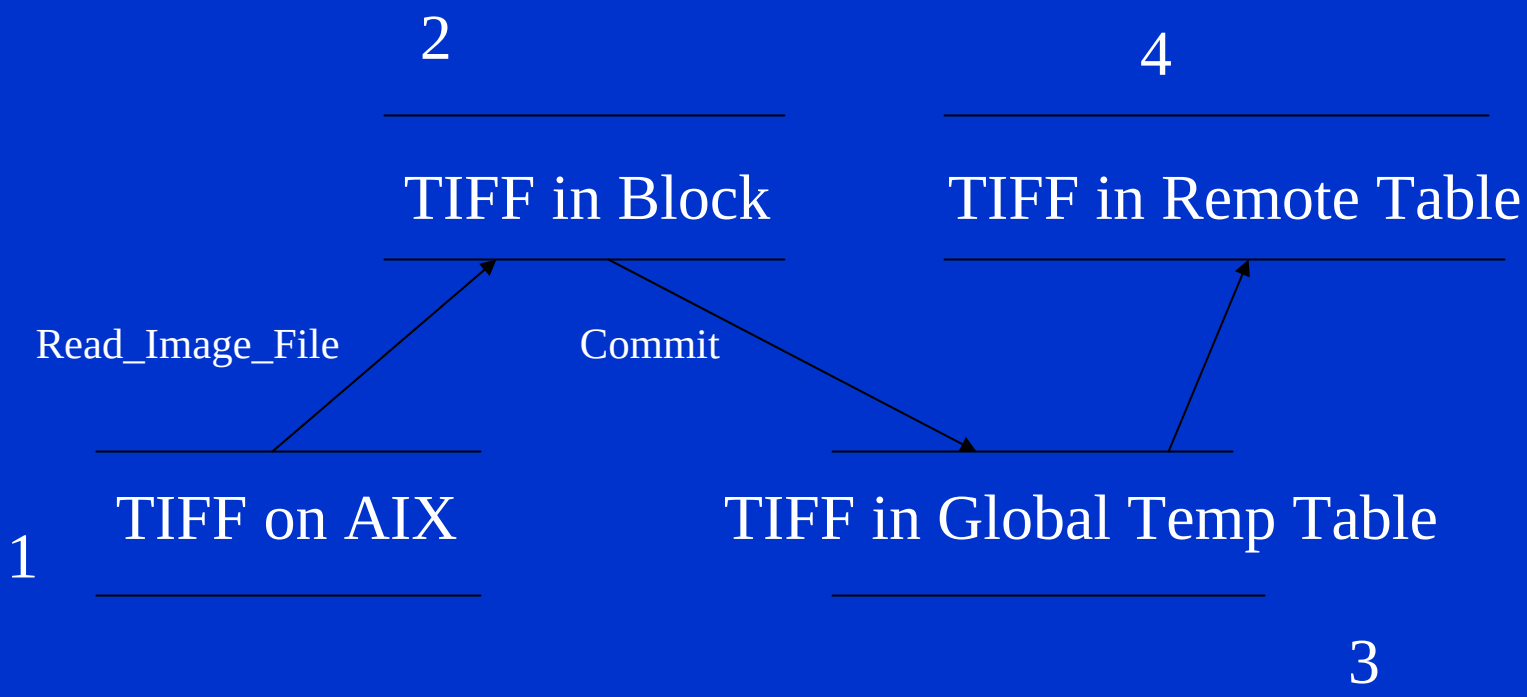
Using Built In - TIFF Storage Into Oracle

- Read TIFF file from host system
  - Store Tiff file in Forms Block
  - read_image_file (lineread, 'TIFF', 'image_detail_local_read.IMG_DATA');
  - COMMIT_FORM - stores TIFF file into global temporary table (image_detail_local_read), same name block.item

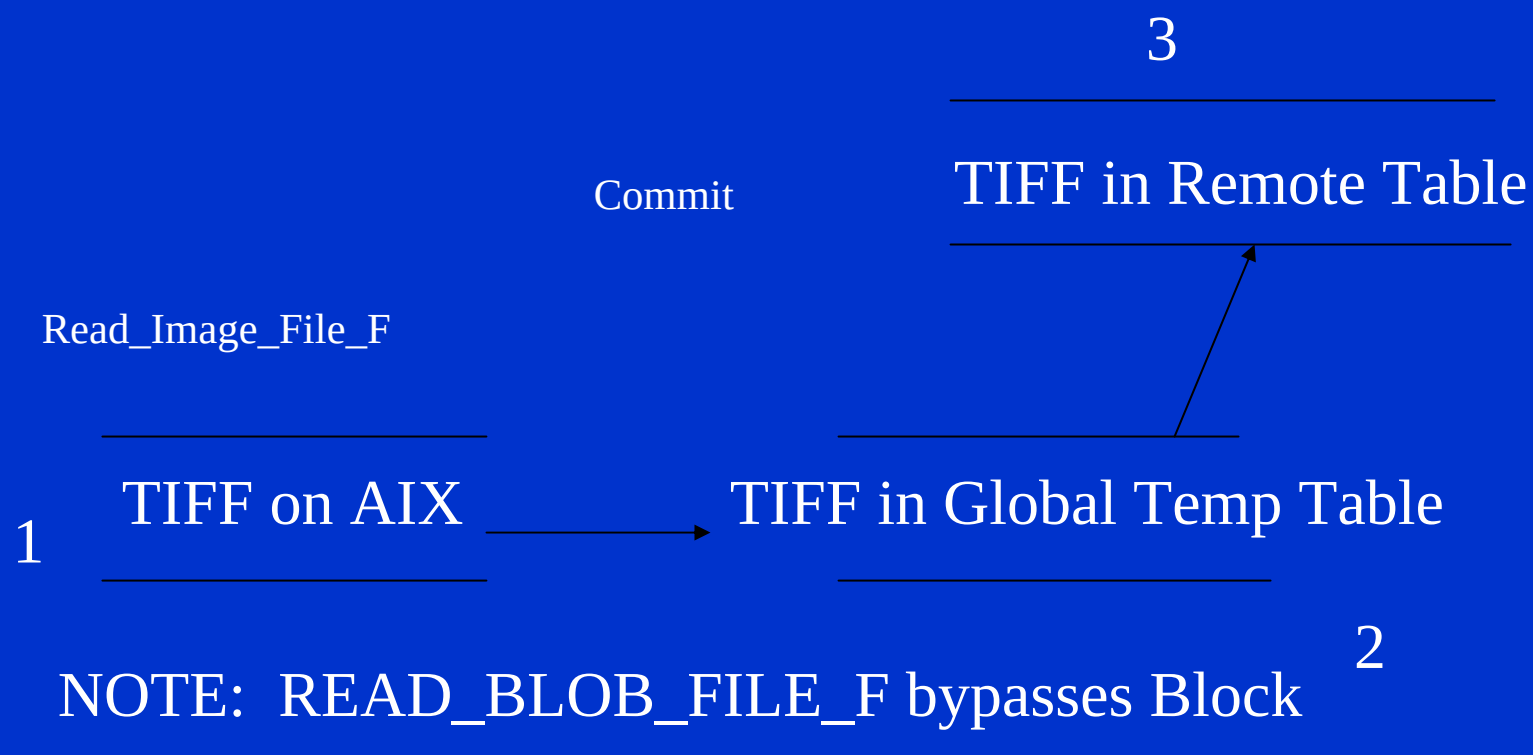
Using Built In - TIFF Storage Into Oracle

- Store TIFF file into Oracle
  - ddl_text := 'INSERT INTO image_detail SELECT * FROM image_detail_local_read';
  - FORMS_DDL (ddl_text);
- image_detail table contains all TIFF files
- CREATE SYNONYM IMAGE_DETAIL FOR IMAGE_DETAIL@tiff_1

TIFF Storage – Data Flow Without Stored Procedure



TIFF Storage – Data Flow Using Stored Procedure

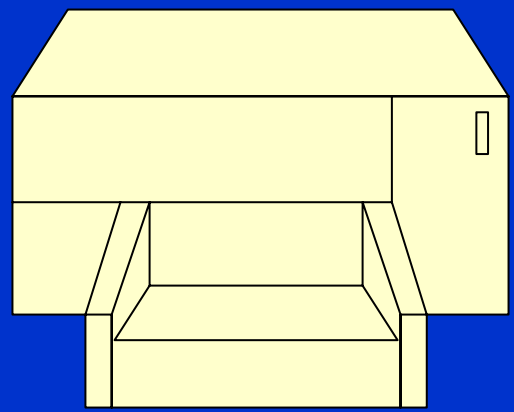


TIFF Retrieval - Print Image

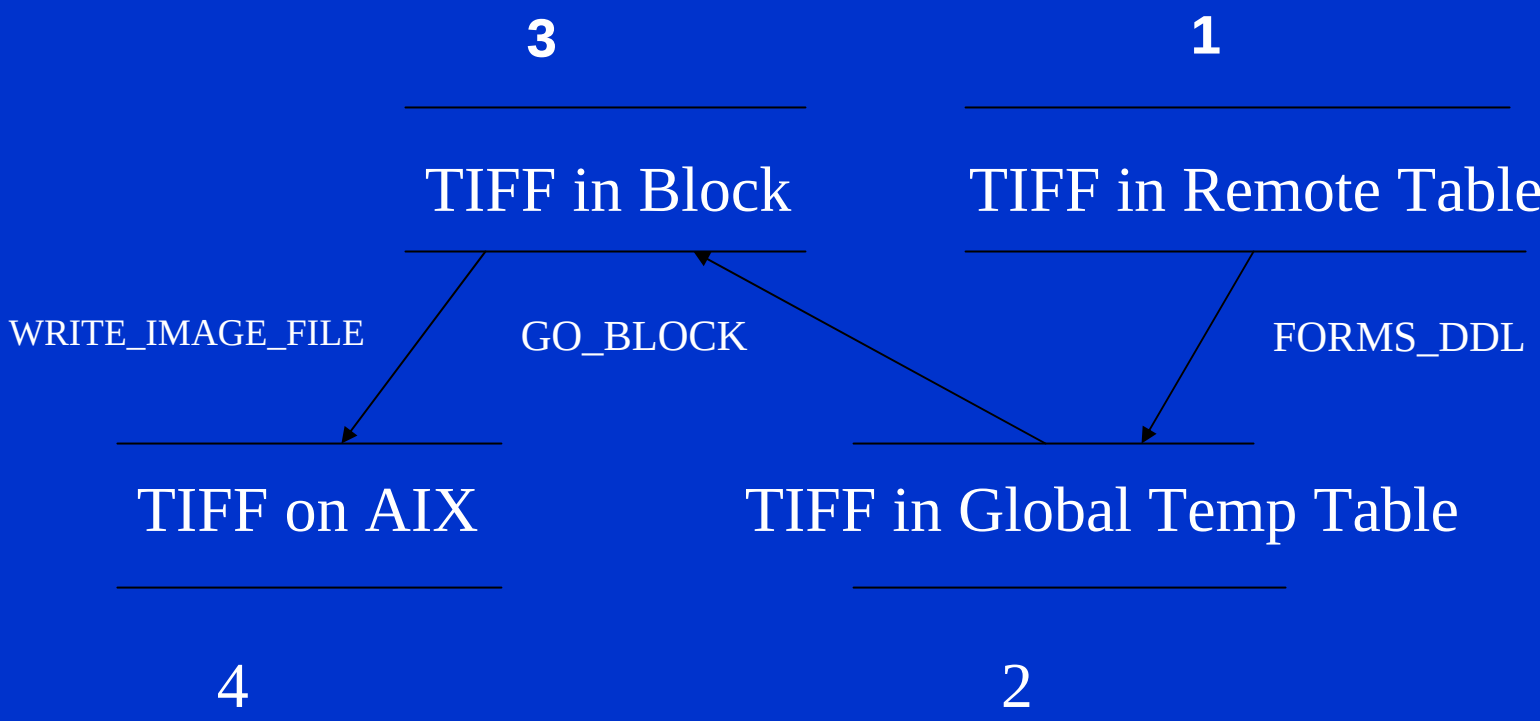
- Use built-in Write_Image_File to retrieve files from ORACLE
- FORMS_DDL
  - retrieve tiff files from remote database
  - store files into global temporary table
- Go_Block
  - transfers TIFF files from global temporary table to Forms block

TIFF Retrieval - Print Image

- Built-in Write_Image_File
  - Transfers TIFF file from Forms block onto host file system
- Print File
  - use TIFF file name on local host system



TIFF Retrieval - Data Flow



Print TIFF Files from Forms 6i

- `host ('enq -P <queuename> ' || lcl_image_file, no_prompt );`

Example T630 Formats

- **T630 Formats with ImageQuick Card (Lexmark fixed a bug)**
  - TIFF grayscale images (monochrome)
  - TIFF LZW (Lempel-Ziv-Welch)
  - TIFF CCITT Group 4
  - TIFF CCITT Group 3 2D
  - TIFF CCITT Group 3 ID
  - TIFF Type 2
  - TIFF Packbits
  - TIFF uncompressed

LEXMARK T630 Bug & Fix

- Send image file to printer
- Printer engine activated
- After one minute, printer engine stopped, no printout
- Image readable using Photo Editor
- LEXMARK supplied a patch that fixed the problem

Resolving Errors

- SEGMENTATION FAULT using Print Image from Forms
- Traced error to TIFF file in MOTO format
  - 4D4D002A0000DC MOTO
  - 49492A0008000000 INTEL
- Solution - convert MOTO (4D4D) to INTEL (4949) format
- EASY

Convert MOTO to INTEL

- Write program swapping bytes from 3rd byte to end of file
- Little Endian vs. Big Endian
  - "Little Endian" means that the low-order byte of the number is stored in memory at the lowest address, and the high-order byte at the highest address. (The little end comes first.) For example, a 4 byte LongInt
  - **Byte3 Byte2 Byte1 Byte0**
  - **will be arranged in memory as follows:**
  - Base Address+0 Byte0
  - Base Address+1 Byte1
  - Base Address+2 Byte2
  - Base Address+3 Byte3
- Intel processors (those used in PC's) use "Little Endian" byte order.

Convert MOTO to INTEL

- **"Big Endian" means that the high-order byte of the number is stored in memory at the lowest address, and the low-order byte at the highest address. (The big end comes first.) Our LongInt, would then be stored as:**
- `Base Address+0  Byte3`
- `Base Address+1  Byte2`
- `Base Address+2  Byte1`
- `Base Address+3  Byte0`
- **Motorola processors (those used in Mac's) use "Big Endian" byte order.**

Problem Swapping Bytes

- Keep track of check sums
- Modify first two bytes i.e. 4D4D to 4949
- Fixing bugs, etc...
- Any freeware?
- Search TIFF on GOOGLE

TIFFCP to the Rescue

- TIFFCP(1) USER COMMANDS TIFFCP(1)
- NAME tiffcp - copy (and possibly convert) a TIFF file
- SYNOPSIS tiffcp [*options*] *src1.tif* ... *srcN.tif dst.tif*
- DESCRIPTION *tiffcp* combines one or more files created according to the Tag Image File Format, Revision 6.0 into a single TIFF file. Because the output file may be compressed using a different algorithm than the input files, *tiffcp* is most often used to convert between different compression schemes. By default, *tiffcp* will copy all the understood tags in a TIFF directory of an input file to the associated directory in the output file. *tiffcp* can be used to reorganize the storage characteristics of data in a file, but it is explicitly intended to not alter or convert the image data content in any way.
- Possibilities ☹ 😐

Try TIFFCP on MOTO TIFF

- tiffcp -c g3 "$tiff_old" "$tiff_new”
- MOTO Tiff File Format

- TIFF Directory at offset 0x8
- Subfile Type: (0 = 0x0)
- Image Width: 2544 Image Length: 3264
- Resolution: 300, 300 pixels/inch
- Bits/Sample: 1
- Compression Scheme: LZW - **Lempel-Ziv & Welch compression**
- Photometric Interpretation: min-is-black
- Software: "Oracle Multimedia Toolkit, 6.0"
- Image Description: ""
- Samples/Pixel: 1
- Rows/Strip: 103
- Planar Configuration: single image plane

After TIFFCP

- **ERRORS**
- **Read error on strip 30; got 318 bytes, expected 634.**
- **Read error on strip 31; got 3365 bytes, expected 3375.**
- **But the** TIFF file is readable
- **TIFF Directory at offset 0x1fb48**
- **Subfile Type: (0 = 0x0)**
- **Image Width: 2544 Image Length: 3300**
- **Resolution: 300, 300 pixels/inch**
- Compression Scheme: CCITT Group 3
- **Photometric Interpretation: min-is-black**
- Software: "Oracle Multimedia Toolkit, 6.0"

Try ENQing TIFF Files

- Now, the modified TIFF file can be printed to a T630 LEXMARK.
- FORMS 6i does not crash
- Simple repair, run TIFFCP on over 48,000 MOTO format file @ ~150k/file

Repairing TIFF Files

- Approach
  - Extract from ORACLE MOTO TIFFs onto the production file system - AIX
  - ftp files to non-production environment
  - TIFFCP all ~48,000 files
  - Store all ~48,000 files back into ORACLE

Oracle Environment

- **Directory entry in SYS.ALL_DIRECTORIES for file path**

- select * from sys.all_directories
- OWNER DIR_NAME DIR_PATH
- ------------------------------ ------------------------------ ------------------
- SYS OUT_DIR /u01/app/
- SYS REBUILD_DIR /u02/oradata/
- 2 rows selected

PL/SQL

- **Write BLOB contents to a file**

```
v_out_file := UTL_FILE.FOPEN(
        location      => 'REBUILD_DIR',
        filename      => 'cal_'||'&1'||'_'||'&2'||'_'||'&3'||'_'||'&4'||'_'||'&5'||'_'||'&6'||'_'||'&7'||'_.tif_prod',
        open_mode     => 'w',
        max_linesize  => 32767);
```

Shell Script Insert TIFF

- Slash fails with ROWID
- File system considers directory
- Use keys
- sqlplus -s scott/tiger@tiff_1 @cal_tiff_insert_slash_1.sql "002207238" "9780MB7226403" "FUB7861" "9743A" "1" "1" "AAAG7lAAO
- AAA+CqAA/" "107589”

Shell Script Extract TIFF

- Slash fails with ROWID
- File system considers directory
- Use keys

- sqlplus -s scott/tiger@tiff_1 @cal_tiff_extract_slash_1.sql "002207238" "9780MB7226403" "FUB7861" "9743A" "1" "1" "AAAG7lAAOAAA+CqAA/" "107589”
- Note “/” in rowid interpreted as directory

PL/SQL

- Store BLOB back into Oracle
- src_file BFILE := BFILENAME('REBUILD_DIR','cal_'||'&1'||'_'||'&2'||'_'||'&3'||'_'||'&4'||'_'||'&5'||'_'||'&6'||'_'||'&7'||
- '_.tif_prod_new');

PL/SQL

- **Store TIFF file to Oracle**
- DBMS_LOB.LOADFROMFILE(--Sets the destination file with the source file value
- dest_lob => dst_file,
  src_lob => src_file,
  amount   => DBMS_LOB.getLength(src_file));
- UPDATE image_detail d --Updates the table (You can use insert...)
- SET img_data = dst_file
  WHERE ROWIDTOCHAR(d.rowid) = '&7';

Outstanding Issues

- Manipulate BLOBs using a remote database – ORA-22992 error
- Printing images to Lexmark T630 – no image, engine activates
- Forms crashes on some images - Segmentation Fault message on form

Resolving Issues

- Manipulate BLOBs using a remote database – use global temporary table
- Printing images to Lexmark T630 – Lexmark supplied firmware patch
- Forms crashes with some images – fix MOTO format

Things to Keep in Mind

- Metalink still logs issues with READ_IMAGE_FILE
- Latest entry Oracle Forms WebUtil : Technical FAQ Doc ID: Note:270940.1 Type: FAQ Last Revision Date: 23-MAR-2006
- Gotcha - ROWID is not always reliable – contains "/" – can be construed as a directory delimiter

Questions

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Final Notes

- Feel free to contact me with any issues
- Email cleviter@ieee.org