Printing in DigiPath 2.0

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PSSU / SSP / System Architecture and Design

Overview

- GDI printing in DigiPath 2.0
- Production printing in DigiPath 2.0
- DigiPath 2.0 features which support production printing

Need for this presentation

- DigiPath’s print path to PSG black and white and highlight color production printers is one of its key current vectors of differentiation
- Designed to enable PSG customers to increase their Xerox printing system usage
- Existing DigiPath production print path does not support color
- Explanation of current implementation will enable future color enhancements

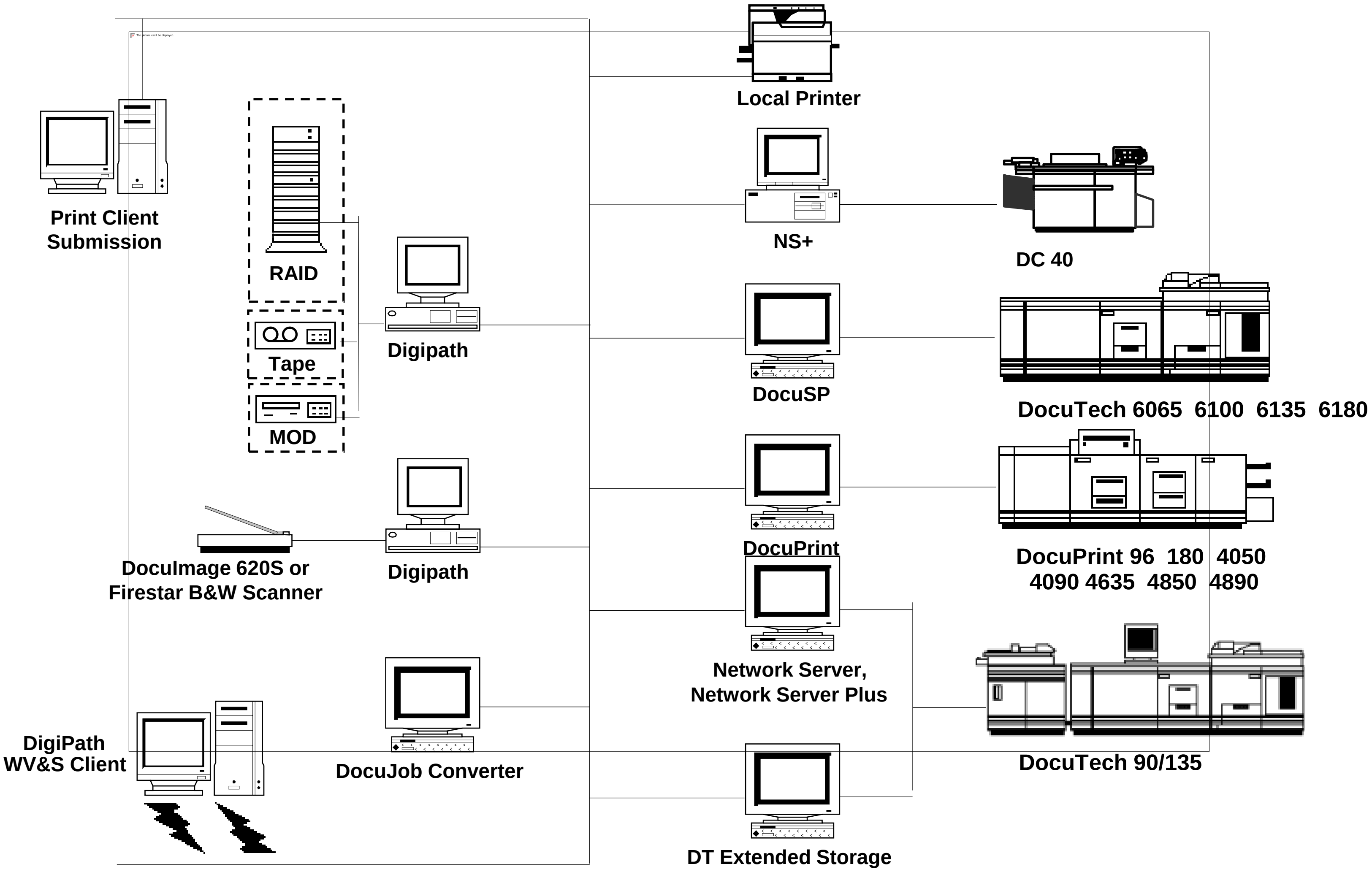
Production Printing Is a System Issue

- DigiPath production printing is not a simple, single feature but integrates several system elements
  - Print file transfer mechanism
  - Knowledge of target DFE
  - Print submission file structure
  - Data content types
  - Structure of compound documents
  - Supported TIFF file types
- Production print path requires interplay of all of these elements

DigiPath’s Multiple Print Paths

- Graphics device interface (GDI) path
- Production print path
  - Standard
  - Extended Connectivity Print Job Manager (EC-PJM)

DigiPath 2.0 Hardware Configuration



Nick Leuci 09/15/2009 10:00

GDI Printing

- Within DigiPath, primarily used to support local draft printing during document creation and edit
- Relatively slow
- Supports any printer with a well-behaved MS Windows NT print driver
  - For each page, DigiPath software creates a page image
    - Multiple TIFFs on a page are imaged on top of one another
    - Alternatively, a Portable Document Format (PDF) or PostScript page is imaged
    - Header, footer, and page number text is overlaid
  - Page image is bit block transferred to the print driver
  - Driver sends instructions and document (e.g., via PCL or PostScript) to the printer
- No special support for distributed content or remote printing
- All content and documents must be pulled to the machine submitting the job and then pushed to the printer
- Only limited support for job attributes

Standard Production Print Path

- Standard production print path is only available to Xerox production printers and DFEs
- The standard production print path has four steps:

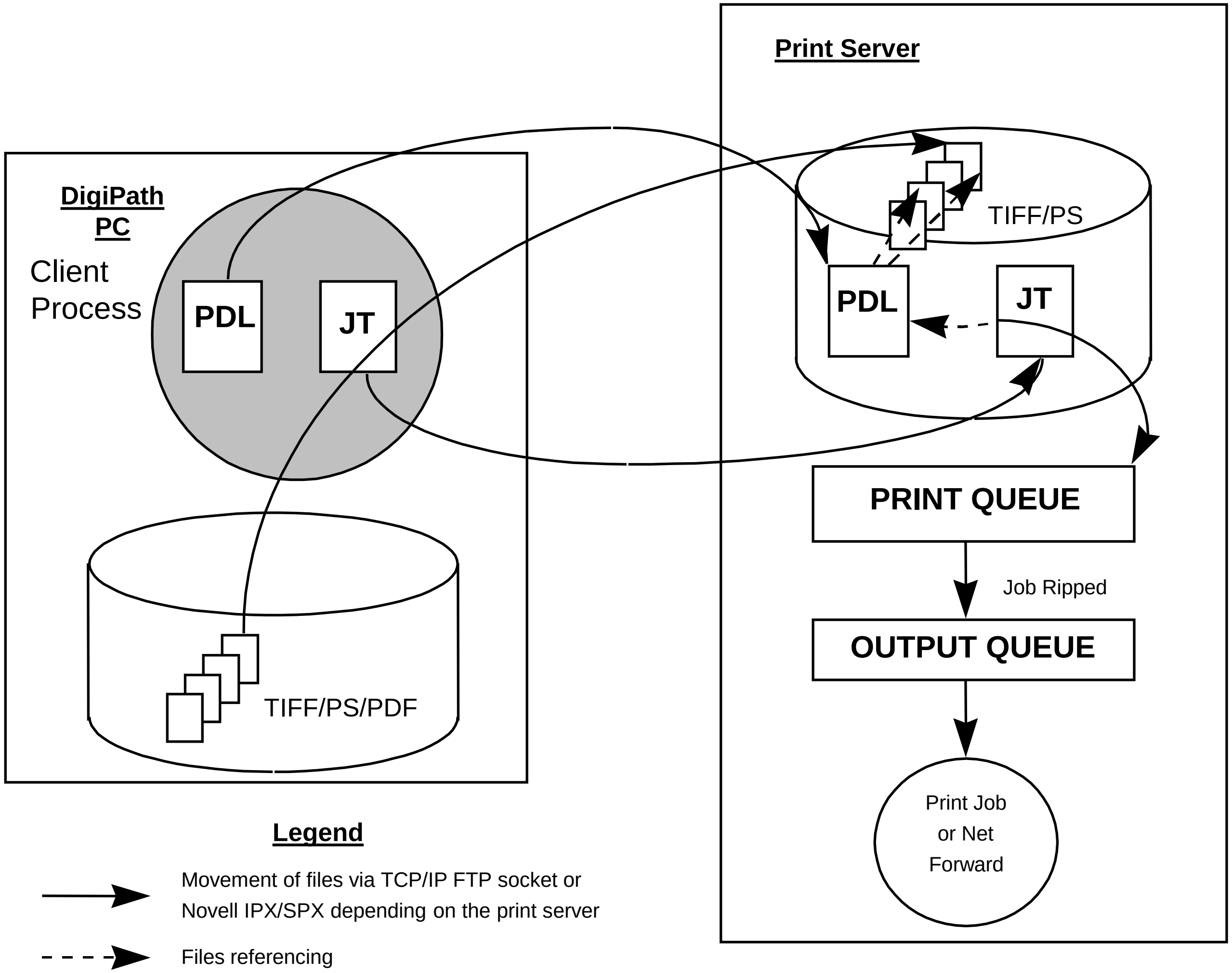
(1) A target directory on the DFE is created.

(2) The document’s data content files are pushed via FTP to this well-known directory.

(3) At the DigiPath platform submitting the job, a relatively small PostScript wrapper referencing the document’s data content files is generated.

(4) LPR protocol prints the PostScript wrapper with the job ticket.

DigiPath Standard Production Printing for Local Data Files



Print Server

TIFF/PS

PDL

JT

PRINT QUEUE

Job Ripped

OUTPUT QUEUE

Print Job
or Net
Forward

DigiPath PC

Client
Process

PDL

JT

TIFF/PS/PDF

Legend

Movement of files via TCP/IP FTP socket or Novell IPX/SPX depending on the print server

Files referencing

Constructing the PostScript Wrapper for the Standard Production Print Path

- The PostScript wrapper contains information from the TIFF header tags
  - TIFF parameters stored in the document’s .RDO file are not used
  - Only TIFF files’ headers are accessed, not the raster image data
- Local TIFFs
  - Local file is opened
  - Header tags are read and processed
  - Local file is closed
- Distributed TIFFs
  - Remote drives must be mapped to make their contents accessible from local machine
  - Remote file is opened
  - Only header tag blocks, not the whole file, are transferred across the network
  - Header tags are read and processed
  - Remote file is closed

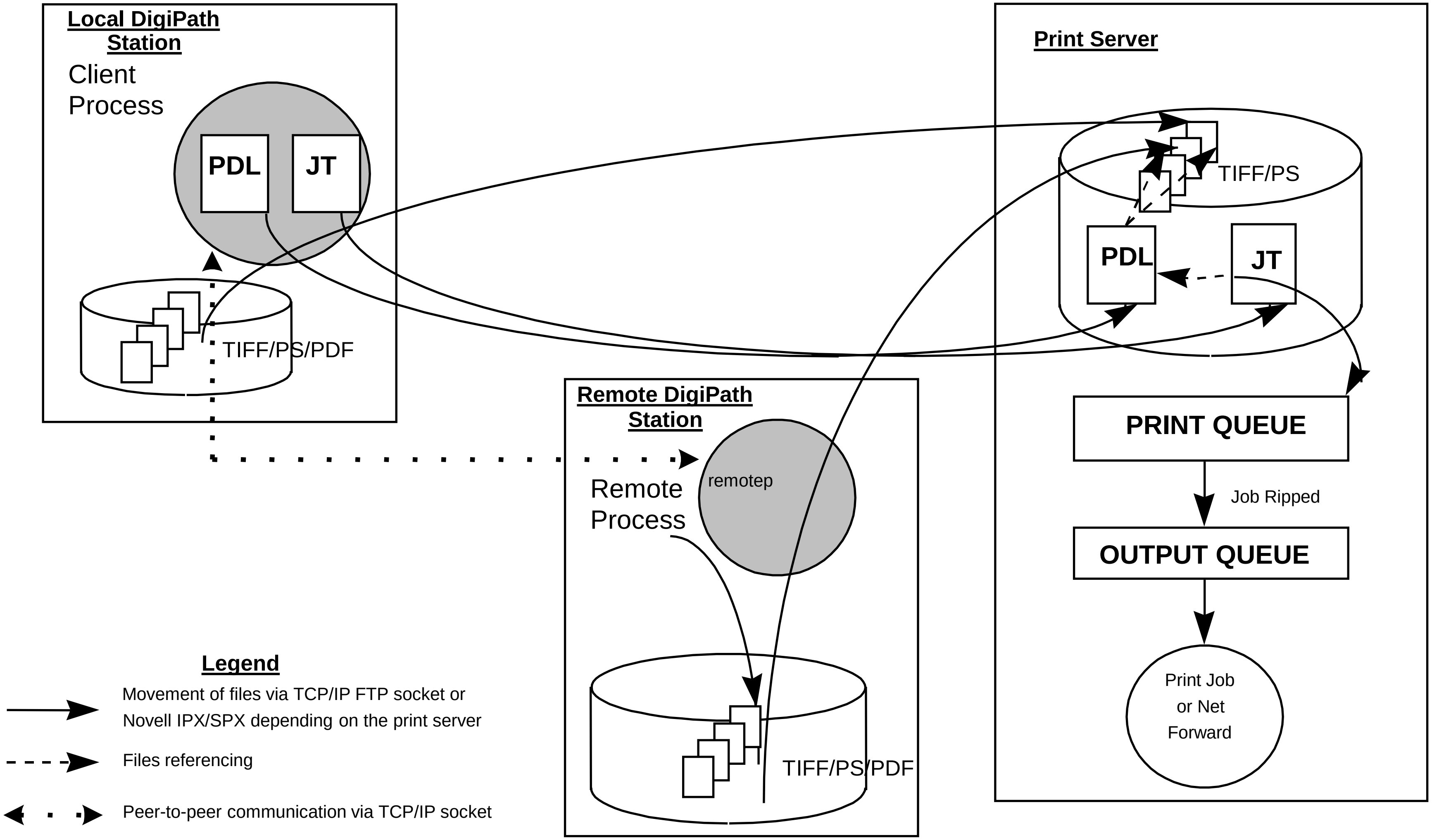
FTP + LPR Versus LPR Alone

- Step (2) FTP transfer of document contents to the DFE
  - Origin dates to early versions of XDOD
  - Initially designed for dedicated client - server, Unix hub with Windows 3.1 PC clients
  - Access to Unix host document contents from Windows 3.1 NFS clients was very inefficient
  - Use of FTP to the printer was over three times faster
  - DigiPath 2.0 now Windows NT peer-to-peer network
  - NFS no longer performance bottleneck in Windows NT
- FTP mechanism to well known directory currently only supported on Xerox DFEs
- FTP to transfer document contents to DFE is still faster than having LPR perform the transfer
  - Recent test shows 17% performance improvement

File Transfers, Distributed Content, and Remote Print Service

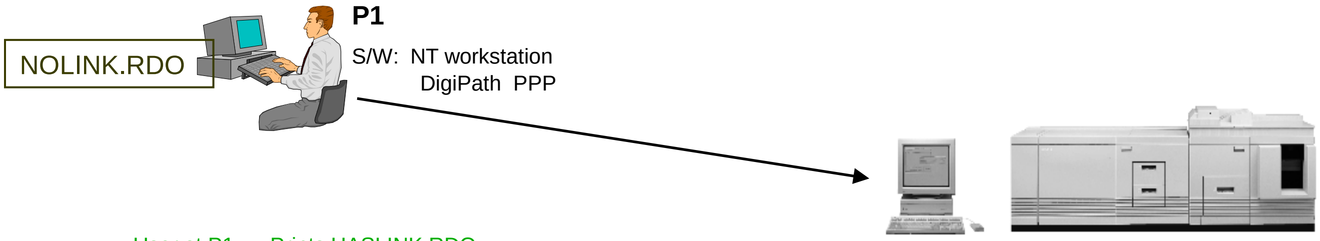
- File transfer mechanism in step (2) also allows important performance optimization
  - To print document, all necessary files must be transferred to the DFE
  - Without DigiPath remote print service, distributed files
    - First must be pulled to the machine from which they are being printed
    - Only then can they be pushed to the DFE for printing
  - With DigiPath remote print service, distributed files can be sent directly to the appropriate DFE
- Because the remote print service pushes distributed content directly to the DFE
  - Necessary transfers are reduced
  - Print performance is improved
  - Optimization is only relevant if the document is distributed
  - Currently only supports single level of distribution
  - Even if FTP + LPR were not faster than LPR, the remote print service requires support for FTP + LPR

DigiPath Standard Production Printing Involving Remote Data Files



Standard Production Printing: Local Document

Without Remote Print Service:



NOLINK.RDO

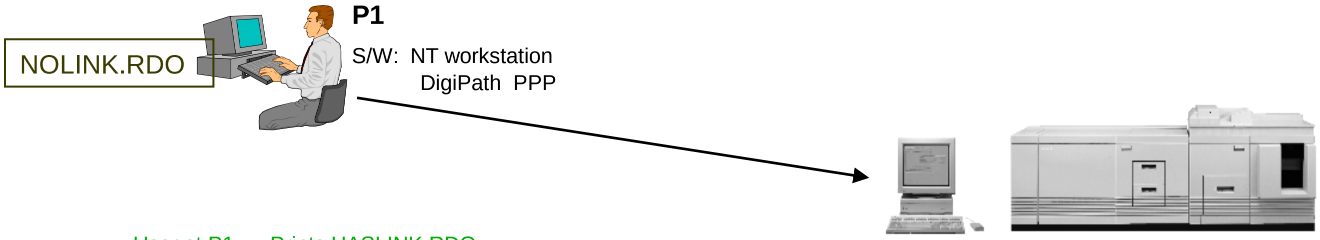
P1

S/W: NT workstation
DigiPath PPP

User at P1: Prints HASLINK.RDO

PPP: Pushes TIFFs in NOLINK.RDO from P1 to printer

With Remote Print Service:



NOLINK.RDO

P1

S/W: NT workstation
DigiPath PPP

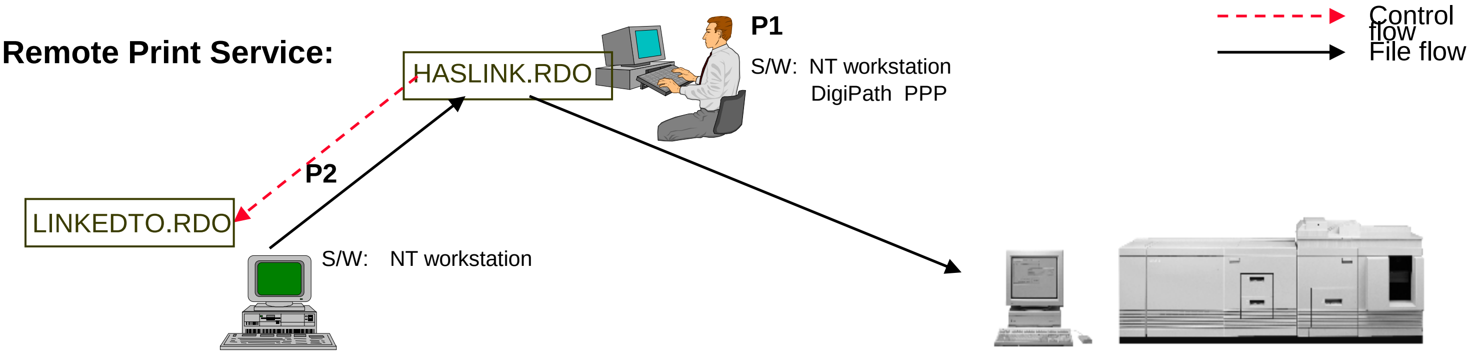
User at P1: Prints HASLINK.RDO

PPP: Pushes TIFFs in NOLINK.RDO from P1 to printer

No difference whether or not the Remote Print Service is present. If the document is wholly local, the Remote Print Service has no impact.

Standard Production Printing: Local Document With Distributed Content

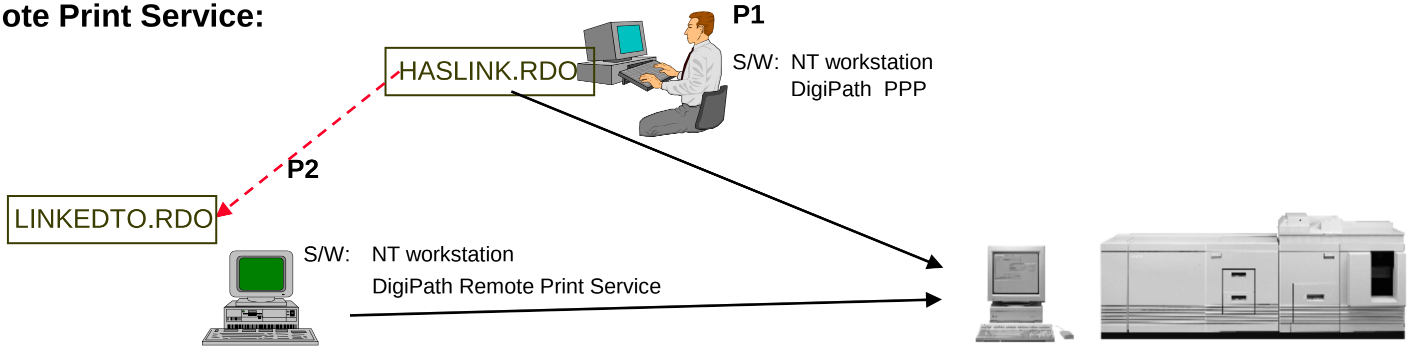
Without Remote Print Service:



User at P1: Prints HASLINK.RDO

PPP: Pushes TIFFs in HASLINK.RDO from P1 to printer
Pulls TIFFs in LINKEDTO.RDO from P2 to P1
Pushes TIFFs in LINKEDTO.RDO from P1 to printer

With Remote Print Service:



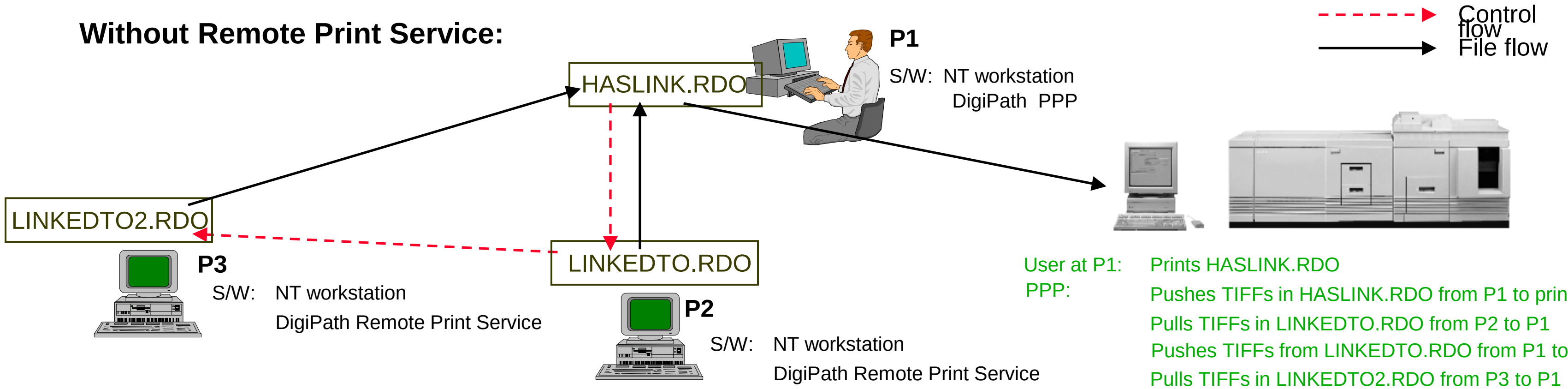
User at P1: Prints HASLINK.RDO

PPP: Pushes TIFFs in HASLINK.RDO from P1 to printer
Pushes TIFFs in LINKEDTO.RDO from P2 to printer

With the Remote Print Service, a local document with distributed content (HASLINK.RDO references LINKEDTO.RDO) is all directly pushed to the printer

Standard Production Printing: Distributed Content Referencing Distributed Content

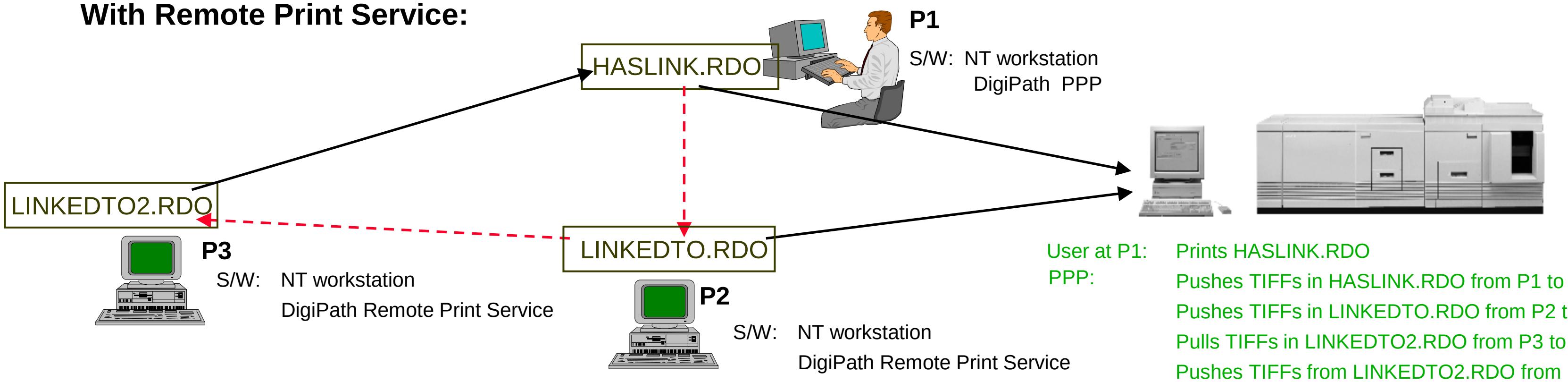
Without Remote Print Service:



User at P1:
PPP:

Prints HASLINK.RDO
Pushes TIFFs in HASLINK.RDO from P1 to printer
Pulls TIFFs in LINKEDTO.RDO from P2 to P1
Pushes TIFFs from LINKEDTO.RDO from P1 to printer
Pulls TIFFs in LINKEDTO2.RDO from P3 to P1
Pushes TIFFs from LINKEDTO2.RDO from P1 to printer

With Remote Print Service:



User at P1:
PPP:

Prints HASLINK.RDO
Pushes TIFFs in HASLINK.RDO from P1 to printer
Pushes TIFFs in LINKEDTO.RDO from P2 to printer
Pulls TIFFs in LINKEDTO2.RDO from P3 to P1
Pushes TIFFs from LINKEDTO2.RDO from P1 to printer

Even with the Remote Print Service, if the distributed content references additional distributed content (HASLINK.RDO references LINKEDTO.RDO which in turn references LINKEDTO2.RDO), it is pulled back to the original workstation and only then pushed to the printer.

DigiPath’s PostScript Print Submission File

- On DocuSP
  - Only uses standard PostScript interpreter
  - Does not rely on DFE TIFF interpreter
  - Any use of nonstandard Xerox DFE performance enhancers is transparent to DigiPath’s PostScript
    - DocuSP still relies on Speedbird library
    - Speedbird library imposes restrictions on acceptable TIFF types
- To print a TIFF file
  - Up to ten TIFFs per page of output document with no PDF or PS on page
  - .RDO file provides certain information on TIFF file Z order, positioning on page, rotation, transparency / opacity, cropping, and highlight color
  - Other information is obtained from TIFF file header tags
    - Header tags are read
    - Information is used as PostScript parameters, particularly for the decode filter

DigiPath's PostScript Print Submission File (continued)

- To print a PDF or PostScript file
  - Only single page of PDF or PS to each document output page
  - Imaging information is contained in the PDF or PS file itself
- To print headers, footers, and page numbers
  - Information is contained in the .RDO file
  - Passed to the DFE in the PostScript file as text (including font specification and positioning)
  - Overlaid on top of the other page components
- Imposition and signaturization handled in PostScript via translation, rotation, and scaling
- Job ticket
  - Used to convey additional attributes (e.g., positioning of document on page, finishing options, page exceptions, etc.)
  - Always prepended to PostScript print submission file

Sample PostScript Wrapper for Standard Production Printing

```
%!PS-Adobe-3.0
%%Creator: DigiPath Production Print
%%Title: XDOD
%%CreationDate: ?
%%For:PostScript2-Version 1.0
%%Orientation:
%%Pages:
%%Origin: ? ?
%%BoundingBox: 0 0 ? ?
%% Digipath 2.0 $Revision:   1.8  $ $Date:   25
Aug 1999 14:57:44  $
%%EndComments


        .
        .
        .
```

Font setup information deleted

```
%%Page: 1
<< /PageSize [612 792] >> setpagedevice
gsave
/myfile (C:\\TEMP\\jacobs1.con\\00000001.tif) (r)
file def
/DeviceGray setcolorspace
myfile 350 setfileposition
0 792 610 sub translate
 0 pop  % *** OK? ***  hShift
0 610 translate
-90 rotate
6592 600 div 72 mul 100 100 div mul
5088 600 div 72 mul 100 100 div mul scale
/wd 6592 def
/ht 5088 def
/bt 1 def
/decd [1 0] def
/picstr
{
 myfile
 <<
  /Uncompressed false
  /K -1
  /EndOfLine false
  /EncodedByteAlign false
  /Columns wd
  /Rows ht
  /EndOfBlock false
  /BlackIs1 true
 >> /CCITTFaxDecode filter
} bind def

/imdict
{
 <<
  /ImageType 1
  /Width wd
  /Height ht
  /BitsPerComponent bt
  /Decode decd
  /ImageMatrix [wd 0 0 ht neg 0 ht]
  /DataSource  picstr
  /Interpolate false
 >>
} bind def
imdict image
myfile closefile
grestore

        .
        .
        .
```

Font setup information deleted

```
/Times-Roman findfont setfont
 currentfont /FontType get 0 ne   % skip for Type
0
 {
  /Times-Roman findfont recode /_Times-Roman exch
definefont pop
  /_Times-Roman findfont setfont
 } if
currentfont 10 scalefont setfont
/str (SAMPLE HEADER TEXT) def
 str
 { 612 str stringwidth pop sub 2 div 0 add } % X
 { 792 10 sub -70 add } % Y
strbackgnd
showpage
%%EOF
```

Page setup →

External file reference →

Offset pointer to file's image data →

TIFF header tag information →

CCITT decode filter parameters

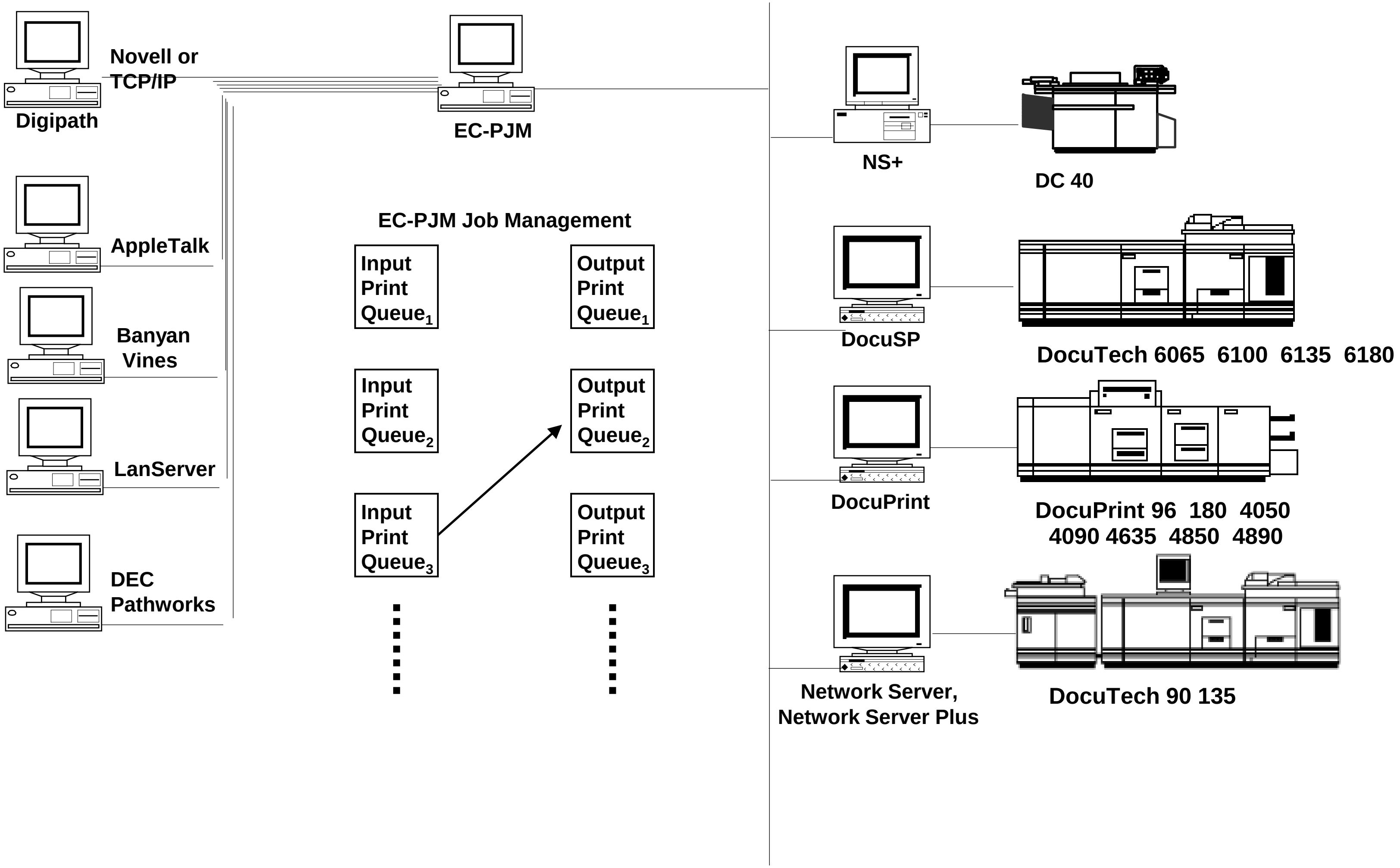
← Image dictionary

← Header text

Extended Connectivity Print Job Manager

- EC-PJM has two parts
  - EC allows connecting Xerox production printers to nonstandard networks (e.g., DEC Net, Banyan Vines, etc.)
  - PJM provides limited output management capabilities (e.g., load balancing by reassigning jobs between input and output print queues)
- DigiPath
  - Does not use EC part of EC-PJM
  - Uses PJM part, treating it simply as another print queue
  - Support for PJM functionality requires the entire print job be contained in a single file
- EC-PJM PostScript file structure precludes use of distributed content transfer optimization
  - The job ticket is preprended to the PostScript print submission file
  - Distributed data content files must be pulled to the workstation from which the document is being printed
  - To eliminate processing problems, temporary local TIFF files are created
  - All data contents are streamed to the print queue in a single file

Extended Connectivity - Print Job Manager



Sample PostScript Data Stream for EC-PJM Production Printing

Page setup

```
%XRXbegin: 001.0201
%XRXtitle: pptest
%XRXsenderName: GWattles
%XRXrecipientName: GWattles
%XRXcopyCount: 1
%XRXpagesToPrint: 1 1
%XRXrequirements: simplex
%XRXoutputLocation: SystemSpecified
%XRXrequirements: collated
%XRXdisposition: PRINT
%XRXpaperType-size: 216 279
%XRXdocumentPaperColors: white
%XRXpaperType-weight: 75
%XRXpaperType-opacity: opaque
%XRXpaperType-preFinish: Plain 0 0
%XRXend
%!PS-Adobe-3.0
%%Creator: DigiPath Production Print
%%Title: XDOD
%%CreationDate: ?
%%For:PostScript2-Version 1.0
%%Orientation:
%%Pages:
%%Origin: ? ?
%%BoundingBox: 0 0 ? ?
%% Digipath 2.0 $Revision:   1.12  $
$Date:   08 Sep 1999 18:20:20  $
%%EndComments
```

```
      .
      .
      .
```

Font setup information deleted

```
/imagestream { currentfile 80 string
readline pop pop image { currentfile
read {37 eq { exit } if } { exit }
ifelse } loop } def
/imagemaskstream { currentfile 80
string readline pop pop imagemask {
currentfile read {37 eq { exit } if } {
exit } ifelse } loop } def
```

```
%%Page: 1
<< /PageSize [612 792] >> setpagedevice
gsave
/DeviceGray setcolorspace
0 792 791 sub translate
 0 pop  % *** OK? ***  hShift
-1 0 translate
5088 600 div 72 mul 100 100 div mul
6592 600 div 72 mul 100 100 div mul
scale
/wd 5088 def
/ht 6592 def
/bt 1 def
/decd [1 0] def
/picstr
{
  currentfile
 <<
  /Uncompressed false
  /K -1
  /EndOfLine false
  /EncodedByteAlign false
  /Columns wd
  /Rows ht
  /EndOfBlock false
  /BlackIs1 true
 >> /CCITTFaxDecode filter
} bind def
```

TIFF header tag information

CCITT decode filter parameters

```
/imdict
{
 <<
  /ImageType 1
  /Width wd
  /Height ht
  /BitsPerComponent bt
  /Decode decd
  /ImageMatrix [wd 0 0 ht neg 0 ht]
  /DataSource  picstr
  /Interpolate false
 >>
} bind def
imdict imagestream
%CCITTdata
ÿÿÿÿÿÿÿÿÿÿÿÿä
```

Image dictionary

CCITT Group 4 data omitted

TIFF file's image data

```
ÿÿÿÿÿÿÿÿÿÿÿÿÿÿÿÀ  @%%%%%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%
grestore
showpage
%%EOF
```

PostScript Submission File Format to Network Server and Network Server Plus

- Of legacy interest only
- Only used to interface to DocuTech 90 and 135
- For NS, the standard production print path is modified to support Novell network protocols
- TIFF file information is passed to NS and NS+ via embedded Xerox proprietary DSC comments
- If XIPP does not support the required job attributes, the DSC comments are not generated
- If target device is not NS / NS+ and the PostScript print submission file contains these comments, they are ignored

Sample PostScript Data Stream for NS and NS+ Production Printing

```
%!PS-Adobe-3.0
%%Creator: DigiPath Production
Print
%%Title: XDOD
%%CreationDate: ?
%%Xerox-XIPP: XIPP-Version 1.0
%%Orientation:
%%Pages:
%%Origin: ? ?
%%BoundingBox: 0 0 ? ?
%% Digipath 2.0 $Revision:   1.8
$ $Date:   25 Aug 1999 14:57:44  $
%%EndComments
```

.
.**Font setup information deleted**
.

```
%%Page: Image
%%XEROX-XIPP: Filename
C:\\TEMP\\jacobs2.con\\00000001.ti
f
%%XEROX-XIPP: Compression 4
%%XEROX-XIPP: Orientation -90
%%XEROX-XIPP: Photometric 0
%%XEROX-XIPP: ImageLength 5088
%%XEROX-XIPP: ImageWidth 6592
%%XEROX-XIPP: ImageSize 216933
%%XEROX-XIPP: RowsPerStrip 1
%%XEROX-XIPP: SamplesPerPixel 1
%%XEROX-XIPP: FillOrder 1
%%XEROX-XIPP: ImageOffset 350
%%XEROX-XIPP: XResolution 600
%%XEROX-XIPP: YResolution 600
%%XEROX-XIPP: XRasterOrigin 0
%%XEROX-XIPP: YRasterOrigin 792
%%XEROX-XIPP: XPageSize 612
%%XEROX-XIPP: YPageSize 792
%%XEROX-XIPP: XBlockPosition 0
%%XEROX-XIPP: YBlockPosition 0
%%XEROX-XIPP: Scale 100
%%XEROX-XIPP: Messages 0
%%PageTrailer
```

```
<< /PageSize [612 792] >>
setpagedevice
gsave
/myfile
(C:\\TEMP\\jacobs2.con\\00000001.t
if) (r) file def
/DeviceGray setcolorspace
myfile 350 setfileposition
0 792 610 sub translate
 0 pop   % *** OK? ***   hShift
0 610 translate
-90 rotate
6592 600 div 72 mul 100 100 div
mul
5088 600 div 72 mul 100 100 div
mul scale
/wd 6592 def
/ht 5088 def
/bt 1 def
/decd [1 0] def
/picstr
{
 myfile
 <<
  /Uncompressed false
  /K -1
  /EndOfLine false
  /EncodedByteAlign false
  /Columns wd
  /Rows ht
  /EndOfBlock false
  /BlackIs1 true
 >> /CCITTFaxDecode filter
} bind def
```

```
/imdict
{
<<
  /ImageType 1
  /Width wd
  /Height ht
  /BitsPerComponent bt
  /Decode decd
  /ImageMatrix [wd 0 0 ht neg 0
ht]
  /DataSource  picstr
  /Interpolate false
 >>
} bind def
imdict image
myfile closefile
grestore
showpage
%%EOF
```

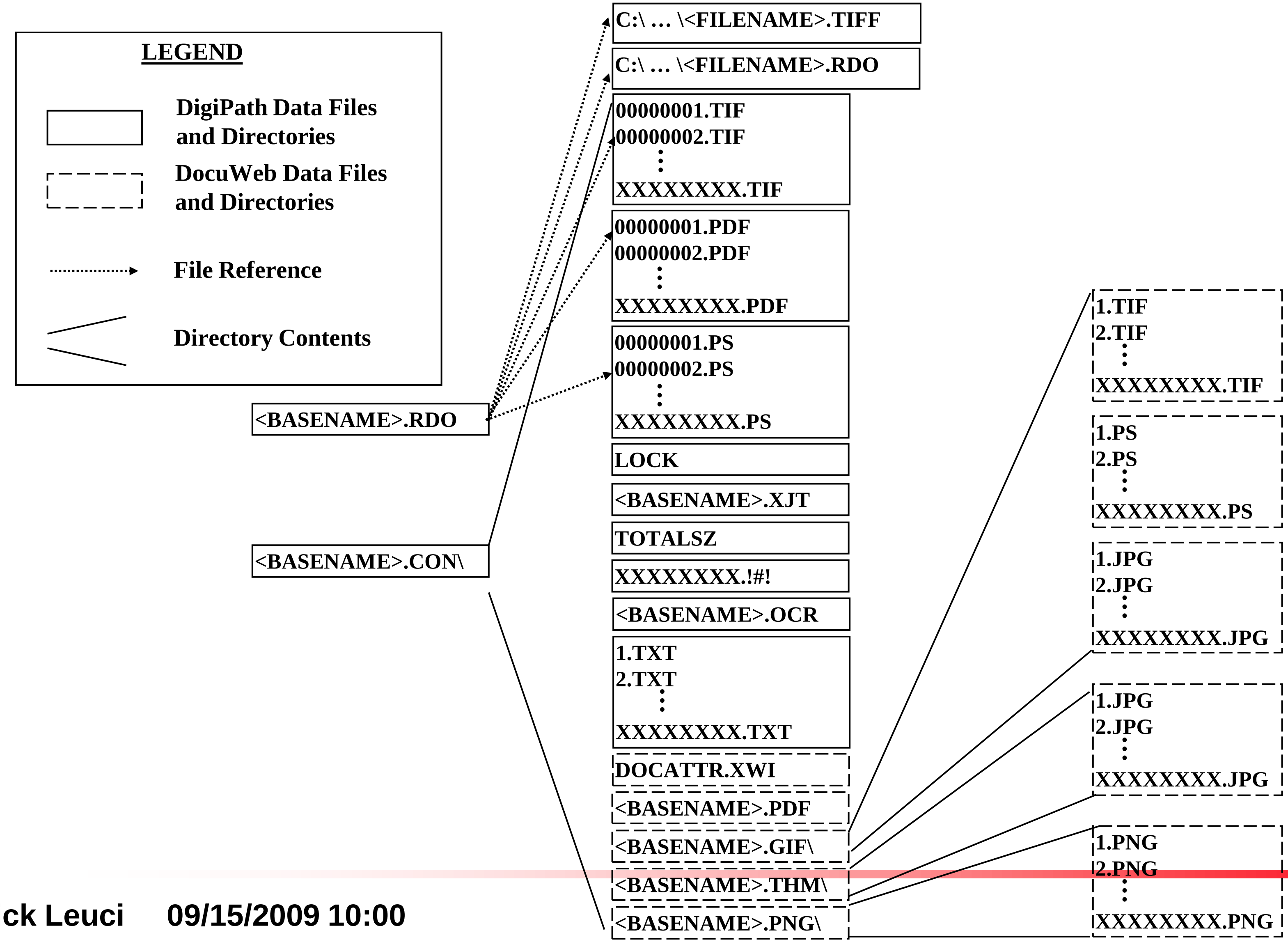
PostScript TIFF access information (ignored by NS and NS+)

TIFF header tag information as DSC comments (ignored by DocuSP)

DigiPath's Document Structure

- DigiPath uses the Raster Document Object (RDO) as its internal document format
- RDOs are
  - Compound documents
  - Editable
  - Printable
- RDO document composition
  - .RDO structure file
  - Raster images (TIFFs)
  - Final form documents (PDF or PostScript)
  - Other RDOs
  - Files for job tickets, web viewing, text search, and support
- Separation of small .RDO structure file from the large data content files improves both edit and print performance
- Since DigiPath data contents is either raster image or final form files, print file can be generated and submitted with minimal overhead
  - Standard PostScript interpreter can process data contents
  - No client side interpreter needed (e.g., to convert a Word file into printable pages)

DigiPath RDO File and Directory Structure



LEGEND

DigiPath Data Files and Directories

DocuWeb Data Files and Directories

File Reference

Directory Contents

<BASENAME>.RDO

<BASENAME>.CON\

C:\ … \<FILENAME>.TIFF

C:\ … \<FILENAME>.RDO

00000001.TIF
00000002.TIF
⋮
XXXXXXXX.TIF

00000001.PDF
00000002.PDF
⋮
XXXXXXXX.PDF

00000001.PS
00000002.PS
⋮
XXXXXXXX.PS

LOCK

<BASENAME>.XJT

TOTALSZ

XXXXXXXX.!#!

<BASENAME>.OCR

1.TXT
2.TXT
⋮
XXXXXXXX.TXT

DOCATTR.XWI

<BASENAME>.PDF

<BASENAME>.GIF\

<BASENAME>.THM\

<BASENAME>.PNG\

1.TIF
2.TIF
⋮
XXXXXXXX.TIF

1.PS
2.PS
⋮
XXXXXXXX.PS

1.JPG
2.JPG
⋮
XXXXXXXX.JPG

1.JPG
2.JPG
⋮
XXXXXXXX.JPG

1.PNG
2.PNG
⋮
XXXXXXXX.PNG

DigiPath’s Supported TIFFs

- DigiPath only supports certain CCITT Group 3 and 4 TIFFs with a single strip representing one continuous full width and height image
  - Does not support multistrip TIFFs
  - Does not support tiled TIFFs
  - Does not properly support multipage TIFFs
  - Since DigiPath’s own scanner generates most of DigiPath’s TIFFs, the exclusions are of minor significance
- Allows generation of simplified PostScript submission file
  - No need to construct more complex decode filters for multistrip or tiled TIFFs
  - Improves PostScript file generation time
  - Simpler PostScript can be RIPed more quickly

DigiPath’s Supported TIFFs (continued)

- When submitting TIFFs for production printing, DigiPath accesses each file’s header tags to set up the PostScript decode filter
- In standard production printing, raster image data is passed as a file reference + a file offset pointer
- In EC-PJM production printing, raster image data is copied to the PostScript data stream
- Binary black and white TIFFs are IQ targeted to specific IOTs, i.e., image data is device dependent

Summary

- DigiPath 2.0 production printing depends upon multiple features
- In moving to color production printing we must understand how all of these system elements interplay with one another