FSG Open Print

Architecture

Agenda

■ Introduction

- ☐ What is Open Printing Architecture ?
- ☐ Architecture Objectives
- ☐ Architecture Working Group Members
- ☐ Accomplishments

■ Technical Review

- ☐ Current Print Services
- ☐ Reference Model
- ☐ Preliminary Print Subsystem Model
- ☐ Use Models

■ Issues / Concerns

■ Next Step

FSG Open Print

Architecture

Introduction

What is Open Printing Architecture ?

- **Open Printing Architecture is a:**
  - ☐ Reference Model of the overall solution
  - ☐ High-Level Architecture abstracting interfaces between components
  - ☐ Detailed Architecture defining interfaces between components

- **Architecture elements contain:**
  - ☐ Reference Model (RM)
    - ■ Overall system diagram
    - ■ Functional decomposition into and description of subsystems.
    - ■ Identification of data and/or control and/or interface between subsystems and/or external systems.
  - ☐ High-Level Architecture (HLA)
    - ■ A glossary of terminology.
    - ■ Analysis and documented Use-Cases and requirements.
    - ■ Identification of applicable/recommended standards for subsystem interfaces.
    - ■ Identification of recommended infrastructure for integrating products.
  - ☐ Detailed Architecture (DA)
    - ■ Specification of system structure (classes, packages, associations – using UML).
    - ■ Specification of system behavior (activity and sequence diagrams – using UML).
    - ■ Identification of the system process structure.
    - ■ Identification of inter-process communication mechanisms.

- **A Open Printing Architecture:**
  - ☐ Guides development of abstract interfaces.

Open Printing Architecture Objectives

Introduction

- Develop a modern Print System for Linux

- Document realistic Use-Models

- Extract and analyze requirements

- Identify applicable, existing, interface specifications for the requirements

- Apply to multiple print services or be print service neutral.

- Complete and document Reference Model, High-Level Architecture, and Detailed Architecture.

Open Printing Architecture Members

- **Participants**

  - ☐ Claudia Alimpich (IBM)

  - ☐ Jody Goldberg (Gnome)

  - ☐ Mark Hamzy (IBM) - chair

  - ☐ Tom Hastings (Xerox)

  - ☐ Norm Jacobs (Sun)

  - ☐ Till Kamppeter (MandrakeSoft)

  - ☐ Ira McDonald (High North Inc)

  - ☐ Glen Petrie (Epson)

  - ☐ Pete Zannucci (IBM)

Accomplishments 2001

Introduction

- ## Oct 25-26, 2001 – Print Summit Meeting
  - ☐ Proposed Reference Model for Open Printing Architecture

Accomplishments 2002

Introduction

- None

Accomplishments 2003

Introduction

- ■ June 10, 2003 – FSG Portland Face-to-Face Meeting
  - ☐ Defined Reference Model

- ■ August 18, 2003
  - ☐ Started Architecture requirements document.

Accomplishments 2004

Introduction

- **Fef 16, 2004**
  - ☐ Completed top-level Use-Model descriptions

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Architecture

Technical Review

Existing Print Services

Technical Review

- **LPR/LPD**

- **IPP / (CUPS)**

- **LPRng**

- **PDQ**

- **PPR**

Open Print Reference Model
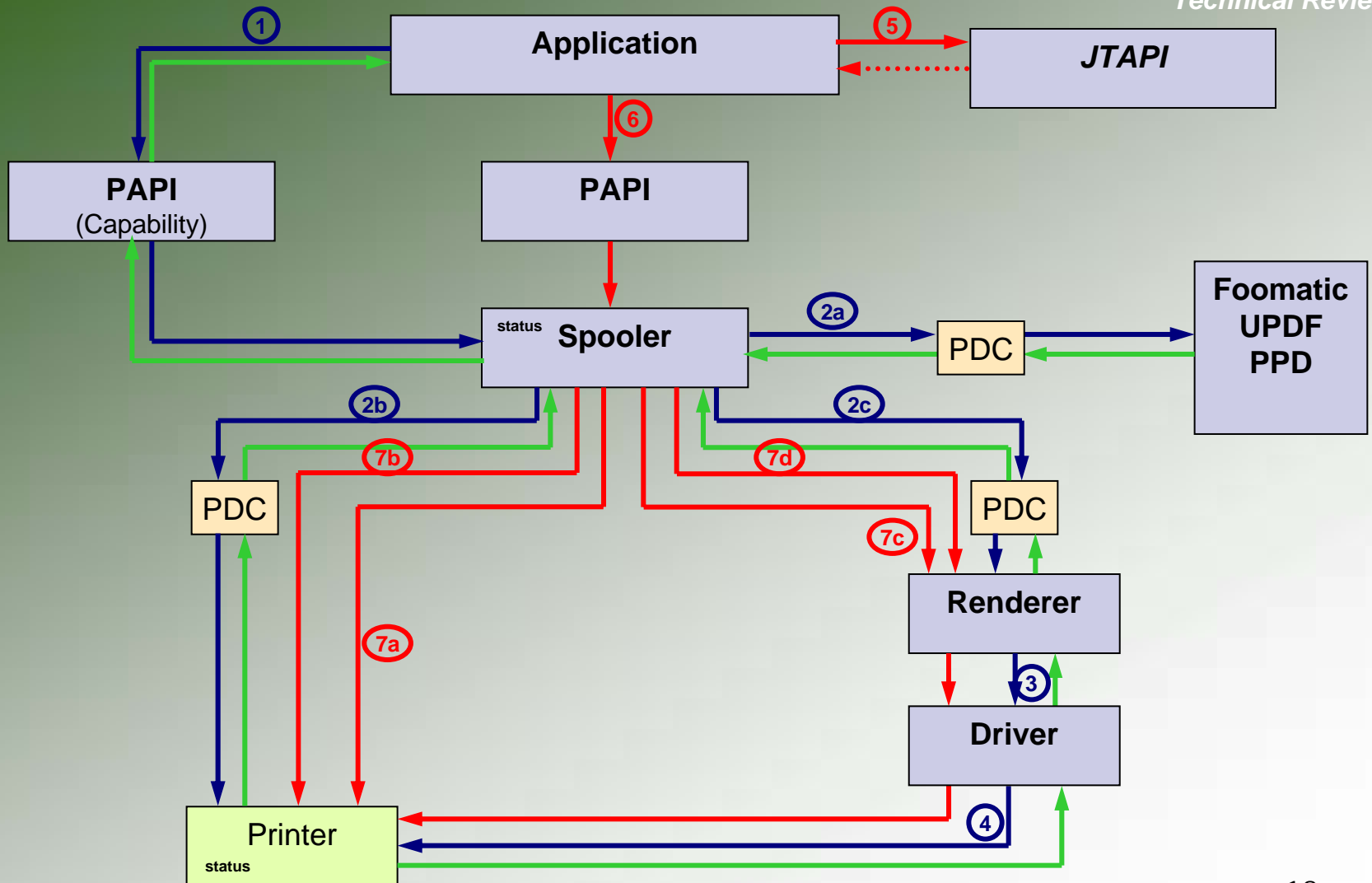
Preliminary Print Subsystem Model (1)
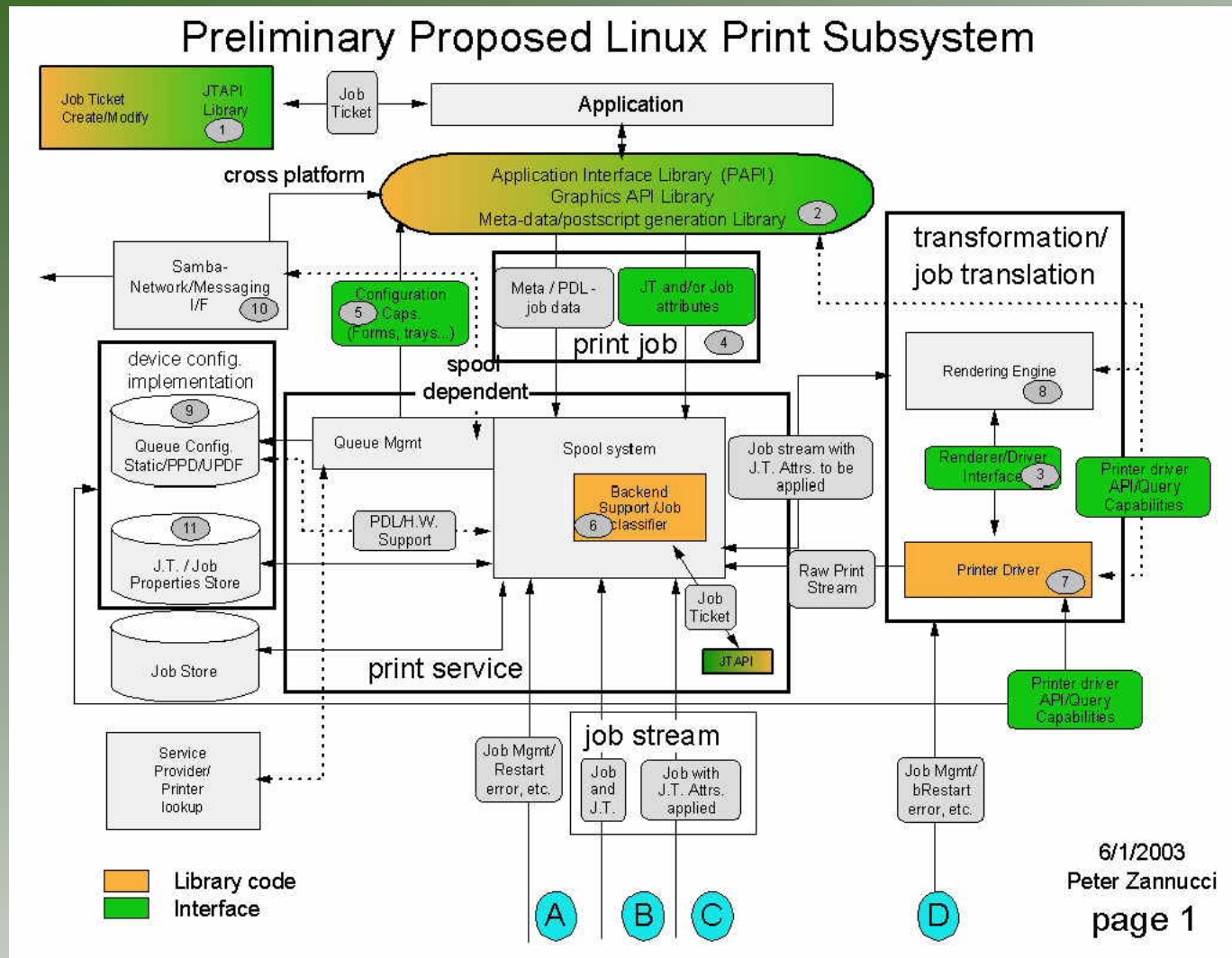
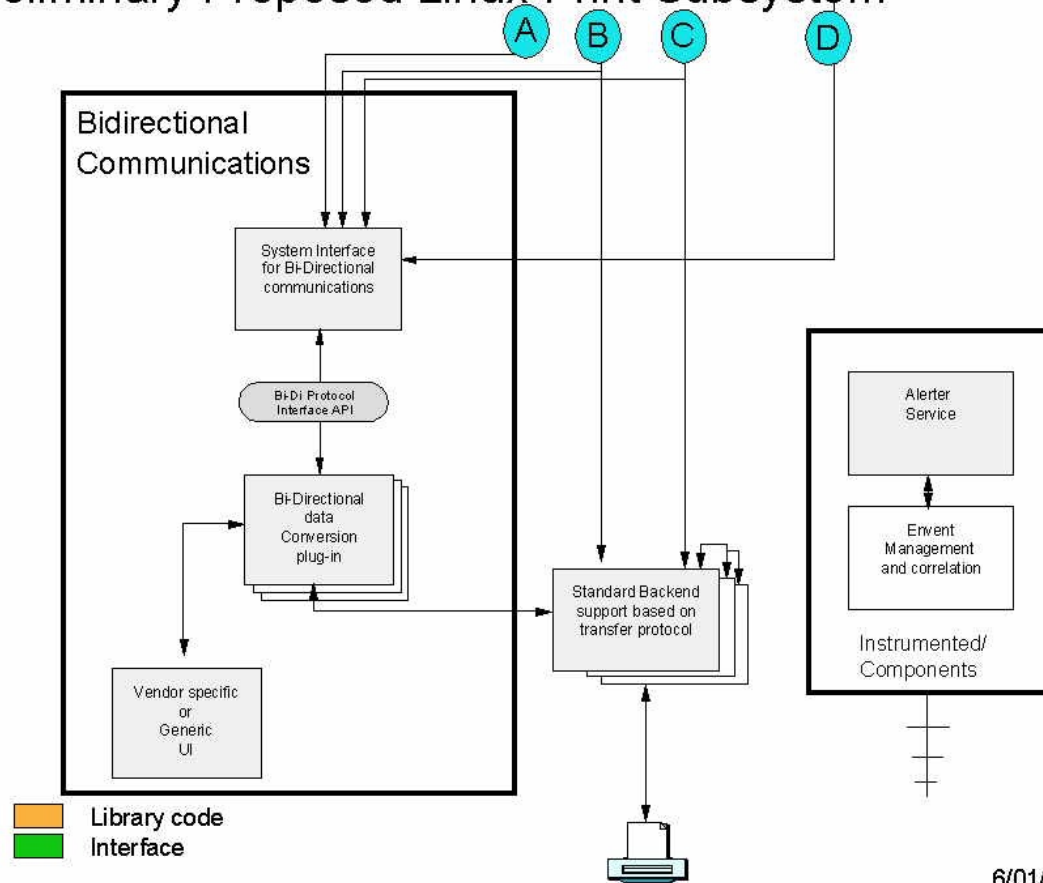# *Preliminary Print Subsystem Model (2)*

Preliminary Proposed Linux Print Subsystem

6/01/2003
Peter Zannucci
page 2

Use-Model (1)

1. **Mobile Printing**

   Mobile printing by reference with document data transformation.

2. **PDA Printing**

   PDA printing directly with document content.

3. **Desktop Personal (Consumer) Printing**

   Print to low end inkjet printer from an application.

4. **Desktop Small-Office/Home-Office Printing**

   Print to mid-volume laser printer, office inkjet and impact printers.

5. **Office Desktop Printing**

   Document from an application is printed on a printer shared by 3-5 workplaces.

Use-Model (2)

6. **Central (Print Room) Office Printing**

Mid to large volume printing from document repository with data transformation and post printing finishing

7. **Desktop File (Direct) Printing**

Print to print device directly form the file-manager/shell-script without going through an application.

8. **Pay-for-Print Printing**

Print using a job ticket from a print driver through a print spooler to a mid-range color laser printer.

9. **Production Printing**

Large volume transactional printing to high-speed production printer.

10. **Graphics Art Printing**

Large volume journal printing to high-speed printing press.

Mobile Printing Use-Model (1)

1.0 Mobile Printing

Mobile printing by reference with document data transformation.

Example Use Model:

Alice goes shopping for a new digital camera to the Fine Camera store downtown. She takes along a magazine review of the new Bright 3000. The sales clerk at the Fine Camera store tells Alice that she would probably prefer the Orion 777. Alice uses her mobile hand-held to browse the Web site of Bright and find the URL for the detailed specs of the Bright 3000. She uses the public access printer in the Fine Camera store to print the Bright 3000 specs. Sure enough, the Orion 777 is a better choice.

Mobile Printing Use-Model (2)

Details: (1)

Alice turns on her mobile hand-held and hits the 'I' (Internet) button. The mobile hand-held starts a Web browser application, which connects to Alice's wireless Internet service provider (ISP) over a 14.4Kbps cellular modem. Alice types the Bright URL (from the magazine review) into her Web browser and hits the Enter key. The Web browser connects to Bright's home page over the Internet (via the HTTP proxy in the cellular ISP's firewall). Alice searches for the Bright 3000 specs (available in HTML) and copies the URL into her GUI clipboard.

Alice hits the 'P' (Print) button. The mobile hand-held starts a print application, which discovers the store's public access printer over Bluetooth using FSG/OP PAPI (which does Bluetooth device discovery) and then forms an ad-hoc wireless Personal Area Network (PAN) with the Target Printer.

Mobile Printing Use-Model (3)

Details: (2)

Alice pastes the saved URL from her GUI clipboard into the print application and hits the Enter key. The Print application sends the URL of the Bright 3000 specs (in HTML) to the Target Printer over Bluetooth using FSG/OP PAPI (sends a Bluetooth Print-By-Reference operation) and then subscribes for print job event notifications using FSG/OP PAPI (sends a Bluetooth Get-Event operation).

The Target Printer creates a second a print job by sending the URL of the Bright 3000 specs to the local Print Service over the store's Ethernet LAN using FSG/OP PAPI (sends an IPP Print-URI operation).

The Print Service fetches the Bright 3000 specs (in HTML) from the Content Provider (Bright's Web server) over the Internet (via the HTTP proxy in the store's Internet firewall).

Mobile Printing Use-Model (4)

Details: (3)

The Print Service transforms the Bright 3000 specs from HTML to Post Script using an FSG PAPI extension or the FSG/OP Transform Service API .

The Print Service creates a third print job by sending the transformed Bright 3000 specs to the Target Printer over the store's Ethernet LAN using FSG/OP PAPI (sends an IPP Print-Job operation).

The Target Printer sends a print job completed notification to the print application in the mobile hand-held over Bluetooth using an FSG/OP PAPI extension (sends a response to the previous Bluetooth Get-Event operation). The print application in the mobile hand-held displays "Print job completed successfully" in a status box. Alice turns off her mobile hand-held, breaking the cellular connection to her wireless ISP and also breaking the Bluetooth PAN link to the store's public access printer.
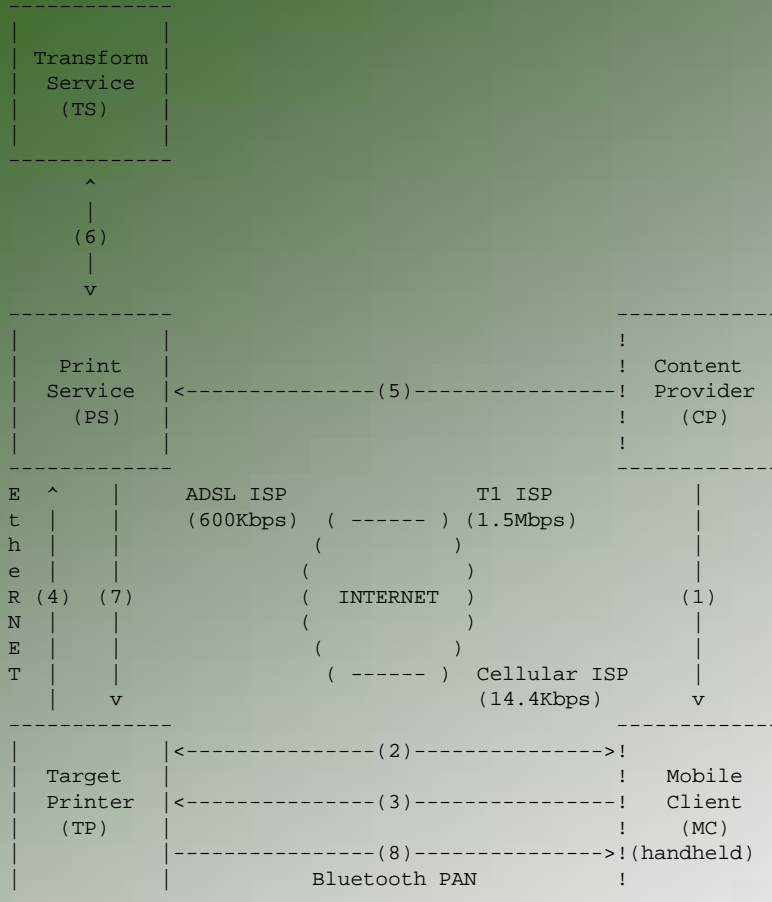
Mobile Printing Use-Model (5)

Details: (4)

Alice picks up her hard-copy print output of the Bright 3000 specs from the store's public access printer.

Exceptions for Use Model:

None noted at this time.

Mobile Printing Use-Model (6)

Use Model Diagram:

```
-------------
|           |
| Transform |
|  Service  |
|    (TS)   |
|           |
-------------
     ^
     |
    (6)
     |
     v
-------------                                      -------------
|           |                                      !           |
|  Print    |                                      ! Content   |
|  Service  |<----------------(5)------------------! Provider  |
|   (PS)    |                                      !   (CP)    |
|           |                                      !           |
-------------                                      -------------
E  ^   |    ADSL ISP          T1 ISP          |
t  |   |    (600Kbps)  ( ------ ) (1.5Mbps)   |
h  |   |              (          )            |
e  |   |             (            )           |
R (4) (7)            (  INTERNET  )          (1)
N  |   |             (            )           |
E  |   |              (          )            |
T  |   |               ( ------ ) Cellular ISP |
   |   v                          (14.4Kbps)   v
-------------                                      -------------
|           |<---------------(2)--------------->!           |
| Target    |                                   ! Mobile    |
| Printer   |<---------------(3)----------------! Client    |
|   (TP)    |                                   !   (MC)    |
|           |----------------(8)--------------->!(handheld) |
|           |          Bluetooth PAN            !           |
-------------                                      -------------
```

1. MC-CP: Internet browse for content URL
2. MC-TP: Bluetooth discovery of wireless printer
3. MC-TP: Bluetooth Print-By-Reference of content URL
4. TP-PS: IPP Print-URI of content URL
5. PS-CP: HTTP Get of content URL
6. PS-TS: Convert content data from HTML to PCL
7. PS-TP: IPP Print-Job of converted content data
8. TP-MC: Bluetooth print completed notification

Mobile Printing Use-Model (7)

Use Model Diagram:

Security Domains:

MC-ISP: Alice's cellular Internet connection (wireless ISP)

MC-TP: Alice's ad-hoc network (Bluetooth wireless PAN)

TP-PS: Fine Camera's enterprise network (Ethernet LAN segment)

PS-ISP: Fine Camera's Internet connection (ADSL modem to ISP)

CP: Bright's enterprise network (Ethernet LAN segment)

CP-ISP: Bright's Internet connection (T1 circuit to ISP)

Cloud: Internet backbone

Mobile Printing Use-Model (8)

Requirements for this Use Model:

The FSP/OP Architecture MUST support:

- Administrative configuration of Print Services and their associations with Target Printers using FSG/OP PAPI;

- Administrative configuration of Target Printers and their associations with Print Services using FSG/OP PAPI;

- Dynamic discovery of network (IP, Bluetooth, IRDA, etc.) Print Services and Target Printers using FSG/OP PAPI;

- Multiple print protocol bindings of FSG/OP PAPI (for direct-connect and non-IP network printing);

- Print-by-reference operations (for example, printing from low-bandwidth mobile devices);

- Print-by-value operations (for example, printing of converted or local content);

- Content conversion by FSG/OP Transform Services (for example, reference printing);

- Job and Printer event notification (for example, job complete, printer intervention required, etc.).

Mobile Printing Use-Model (9)

Requirements for similar Use Models:

- Dynamic discovery of direct-connect (USB, parallel, etc.) local Print Services and Target Printers using FSG/OP PAPI;

FSG Open Print

Architecture
Issues/Concerns

Issues / Concerns

■ Need Japanese market printing Use-Models.

■ How to accelerate Architecture work to meet the subsystem development schedules.

■ How to engage other printer solution developers to participate in FSG Open Printing.

■ Prioritizing identified subsystems that should be addressed next.

■ Resources and/or Funding for Reference Implementation.
  ☐ Supplied by FSG
  ☐ Supplied by End User – Japanese, European, North American Governments
  ☐ Supplied by Contributing Companies
  ☐ Supplied by Volunteers

Impact is Schedule, Schedule and Schedule

FSG Open Print

Architecture

Next Steps

What's next - schedule

■ Open Print Requirements Document

- □ May   27, 2004 - Complete prioritization of identified sub-systems
- □ Sept   24, 2004 - Complete requirements details
- □ Nov   28, 2004 - Integrate FSG-Japan Use-Models
- □ Jan   26, 2005 - Identify and summarize requirements

■ High-Level Architecture/Reference Model

- □ Sept   31, 2005 - Completed document

■ Detailed Architecture

- □ June 1, 2006   - Complete document

How to accelerate the process and schedule?

24 March 2004   **Funding ! More Participants !**   **30**

FSG Open Print

Architecture
Questions / Comments

Architecture Working Group Information

- Weekly FSG Architecture conference calls
  - ☐ Thursday at 3:00 PM US Eastern for 1-2 hours

- To subscribe to FSG Architectcure mailing list:
  - ☐ http://freestandards.org/mailman/listinfo/printing-architecture

- To post a message to FSG Architecture mailing list
  - ☐ printing-architecture@freestandards.org

- To view FSG Architecture mailing list archives
  - ☐ http://freestandards.org/mailman/listinfo/printing-architecture

- To find FSG Architecture documents
  - ☐ ftp://ftp.pwg.org/pub/pwg/fsg/archtiecture/

FSG Open Print

Architecture
Support Slides

Mobile Printing Use-Model (1)

1.0 Mobile Printing

Mobile printing by reference with document data transformation.

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Mobile Printing Use-Model (2)

Details: (1)

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Alice hits the 'P' (Print) button. The mobile hand-held starts a print application, which discovers the store's public access printer over Bluetooth using FSG/OP PAPI (which does Bluetooth device discovery) and then forms an ad-hoc wireless Personal Area Network (PAN) with the Target Printer.

Mobile Printing Use-Model (3)

Details: (2)

Alice pastes the saved URL from her GUI clipboard into the print application and hits the Enter key. The Print application sends the URL of the Bright 3000 specs (in HTML) to the Target Printer over Bluetooth using FSG/OP PAPI (sends a Bluetooth Print-By-Reference operation) and then subscribes for print job event notifications using FSG/OP PAPI (sends a Bluetooth Get-Event operation).

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Mobile Printing Use-Model (4)

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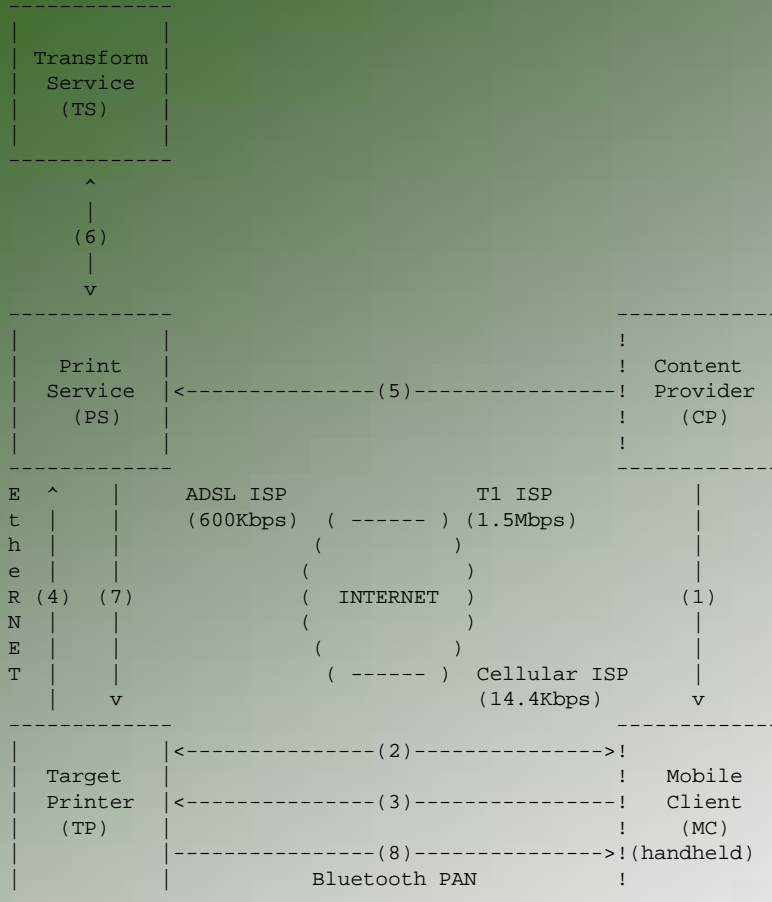# *Mobile Printing Use-Model (5)*

Details: (4)

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Exceptions for Use Model:

None noted at this time.

Mobile Printing Use-Model (6)

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```
-------------
|           |
| Transform |
|  Service  |
|    (TS)   |
|           |
-------------
      ^
      |
     (6)
      |
      v
-------------                                    -------------
|           |                                    !           |
|   Print   |                                    ! Content   |
|  Service  |<---------------(5)-----------------! Provider  |
|    (PS)   |                                    !   (CP)    |
|           |                                    !           |
-------------                                    -------------
E  ^   |      ADSL ISP          T1 ISP          |
t  |   |     (600Kbps)  ( ------ ) (1.5Mbps)    |
h  |   |             (          )               |
e  |   |            (            )              |
R (4) (7)          (   INTERNET   )            (1)
N  |   |            (            )              |
E  |   |             (          )               |
T  |   |          ( ------ )  Cellular ISP      |
   |   v                      (14.4Kbps)        v
-------------                                    -------------
|        |<---------------(2)---------------->!           |
| Target |                                    ! Mobile    |
| Printer|<---------------(3)-----------------! Client    |
|  (TP)  |                                    !   (MC)    |
|        |----------------(8)---------------->!(handheld) |
|        |         Bluetooth PAN              !           |
-------------                                    -------------
```

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3. MC-TP: Bluetooth Print-By-Reference of content URL
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Mobile Printing Use-Model (9)

Requirements for similar Use Models:

- Dynamic discovery of direct-connect (USB, parallel, etc.) local Print Services and Target Printers using FSG/OP PAPI;

PDA Printing Use-Model

2.0 PDA Printing

TBD

Example Use Model:

TBD

Desktop Personal Printing Use-Model

3.0 **Desktop Personal (Consumer) Printing**

Print to a low end inkjet printer from an application

Example Use Model:

Dorothy has been editing and formatting her biology term paper for weeks. She takes her laptop computer to class and constantly updates her term paper with new information from the lectures and labs. She uses her portable scanner and graphics editor to illustrate the step-by-step processes in her term paper as well as the final charts and graphs which will are all integrated into her word processor. She does not final edit the night before. Then she loads her 2000XYZ-Color inkjet printer with the special paper required by the professor; she connects the USB cable from her printer to her laptop and she's ready to print. She has already formatted the print job but brings up the print preview window to double check as the special paper is expensive. Finally, she brings up the print dialog box and makes her selections. She selects collated copies, highest print quality and background printing mode before hitting the print button (she still has work on her chemistry assignment). Thirty-eight minutes later she removes the printed pages, carefully inspects each page and staples each copy into special cover sheets for the biology class.

Desktop SOHO Printing Use-Model

4.0 Desktop Small-Office/Home-Office Printing

Print to mid-volume laser printer, office inkjet and impact printers

Example Use Model:

Keith's small company produces about 5000 widgets a month for a large industrial customer. Keith has two employees and the customer now wants a data sheet on each widget along with a summary report. The data base has been completed for the month and all the widgets have been packaged. The three print task that Keith needs to perform this month are:

a Keith then brings up the data base and requests a text summary report - he'll need 25 copies this month. From the command-line Keith sends the text summary report to the print system requesting 25 copies. Within seconds, the laser printer, connect over a BlueTooth adaptor, warms up and begin producing the 25 copies.

b. Keith returns to the data base software and now request data sheets (in post-script) for each widget. Keith spent weeks designing/creating the template for the data sheets, including color and graphics. Navigating to the directory with this month's data sheets; he again sends post-script formatted data sheets to the print system, requesting two copies of each data sheet on the office inkjet printer.

c. Concurrently, Keith decides to do the timecards for his temporary employees. The temporary employee agency requires 3-part timecards to be submitted. The impact printer is loaded with pin-feed 3-part stock and is connected via the parallel port. After looking over the spread data, Keith selects the print action in the accounting software instructing the application to send a text version the timecard data to print system.

Office Desktop Printing Use-Model (1)

5.0 Office Desktop Printing

Document from an application is printed on a printer shared by 3-5 workplaces.

Example Use Model:

Till is working in an office with three other employees; namely, Claudia, Mark and Glen that have individual computers. In the same room there are two printers; specifically, a low-volume color inkjet connected to Mark's computer and a low-volume black/white laser printer connected to Glen's computer for printing confidential material. Till wants to print some color documents to the color inkjet printer and print his black-and-white documents to the laser printer. All document have differing quality requirements. Because the documents are confidential then should be printed not be on the central printer in the hallway.

Office Desktop Printing Use-Model (2)

Details:

Till creates a confidential document containing color photos in an office application on his desktop computer. He chooses "File"/"Print" in his application program to print the document.

The application program contacts the local print service on Till's computer to request the available printers and their capabilities such as Description, Location, bw/color, photo-capable, ...

The local print service communicates with the other print services on the local network to exchange the information of the available printers.

All machines hosting and sharing a print queue advertises a list of their print queues and server's IP addresses to all computers on the network.

All other print services are listening for these advertisements to receive the print queue list.

The local print service knows about the existence of all queues now and asks all print servers for their basic printer capabilities. As an example the following is returned for the color inkjet, laser print and the central hallway printer;

inkjet:Mark 6-ink photo color printer, room of W, X, Y, and Z;

laser:Glen desktop bw laser printer, 10 p/min, room of W, X, Y, and Z

central_server:XYZ workgroup color laser 50 p/min, hallway 1st floor

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Office Desktop Printing Use-Model (3)

Details:

Then the local print service sends the information to the application program

The application displays the printing dialog with the available printers.

Till chooses the photo-capable color inkjet printer in his office, so that no one can see this confidential document.

This document is for a valued customer so Till wants to produce the document on high quality paper in high resolution. Till clicks on the options button to display a vendor specific option dialog for this printer. Tills selects photo print quality mode on glossy inkjet paper in the option dialog. Till closes the option dialog and returns to the print dialog.

Till selects "Notification on job completion".

Till clicks the "Print" button in the printing dialog to initiate printing.

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Office Desktop Printing Use-Model (4)

Details:

The application PostScript generator resizes the photos from the camera's 14 mega-pixels to the 600 DPI of the inkjet printer and creates the PostScript document with all fonts and photos embedded. The application PostScript generator stops with a message dialog because elements of the document located outside the margin area. Till clicks "Yes" to override the nominal printing margins and/or accept clipping.

The application submits the print job to the local spooler with all options specified in a job ticket.

The local spooler passes the print job on to the remote spooler on Mark's machine.

The spooler on Mark's machine parses the job ticket and calls the appropriate renderer and driver to spool converted job data in the inkjet's native language.

The spooler on Mark's machine sends an alert to Till's machine indicating that should photo paper be loaded.

Office Desktop Printing Use-Model (5)

Details:

Till's machine displays a job dialog to load photo paper.

Till loads the photo paper and clicks "OK".

The job dialog on Till's machine, via PAPI/IPP, notifies the spooler on Mark's machine has been photo paper is loaded.

The spooler on Mark's machine sends the rendered job data to the USB port and the printer begins printing.

Till receive the job completion notification in a job dialog.

Till clicks "OK" and walks to the inkjet printer and picks up his document.

Central Office Printing Use-Model

6.0 Central (Print Room) Office Printing

Mid to large volume printing from document repository with data transformation and post printing finishing

Example Use Model:

To be re-written.

Desktop File Printing Use-Model

7.0 Desktop File (Direct) Printing

Print to print device directly from file-manager/shell-script without going through an application

[Note: Print to print service directly from file manager versus going through application.]

Example Use Model:

Robert is the lead engineer on the power subsystem of the company's next generation satellite. He has spent the last 6 month working with individual engineering and other departments on no less than 12 interrelated specifications and design documents. People have been delivering him Postscript versions of their document over the last several days. Robert recently bought a wide format color inkjet printer from the Acme print company. The printer does not print Postscript natively; so Robert downloads and installs the latest version of GhostScript along with the print driver from the web. Robert types in the print options, printer model, the output URL and location of the print data for GhostScript at the command line and wait for each document to be printed. Robert begins the task of checking and removing ambiguities between the specifications.

Example two of Model: - With Auto discovery (direct connect and network connect) and install.

To be written

Pay-for-Print Printing Use-Model (1)

8.0 Pay-for-Print Printing

Print using a job ticket from a print driver through a print spooler to a mid-range (90 PPM) color laser printer.

Example Use Model:

Amy is a student at the university who has to do research on controlling forest fires near densely populated areas. She decides to go the library at the university so that she can access restricted archives of information pertaining to her topic. The archive contains research papers that have information that is controversial, so some of the information has never been made public.

Amy was given a PrintCard by the university at the beginning of the semester that gives her $10 worth of print credit. The PrintCard has a magnetic strip which is encoded with her student Id and the balance for her printing account. Duplex black/white prints cost 10 cents per sheet and duplex color prints cost $1 per sheet. The student must enter their student ID and a PIN code to use the PrintCard.

Amy searches the restricted archives and finds a document of interest, both for use in her research and to her parents whose house was recently burned down by a forest fire. The document is formatted to print on legal size paper and has front and back cover sheets.

Pay-for-Print Printing Use-Model (2)

Example Use Model: (2)

Amy selects the Print menu item on the Netscape browser and the Print dialog displays. She selects a printer called ColorLibraryPrinter. She selects legal size paper, duplex, covers, left corner staple, and two copies (one for her parents and one for herself). She clicks the OK button. A dialog displays asking her to swipe her PrintCard and to enter her student ID and PIN number. She does as instructed and clicks OK.

A print application is called by the print driver to create a job ticket that contains the information that Amy selected in the Print dialog. The print application pre-appends the job ticket that it generated to the postscript file that was generated by the print driver and returns the result to the print driver. The print driver makes contact with Print Services and sends the print job that contains the ticket pre-appended to the Postscript file to the Print Service over the network. The Print Service recognizes the print job as a ticketed job, strips off the job ticket and consumes the job ticket. From the consumed job ticket, the Print Services extracts the name of the printer that the print job is to be sent to and maps the name to the IPP URL of the printer. The Print Service contacts the printer called ColorLibraryPrinter using its IP address and sends the print job that contains the job ticket pre-appended to the postscript file to ColorLibraryPrinter. ColorLibraryPrinter receives the print job, recognizes that the print job contains a ticketed job, strips off the job ticket, and consumes the job ticket.

Pay-for-Print Printing Use-Model (3)

Example Use Model: (3)

Amy walks to the first floor of the library to the printer labeled ColorLibraryPrinter. She swipes her PrintCard and enters her student ID and PIN on the printer console when prompted. A summary of Amy's print job appears on the printer console asking her if the options are correct. Amy has decided to also print a copy of the paper for her brother Tim, so she changes the number of copies to three and clicks OK. Amy's print job completes printing and her PrintCard debited. She picks up her print job from the printer's over-size output bin and examines the output. A message on the printer console asks if the print output looks correct. Amy clicks OK. Amy leaves the library with the three copies of the research paper.

To be restructured to have a single paragraph and details in above moved to Details section below.

Production Printing Use-Model

9.0 Production (Transactional, Statements) Printing

    TBD

Example Use Model:

TBD

Graphics Art Printing Use-Model

10.0 Graphics Art (non-offset) Printing
TBD

Example Use Model:
TBD