OpenPrinting

We make printing just work!

2000 – 2025: 25 years of printing for FOSS

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What we are doing

- Development of printing **architecture**, **technology**, **infrastructure** on Linux, Unix, and POSIX-style operating systems
- Collaboration with **IEEE-ISTO Printer Working Group (PWG)** especially on the **Internet Printing Protocol (IPP)**
- **Driverless scanning** support in cooperation with SANE
- Integration of printing with the **desktop environment**, esp. print dialogs and printer setup tools
- Integration in **all types of operating systems** (classic DEB, RPM, .../immutable) with **all packaging methods** (Snap, Docker, ...)
- **Printer/driver compatibility look-up lists** (Driverless printers, Foomatic)
- Helping **manufacturers** on printer driver design and integration

What we are doing

- **Maintaining the components**
  - CUPS
  - cups-filters
  - ipp-usb (IPP over USB)
  - Common Print Dialog Backends (CPDB)
  - pappl-retrofit
- **Printer compatibility databases**
  - Foomatic
  - List of driverless printers
- **Contribtutions to other projects:** GNOME, KDE, LibreOffice, ...

How it all began ...

- I was **system administrator** in Theoretical Physics department in 1997-2000
- We had **Unix** (SGI, Digital) and **Linux** (SUSE) machines
- **Printing via LPD**
- 2 **PostScript laser printers**: **2 trays**, **Duplex** (Off/Long Edge/Short Edge)
- **LPD has no support for options**, but **tricky scripting** (by my predecessors) allowed users to select tray and duplex mode
- We got **color laser with many more options**, only **proprietary GUI** to select everything

How it all began ...

- **CUPS 1.x** came in the beginning 2000
- **Article about CUPS** in German “Linux Magazin”, by **Kurt Pfeifle**, made me discover CUPS
- I **deployed CUPS in department**, fully supports PostScript printers, including all options via PPD (PostScript Printer Description) files
  => Makes color laser fully supported under Linux
- CUPS only has command line interface for options, so I quickly wrote up a **simple print dialog** (X Printing Panel, XPP) with FLTK toolkit.
- **Published it on Freshmeat**
- **Kurt Pfeifle discovered it**, invited me to the **LinuxTag 2000**, largest free software show in Europe, in July 2000 ...

How it all began ...

- ... and in August 2000 **I lived in Paris**! (Do not try to speak French with me)
- Hired by **MandrakeSoft**, first task to **switch their distro to use CUPS**!
- I had to **package CUPS** ...
- ... but also get **PPD files for all the printer drivers** which were available for LPD
- There was the **linuxprinting.org** site with a printer/driver compatibility database and an **automatic PPD file generator**, Foomatic
- There was not enough driver data, had to fill in **invocation command lines** and **option lists**
- **All this made the fall-2000 edition of Mandrake Linux work with CUPS, without loss of support for any printer!**

How it all began ...

- Printing got **much easier** with Mandrake Linux
- And I did a lot of **evangelism** and **community work**:
  - **Community booths about OpenPrinting** on LinuxTag 2001-2006
  - Half-day and full-day **workshops about CUPS** on system administrator and developer and admin conferences
  - Many **talks** on different conferences
  - Organized **hackfests**
- All this **made the other distributions follow**, making CUPS the standard
- **Other printing systems**, like LPD, LPRng, PPR, ... **disappeared** and got not maintained any more

How it all began ...

- Co-founded **OpenPrinting** in 2001
- Participated in **development of printing-related APIs**
- **Organized first OpenPrinting Summit** in 2006 in Atlanta, Georgia
- On the Summit **Ian Murdock** (founder of Deb**Ian**) **invited me to work at Free Standards Group full-time** to **merge linuxprinting.org into OpenPrinting** and **manage OpenPrinting**.
- In 2007 **Free Standards Group and OSDL merged** to be **the Linux Foundation** and so OpenPrinting got part of the Linux Foundation
- From 2006 on **I worked full-time on OpenPrinting**, full-time at the Linux Foundation, 1/3 part-time at **Canonical** (for Ubuntu packaging)
- **I Got one of the 8 fellows of the Linux Foundation**

How it all began ...

- I organized **annual OpenPrinting Summits**, later together with the Printer Working Group (PWG)
- Since 2008 I organized the **participation of the Linux Foundation in the Google Summer of Code**, accepted every year
- From 2015 on I worked together with **Aveek Basu** (that time at Lexmark India). Aveek found GSoC contributors at Indian universities, most from IIT Mandi. He also created a **selection process** for OpenPrinting GSoC contributors
- From 2023 annual **Opportunity Open Source Conferences in India**, to attract students to participate in Open Source. Mandi 2023 helped to bring 11 GSoC contributors to OpenPrinting!

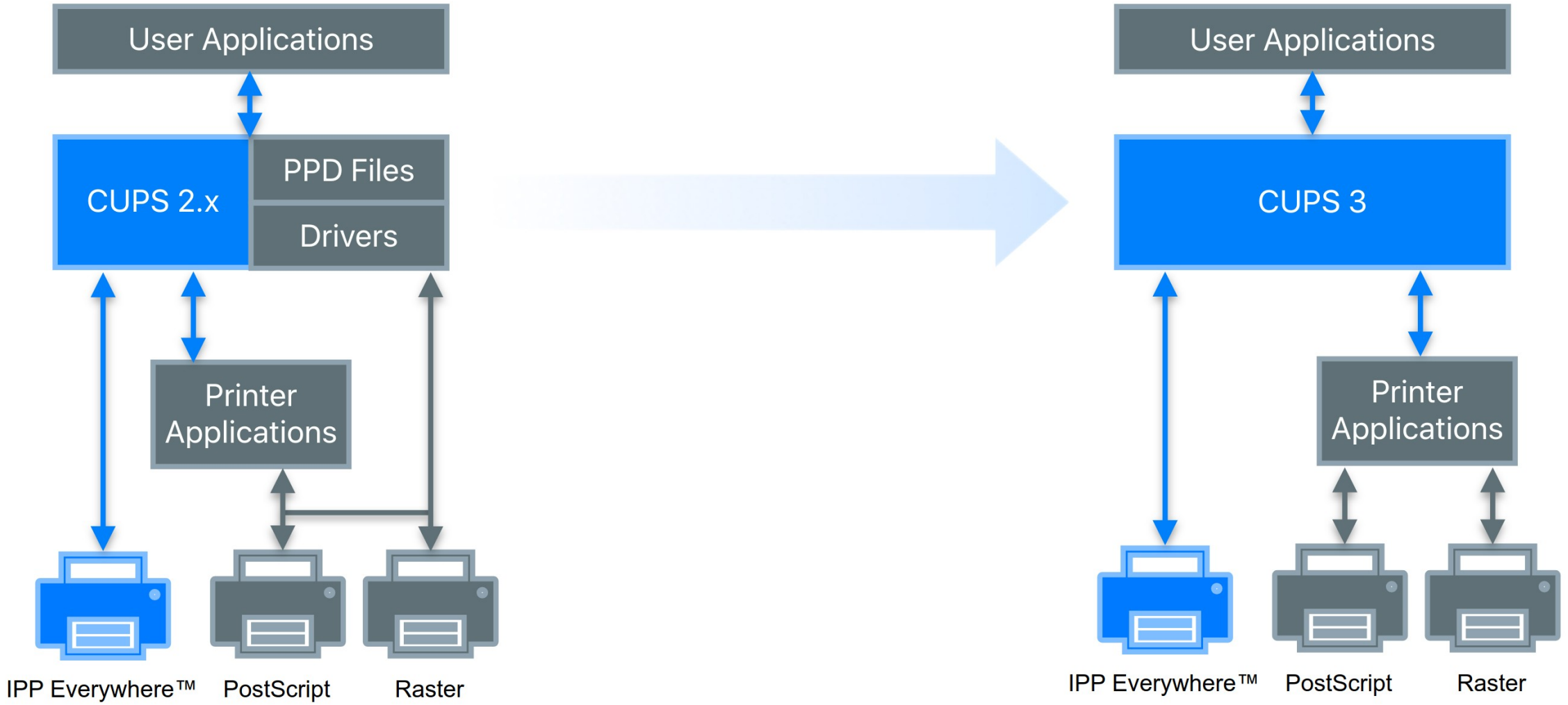
Achievements

- Made **CUPS** the **standard printing system** for POSIX-style operating systems
- **All free printer drivers work with CUPS**
- Switched **standard print job forma**t from PostScript to **PDF**
- **Grand unified Ghostscript**: Merged Mike Sweet’s ESP Ghostscript fork and all third-party drivers into upstream Ghostscript at Artifex.
- **System-config-printer** improvement and maintainership
- **cups-filters**: Continued filters and backends which Apple dropped
- **Common Print Dialog Backends**
- **All free printer drivers in Printer Applications**
- **Snaps** and **OCI container images** of **CUPS** and **Printer Applications**

New Architecture for Printing and Scanning

- **Modern printers are driverless IPP**
  - Auto-discoverable via DNS-SD
  - Tell full capabilities via IPP
  - Use standard job formats: PDF, PWG Raster, Apple Raster, PCLm
- **Stop** supporting **PostScript Printer Description** files (PPD, deprecated)
- **CUPS gets all-IPP**, no classic PPD/filter-based drivers (CUPS 3.x)
- Driver still needed? Use **Printer Applications**, a software **emulation of IPP printers**

New Architecture for Printing and Scanning



New Architecture for Printing and Scanning

- Needs
  - Desktop integration
    - **Printer setup tools**: GNOME Control Center, KDE, desktop-independent, for further desktops
    - **Print dialogs**: CPDB support for GTK and Qt dialogs, also for LibreOffice, Mozilla (Firefox, Thunderbird), Chromium Browser
  - **Scanner Applications to replace SANE**
- Nice to have
  - **Native Printer (Scanner) Applications** for HPLIP, Gutenprint

CUPS

- **CUPS 2.5.x**
  - **Features**
    - **Oauth 2.0/OpenID** authentication
    - Discovery: **“Wide-area” DNS-SD** (DNS-SD over traditional DNS)
    - Localization: **Join Weblate**, **multi-language PPDs** for driverless IPP
    - **"job-sheets-col"** (banner pages on specific media using standard formats)
    - Security: **X.509 certificate** management improvements
    - **Web interface**: Modernization/"face lift"
    - **API backports from libcups3**: HTML form, IPP file, JSON/JWT, X.509 certificates
  - **Beta1 release**: Somewhere in the coming weeks

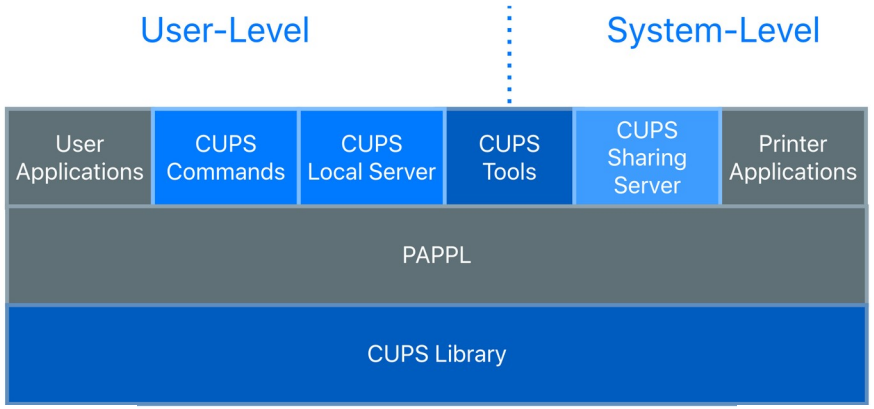
CUPS

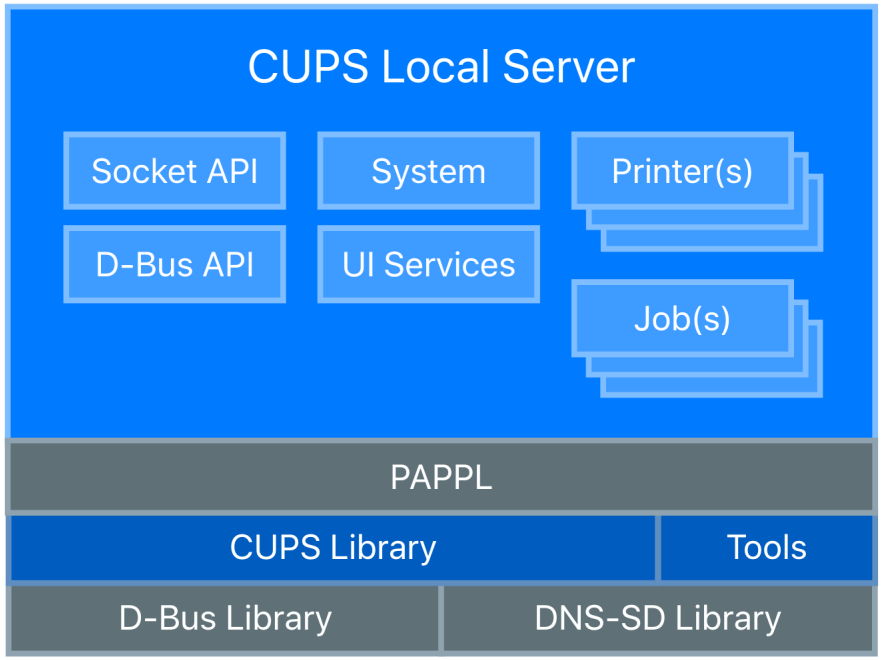
- **CUPS 3.x**
  - **Features**
    - **Modularization**
      - **libcups3** + CUPS tools (ipptool, ...)
      - **Local server** + command line utilities (lp, lpstat, ...)
      - **Sharing server**
    - **All-IPP – New Architecture**
      => **Printer Applications** required for legacy printers
    - To be **removed**: PPD support, Kerberos support
  - All components to be released up to **January/February 2026**
  - **Ubuntu** switchover in **26.10** (Such a big change not accepted in 26.04 **LTS**)

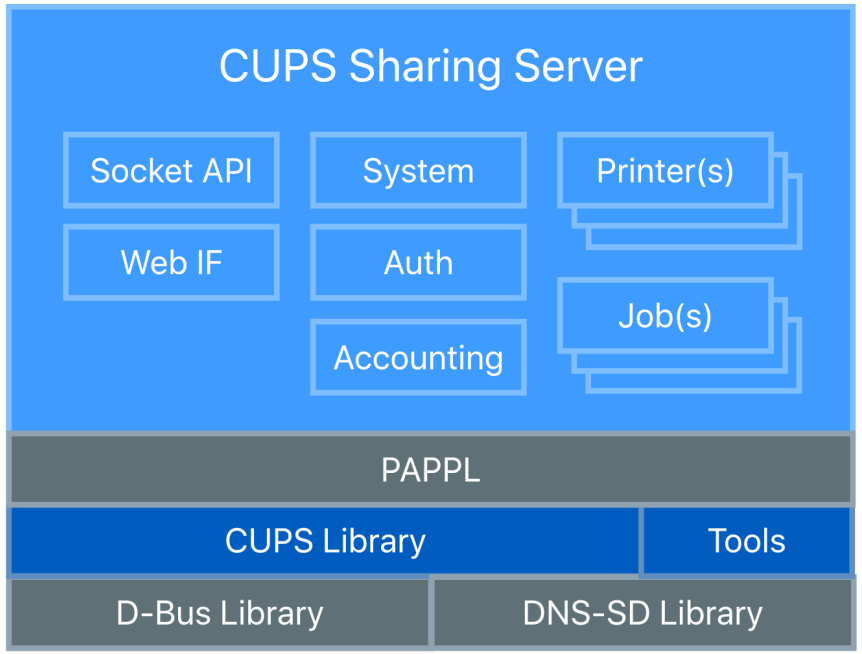
CUPS

- **CUPS 3.x**
  - **Local server**
    - Handles **local print requests** for desktop/mobile devices
    - Only **temporary IPP Everywhere print queues**
    - **Runs as user**
    - **UNIX domain socket** (D-Bus to poll socket path)
  - **Sharing server**
    - Handles **network print requests** and local printing on headless servers
    - Full print **accounting/ACLs/pre-processing** of documents
    - **OAuth 2** and **PAM**-based authentication/authorization
    - **IPP Shared Infrastructure Extensions/System** support

CUPS







Printer APPLication framework – PAPPL

- **Simple libcups-based C framework/library** for developing **Printer Applications**
  - Also used to provide the **CUPS 3.x local and sharing servers**
- Supports **JPEG**, **PNG**, **PWG Raster**, **Apple Raster**, and "raw" printing
  - Other formats can be supported
- **PAPPL 2.0** (**end-2025**) - Features and Improvements:
  - **Authentication:** OAuth 2.0/OpenID
  - **Cloud Printing:** IPP INFRA and SYSTEM support
  - **Discovery:** More DNS-SD options (**local-only**, **disabled**)
  - Print: **`finishings`**, **`job-password`**, **`job-release-action`**, **`job-sheets`**/**`-col`**
  - **Multiple-document jobs**, **PDF** and **plain text** support via **`ipptransform`**
  - Other: **Idle-exit/on-demand** support, increased limits

Reliability and Security: Google OSS-Fuzz

- Many bugs are not found by the usual **manual testing**, **CI/unit testing**, or **bug reports**
- **Fuzz testing** (“fuzzing”): Continued running of tests with **randomly modified input** to find unexpected behavior (aka as **bugs**)
- **Requires**
  - **Test harnesses**: Methods to call the software exercising as much as possible of it (XX% coverage), can be generated by AI/LLM (OSS-Fuzz-Gen)
  - **Input generator**: Generates randomized input which does not get trivially rejected
  - **High-performance cluster** for permanent test running (Google OSS-Fuzz)

Reliability and Security: Google OSS-Fuzz

- OpenPrinting is **supplying an essential part of the ecosystem** and many orgs use OpenPrinting's work, software included **in all major OS distributions**
- 20 of 37 repos written in **memory-unsafe languages (C/C++)**
- Oxidizing (converting to **Rust**) **too much work and bug-prone**
- **OpenPrinting joined OSS-Fuzz** via GSoC 2024 project, continuing in GSoC 2025
- Started with **cups**, **libcups**, **cups-filters**
- **Success:** 41 issues reported with 21 resolved, 5000+ LoC changes
- From unit testing to fuzz harness
- Adapting various of test input format (e.g., **IPP** Protocol, **PDF** file, and **argv** input)
- **GSoC 2025: AI/LLM-based** harness generator **OSS-Fuzz-Gen**

Further projects

- **Visual analysis of filter/print output**
  - Check text content (OCR), margins, colors, resolution, …
  - **Automated testing**, like CI or fuzzing also detects **functional problems**, not only crashes and errors
  - Inspired by **GNOME’s openQA**
- **Emulation of real-life IPP multi-function device**
  - Not only emulating to IPP standards but also **emulating quirks**
  - Testing of **quirk handling**
  - Reproducing **user-reported bugs**

Further projects

- **Porting CUPS and Printer Applications to Zephyr RTOS**
  - Printing from IoT devices
  - Cheap upcycling of legacy printers to driverless IPP
- **Rust bindings for libcups and CPDB**
  - Printing support for desktop apps written in Rust, and also for the COSMIC desktop

Windows Protected Print

- **“New Architecture” also under Windows**
- Microsoft introduces **Windows Protected Print**
  - **All-IPP – Only driverless IPP printers (Mopria) supported**
  - **Legacy printers not supported any more by Microsoft**
    => Workaround: Printer Applications under WSL
  - Underlying code is said to come from **Mopria – No CUPS**
  - Important reason for doing this is also **security**, doing away with third-party (manufacturer) drivers and their vulnerabilities
  - **Print Support Apps (PSA)**: Apps which add printer-specific software extensions – **Is that driverless???**

Get involved

- **Code, bug triage, CI testing, packaging, documentation, web site**
- **Google Summer of Code: Contributor, Mentor:** https://wiki.linuxfoundation.org/gsoc/google-summer-code-2025
- OpenPrinting **GitHub**: https://github.com/OpenPrinting/
  Michael Sweet's GitHub: https://github.com/michaelrsweet/
- OpenPrinting **mailing list**: printing-architecture@lists.linux.dev
  https://lore.kernel.org/printing-architecture/
  https://subspace.kernel.org/lists.linux.dev.html
- **OpenPrinting News**: https://openprinting.github.io/news/
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