



Printer Driver Development - as a 3rd Party.

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Epson EPL project

Recent Trends

- Larger Multi-function devices — scanner, fax modems
- Smart handhelds
- PictBridge

How it happened?

Brought the “wrong” Epson printer one year... Long story...

TODOs:

- bugs with EPL-6x00L
- Foomatic 4.0
- LSB ?

How People do it?

- Black box
- Disassemble

How People do it?

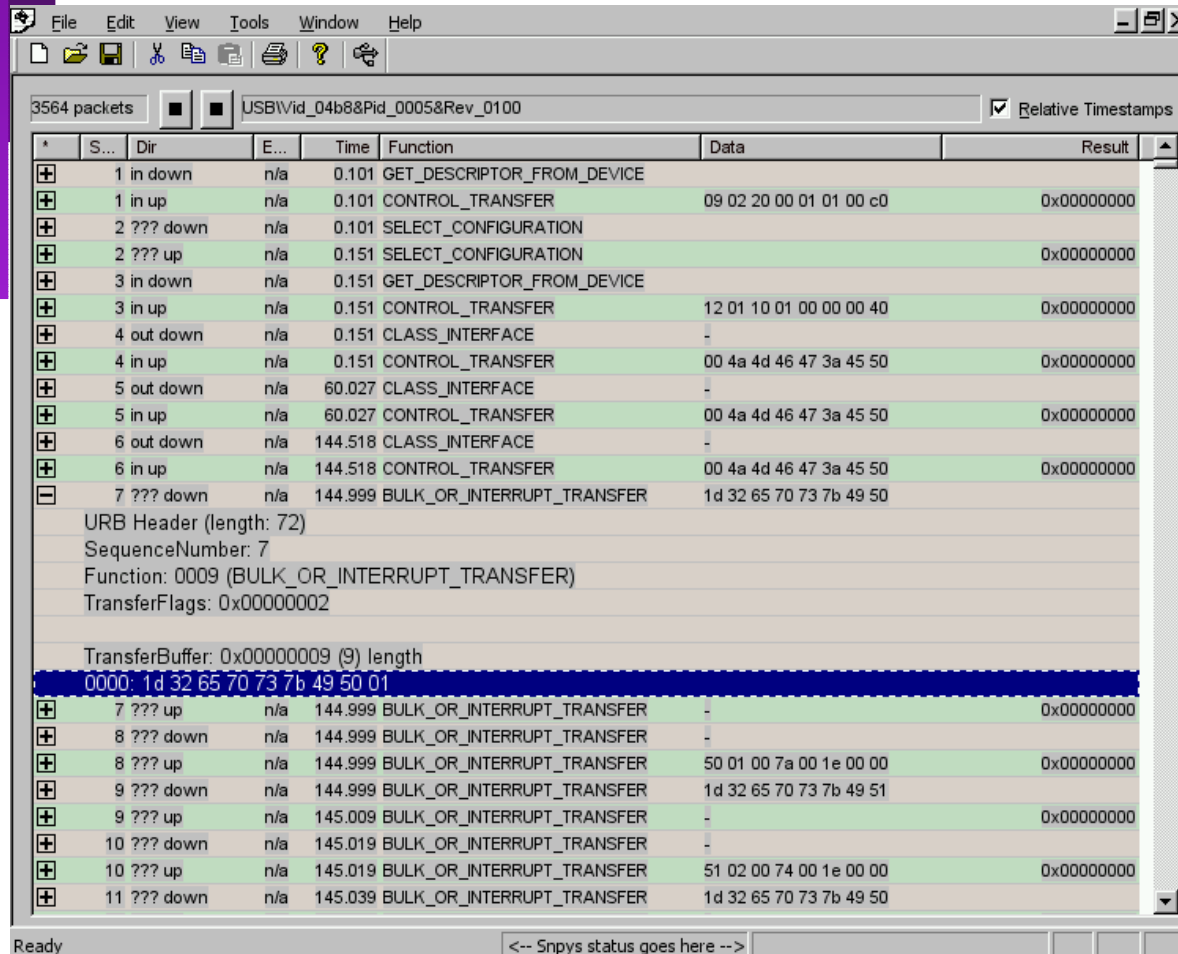
- How we did it:
 - print to FILE :
 - USB snoop
- How others do it:
 - Guest OS in Boch/VMware virtualization
 - hardware signal analyzer

How People do it?

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Any Mac OS X techniques?

How People do it?



The screenshot shows a window titled "USBVid_04b88Pid_0005&Rev_0100" with a menu bar (File, Edit, View, Tools, Window, Help) and a toolbar. The main area displays a list of 11 packets. The columns are: #, S..., Dir, E..., Time, Function, Data, and Result. The data for the 11 packets is as follows:

#	S...	Dir	E...	Time	Function	Data	Result
1	+	in	down	n/a	0.101	GET_DESCRIPTOR_FROM_DEVICE	
1	+	in	up	n/a	0.101	CONTROL_TRANSFER	09 02 20 00 01 01 00 c0 0x00000000
2	+	???	down	n/a	0.101	SELECT_CONFIGURATION	
2	+	???	up	n/a	0.151	SELECT_CONFIGURATION	0x00000000
3	+	in	down	n/a	0.151	GET_DESCRIPTOR_FROM_DEVICE	
3	+	in	up	n/a	0.151	CONTROL_TRANSFER	12 01 10 01 00 00 00 40 0x00000000
4	+	out	down	n/a	0.151	CLASS_INTERFACE	-
4	+	in	up	n/a	0.151	CONTROL_TRANSFER	00 4a 4d 46 47 3a 45 50 0x00000000
5	+	out	down	n/a	60.027	CLASS_INTERFACE	-
5	+	in	up	n/a	60.027	CONTROL_TRANSFER	00 4a 4d 46 47 3a 45 50 0x00000000
6	+	out	down	n/a	144.518	CLASS_INTERFACE	-
6	+	in	up	n/a	144.518	CONTROL_TRANSFER	00 4a 4d 46 47 3a 45 50 0x00000000
7	-	???	down	n/a	144.999	BULK_OR_INTERRUPT_TRANSFER	1d 32 65 70 73 7b 49 50
URB Header (length: 72)							
SequenceNumber: 7							
Function: 0009 (BULK_OR_INTERRUPT_TRANSFER)							
TransferFlags: 0x00000002							
TransferBuffer: 0x00000009 (9) length							
0000: 1d 32 65 70 73 7b 49 50 01							
7	+	???	up	n/a	144.999	BULK_OR_INTERRUPT_TRANSFER	- 0x00000000
8	+	???	down	n/a	144.999	BULK_OR_INTERRUPT_TRANSFER	-
8	+	???	up	n/a	144.999	BULK_OR_INTERRUPT_TRANSFER	50 01 00 7a 00 1e 00 00 0x00000000
9	+	???	down	n/a	144.999	BULK_OR_INTERRUPT_TRANSFER	1d 32 65 70 73 7b 49 51
9	+	???	up	n/a	145.009	BULK_OR_INTERRUPT_TRANSFER	- 0x00000000
10	+	???	down	n/a	145.019	BULK_OR_INTERRUPT_TRANSFER	-
10	+	???	up	n/a	145.019	BULK_OR_INTERRUPT_TRANSFER	51 02 00 74 00 1e 00 00 0x00000000
11	+	???	down	n/a	145.039	BULK_OR_INTERRUPT_TRANSFER	1d 32 65 70 73 7b 49 50

At the bottom of the window, there is a status bar with the text "Ready" and "<-- Snypys status goes here -->".

The Epson EPL 5700L

```
xterm
-----1-----2-----3-----4-----5-----6-----7-----8-----
000000 00 00 01 01 01 00 00 03 02 00 ff 40 06 ac 00 00 * .....@.... *
000010 00 00 25 fd 35 41 00 98 ff 00 01 ff fe 01 29 01 * ..%.5A..... *
000020 a4 04 00 01 00 00 00 68 a0 1d 74 03 0e 80 01 d0 * .....h.t.... *
000030 40 3a e8 07 1d 00 03 a0 80 74 d0 0e 3a 01 07 40 * @:.....t...@ *
000040 00 e8 a0 1d 74 03 0e 80 01 d0 40 3a e8 07 1d 00 * .....t.....@ *
000050 03 a0 80 74 d0 0e 3a 01 07 40 00 e8 a0 1d 74 03 * .....t...@...t *
000060 0e 80 01 d0 40 3a e8 07 1d 00 03 a0 80 74 d0 0e * .....@:.....t *
000070 3a 01 07 40 00 e8 a0 1d 74 03 0e 80 01 d0 40 3a * :.t.....@:.. *
000080 e8 07 1d 00 03 a0 80 74 d0 0e 3a 01 07 40 00 e8 * .....t...@... *
000090 04 00 01 00 00 00 68 a0 1d 74 03 0e 80 01 d0 40 * .....h.t.....@ *
0000a0 3a e8 07 1d 00 03 a0 80 74 d0 0e 3a 01 07 40 00 * .....t.....@ *
0000b0 e8 a0 1d 74 03 0e 80 01 d0 40 3a e8 07 1d 00 03 * .....t.....@ *
0000c0 a0 80 74 d0 0e 3a 01 07 40 00 e8 a0 1d 74 03 0e * .....t.....@ *
0000d0 80 01 d0 40 3a e8 07 1d 00 03 a0 80 74 d0 0e 3a * @:.....t...@:.. *
0000e0 01 07 40 00 e8 a0 1d 74 03 0e 80 01 d0 40 3a e8 * ..@:.....t...@:.. *
0000f0 07 1d 00 03 a0 80 74 d0 0e 3a 01 07 40 00 e8 04 * .....t.....@ *
000100 00 01 00 00 00 68 a0 1d 74 03 0e 80 01 d0 40 3a * .....h.t.....@ *
000110 e8 07 1d 00 03 a0 80 74 d0 0e 3a 01 07 40 00 e8 * .....t.....@ *
000120 a0 1d 74 03 0e 80 01 d0 40 3a e8 07 1d 00 03 a0 * .....t.....@ *
000130 80 74 d0 0e 3a 01 07 40 00 e8 a0 1d 74 03 0e 80 * .....t...@...t *
000140 01 d0 40 3a e8 07 1d 00 03 a0 80 74 d0 0e 3a 01 * ..@:.....t... *
000150 07 40 00 e8 a0 1d 74 03 0e 80 01 d0 40 3a e8 07 * .t.....@:.... *
000160 1d 00 03 a0 80 74 d0 0e 3a 01 07 40 00 e8 04 00 * .....t...@... *
000170 01 00 00 00 68 a0 1d 74 03 0e 80 01 d0 40 3a e8 * .....h.t.....@ *
000180 07 1d 00 03 a0 80 74 d0 0e 3a 01 07 40 00 e8 a0 * .....t.....@ *
000190 1d 74 03 0e 80 01 d0 40 3a e8 07 1d 00 03 a0 80 * .....t...@... *
0001a0 74 d0 0e 3a 01 07 40 00 e8 a0 1d 74 03 0e 80 01 * .....t.....@ *
0001b0 d0 40 3a e8 07 1d 00 03 a0 80 74 d0 0e 3a 01 07 * .....t.....@ *
0001c0 40 00 e8 a0 1d 74 03 0e 80 01 d0 40 3a e8 07 1d * @:.....t...@:.. *
0001d0 00 03 a0 80 74 d0 0e 3a 01 07 40 00 e8 04 00 01 * .....t...@... *
0001e0 00 00 00 68 a0 1d 74 03 0e 80 01 d0 40 3a e8 07 * .....h.t.....@ *
0001f0 1d 00 03 a0 80 74 d0 0e 3a 01 07 40 00 e8 a0 1d * .....t.....@ *
000200 74 03 0e 80 01 d0 40 3a e8 07 1d 00 03 a0 80 74 * .....t.....@ *
000210 d0 0e 3a 01 07 40 00 e8 a0 1d 74 03 0e 80 01 d0 * .....t.....@ *
000220 40 3a e8 07 1d 00 03 a0 80 74 d0 0e 3a 01 07 40 * @:.....t...@:.. *
000230 00 e8 a0 1d 74 03 0e 80 01 d0 40 3a e8 07 1d 00 * .....t.....@ *
000240 03 a0 80 74 d0 0e 3a 01 07 40 00 e8 04 00 01 00 * .....t...@... *
000250 00 00 68 a0 1d 74 03 0e 80 01 d0 40 3a e8 07 1d * .....h.t.....@ *
000260 00 03 a0 80 74 d0 0e 3a 01 07 40 00 e8 a0 1d 74 * .....t...@... *
000270 03 0e 80 01 d0 40 3a e8 07 1d 00 03 a0 80 74 d0 * .....@:.....t *
000280 0e 3a 01 07 40 00 e8 a0 1d 74 03 0e 80 01 d0 40 * .....@:.....@ *
1 ORU /tmp/5700L.SPL 3 * 4 * 5 * 6 * 7 * 8
```

- 7-byte band header (4-byte data count)
- 13-bit repeats
- 16-bit word packed
- MSB first

The HP CLJ3550

```
xterm
-----*-----1-----*-----2-----*-----3-----*-----4-----*-----5-----*-----6-----*-----7-----*-----8-----
000000 1b 25 2d 31 32 33 34 35 58 40 50 4a 4c 20 53 45 * ,%-12345X@PJL SE *
000010 54 20 53 54 52 49 4e 47 43 4f 44 45 53 45 54 3d * T STRINGCODESET= *
000020 55 54 46 38 0a 40 50 4a 4c 20 4a 4f 42 20 4e 41 * UTF8,@PJL JOB NA *
000030 4d 45 3d 22 67 73 70 72 69 6e 74 22 0a 40 50 4a * ME="gsprint",@PJ *
000040 4c 20 53 45 54 20 4a 4f 42 41 54 54 52 3d 22 4a * L SET JOBATTR="J *
000050 6f 62 41 63 63 74 31 3d 53 59 53 54 45 4d 22 0a * obAcct1=SYSTEM", *
000060 40 50 4a 4c 20 53 45 54 20 4a 4f 42 41 54 54 52 * @PJL SET JOBATTR *
000070 3d 22 4a 6f 62 41 63 63 74 32 3d 56 4f 47 4f 4e * ="JobAcct2=VOGON *
000080 22 0a 40 50 4a 4c 20 53 45 54 20 4a 4f 42 41 54 * ",@PJL SET JOBAT *
000090 54 52 3d 22 4a 6f 62 41 63 63 74 33 3d 56 4f 47 * TR="JobAcct3=VOG *
0000a0 4f 4e 22 0a 40 50 4a 4c 20 53 45 54 20 4a 4f 42 * ON",@PJL SET JOB *
0000b0 41 54 54 52 3d 22 4a 6f 62 41 63 63 74 34 3d 32 * ATTR="JobAcct4=2 *
0000c0 30 30 34 31 31 31 32 30 35 34 38 33 36 22 0a 40 * 0041112054836",@ *
0000d0 50 4a 4c 20 44 4d 49 4e 46 4f 20 41 53 43 49 49 * PJL DMINFO ASCII *
0000e0 48 45 58 3d 22 30 34 30 30 34 30 31 30 31 30 * HEX="04000401010 *
0000f0 32 30 44 31 30 31 30 30 31 31 35 33 32 33 30 33 * 20D1010011532303 *
000100 30 33 34 33 31 33 31 33 31 33 32 33 30 33 35 33 * 0343131313230353 *
000110 34 33 38 33 33 33 36 22 0a 40 50 4a 4c 20 53 45 * 4383336",@PJL SE *
000120 54 20 43 4f 50 49 45 53 3d 31 0a 40 50 4a 4c 20 * T COPIES=1,@PJL *
000130 53 45 54 20 52 45 53 4f 4c 55 54 49 4f 4e 3d 36 * SET RESOLUTION=6 *
000140 30 30 0a 40 50 4a 4c 20 53 45 54 20 54 49 4d 45 * 00,@PJL SET TIME *
000150 4f 55 54 3d 39 30 0a 40 50 4a 4c 20 45 4e 54 45 * OUT=90,@PJL ENTE *
000160 52 20 4c 41 4e 47 55 41 47 45 3d 50 43 4c 58 4c * R LANGUAGE=PCLXL *
000170 0a 29 20 48 50 2d 50 43 4c 20 58 4c 3b 33 3b 30 * ) HP-PCL XL;3;0 *
000180 3b 43 6f 6d 6d 65 6e 74 20 50 43 4c 2d 58 4c 20 * :Comment PCL-XL *
000190 4a 65 74 52 65 61 64 79 20 67 65 6e 65 72 61 74 * JetReady generat *
0001a0 6f 72 0a c0 00 f8 86 c0 03 f8 8f d1 58 02 58 02 * or.....X.X. *
0001b0 f8 89 41 c0 00 f8 88 c0 01 f8 82 48 c0 00 f8 28 * ..A.....H..( *
0001c0 c0 02 f8 25 c0 01 f8 26 43 d3 64 00 64 00 f8 2a * ...%...&C.d.d.* *
0001d0 75 d3 00 00 00 00 f8 4c 8b c0 00 f8 1d 94 c0 00 * u.....Lk..... *
0001e0 f8 1d 92 c0 06 f8 03 6a c2 00 40 70 68 f8 91 c1 * .....j..@ph... *
0001f0 a0 12 f8 6c c1 9f 1a f8 6b c1 32 00 f8 93 c1 80 * .....l.....k.2..... *
000200 00 f8 94 c0 04 f8 97 c0 00 f8 98 c2 00 00 03 00 * ..... *
000210 f8 95 c2 38 03 00 00 f8 92 46 00 80 00 03 00 00 * ..8.....F..... *
000220 02 00 00 00 03 00 00 00 04 00 00 00 05 00 00 00 * ..... *
000230 05 00 00 00 05 00 00 00 05 00 00 00 05 00 00 00 * ..... *
000240 03 00 00 00 06 00 00 00 05 00 00 00 08 00 00 00 * ..... *
000250 05 00 00 00 08 00 00 00 05 00 00 00 08 00 00 00 * ..... *
000260 04 00 00 00 05 00 00 00 05 00 00 00 05 00 00 00 * ..... *
000270 05 00 00 00 05 00 00 00 05 00 00 00 05 00 00 00 * ..... *
000280 05 00 00 00 08 00 00 00 05 00 00 00 08 00 00 00 * ..... *
1 ORU /cdrom/WINDOWS/system32/spool/PRINTERS/00243.SPL -----*-----7-----*-----8-----
```

Normal PJL, PCL XL headers.

- Band data encapsulated in PCL XL VendorUnique operator.

Disassembling

- IDA Pro
- .NET : Reflector
- Java : ??

Manufacturer: Linux driver, why not?

Fact: *Manufacturers are out for making money.*

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- hardware
- consumables e.g. ink/toner cartridges
- support contracts

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- Cannot admit to hardware design faults and subsequent software work arounds, etc.

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Decision makers don't understand.

Manufacturer: Linux driver, why?

- Sale opportunities; print servers
- New emerging market segments:
 - commodities — tied-in with blue-tooth mobile+phone, embedded devices, PDA, WebPAD
 - PictBridge
- product/market differentiator — same product class, more OSes supported

Manufacturer: Linux driver, how?

- IJS
- OPVP/OPRP
- pnm filters
- Cups backends
- ...

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- Source code

Interesting technologies

- Wine — native bridge?
- XEN
- Mingw

Just to use printer?

- Cups
- Samba
- Redmon
- Gsprint (Win32 ghostscript mswinpr2 driver)

An interesting 4-queue set-up

- `smbpool` (backend of `linux-cups-queue1`) sends postscript to `Windows-queue-1`
 - `Windows-queue1` receives postscript, sends to redirected port `RPT1` :
 - `Redmon` drives `Windows-queue2` with `gsprint`.
 - `Windows-queue2` converts GDI calls to printer-specific code, send to `linux-cups-queue2`
- ```
net use LPT2 \\linux\queue2 /p:y
net use LPT2 \\linux\queue2 /persistent:yes
```
- `Linux-queue2` is raw (unfiltered) queue to printer port, where printer is attached.