Bits, Gates, Traces, and Pins Copyleft and Licensing in Open Hardware

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Disclaimers

- Josh is not a lawyer
- Jessica is not your lawyer
- Neither of us are speaking for our company
 - We'll assume you aren't either
- This is not legal advice
- Citations based primarily on US law
 - Portions applicable globally
 - International commentary/correction welcome
- Please feel free to ask questions at any time

Software Architecture

94. 	- 22
8	-3
	-3
2	



Linking object files or libraries





Linking object files or libraries



fork/exec





fork/exec



Linking object files or libraries



Servers, RPC, Sockets





fork/exec



Linking object files or libraries



Servers, RPC, Sockets



Shared memory





fork/exec



Shared memory



Linking object files or libraries



Servers, RPC, Sockets



Standard APIs

Permissive licensing

Copyleft

Hardware Architecture



Physical object



Circuits on an ASIC



Components on an SoC



FPGA bitstream



Chips on a board



Printed circuit board (PCB)





Connectors

Forms of Hardware





STL file

Physical object

Mask / Layout



Schematic

Physical chip



FPGA bitstream

Programmed FPGA



PCB layout

Physical PCB

Permissive licensing

Copyleft

Intent

Copyleft & Hardware

- interesting and non-trivial
- permissive is easy, but does it give you what you want?
- copyleft goals
 - enable study of complete design in the form(s) preferred for making modification
 - \circ $\,$ allow modification and distribution of modified design $\,$
 - ensure original licensor is able to benefit the same way licensee did by having changes/derivatives made available under same license
 - ensure recognition/attribution of creative origin
 - expand the size of the "open commons"

+ additional hardware-specific goals

Implementation: Exclusive Rights

Exclusive Rights for Authors & Makers

- Copyright
- Patent
- Mask Work
- Trademark

17 U.S.C. ∮ 101 et seq

Copyright

• Exclusive rights to:

- **reproduce** the work
- **distribute copies** of the work to the public
- perform the work publicly
- display the work publicly
- **prepare derivative works** based on the work

- Subject matter
 - literary works
 - pictorial, graphic, & sculptural works
 - other (musical, dramatic, pantomime and choreographic, motion pictures and other audiovisual works, sound recordings, architectural works)

Patent

35 U.S.C. **∮** 100 et seq

- Exclusive rights to:
 - **make** the invention
 - **use** the invention
 - **sell** the invention
 - **import** the invention

- Subject matter
 - process
 - machine
 - manufacture
 - composition of matter

Check out Frederik Questier's talk "Protect your freedom to operate with Open Patents: Hacking the patent system" tomorrow @ 10:20 a.m.!

Mask Work

• Exclusive rights to:

- **reproduce** the mask work by optical, electronic, or any other means
- **import** or **distribute** a semiconductor chip product in which the mask work is embodied
- induce or knowingly to cause another person to do any of the acts above

- Subject matter
 - Mask work **fixed in a semiconductor chip**

Trademark

- Exclusive rights to use the mark
 - Includes ability to prevent use of confusingly similar mark by unauthorized party

- Subject matter
 - Word, name, symbol or device used to identify product

Protectable? Protected? Hardware & Forms, redux

Printed Circuit Board

- schematic capture / logical circuit design
- layout / physical implementation
- manufactured board that embodies design



kicad_eeschema.png, by KiCad-pcb.org, CC BY 3.0



kicad_pcbnew.png, by KiCad-pcb.org, CC BY 3.0



https://github.com/fd0/hackrf-one-pictures/blob/ master/img_0009.jpg, public domain

Silicon

• Mask works



<u>Semiconductor_photomask.jpg</u>, by Peellden - Own work, <u>CC BY-SA 3.0</u>



Intel_CPU_Core_i7_2600K_Sandy_Bridge_top.jpg, by Eric Gaba, CC BY-SA 3.0

Silicon, continued

- IP cores
 - Hard
 - Soft
 - Libraries



Adapted from IP Quality & Reuse.jpg, by Patrickyip - own work, Public Domain





FPGA bitstream



Programmed FPGA

Open Hardware, including "opened" FPGA!



https://gitlab.com/Folknology/mystorm/tree/master

Enclosure

Original design, created in CAD tool vs. scan of existing object

- Useful vs. creative
- Separability analysis required to determine whether copyright applies



Intel Galileo enclosure by bubbasnow, CC BY-SA.

State of Open Hardware Licensing

License	Solderpad Hardware License	CERN OHL	TAPR OHL	GPLv3	Our Ideal Hardware License
Source availability requirement?	N	Y	Y	Y	Y
Derived works must remain under same license?	N	Y	Y	Y, with exceptions	Y, with exceptions
Use for any purpose?	Y	Y	N	Y	Y
Patent grant?	Y	Y	Y	Y	Y
Treat physical hardware like "binaries": require source?	N	Y	Y	N	Y
Compatible with copyleft SW license (i.e., GPLv3)?	γ	N	N	γ	γ

License Compatibility

- Want to support copying between software, hardware, firmware, documentation, specifications
- Boundaries will become fuzzier over time
- "Eating the world"
- Want compatible licenses for all of these ecosystems
 - Please do: account for hardware in new revisions of licenses
 - Please don't: write your own license for hardware

Open Hardware Ecosystem

- Early days of open hardware
- Most production designs still include proprietary components
- Similar to the early days of Free Software
- Proprietary parts libraries remain a major obstacle
 - Open hardware needs open part libraries!

Recommendations

- For chips, use GPLv3 for copyleft
- For PCBs, use copyleft if desired (many will respect intent)
 - Likely ineffective for physical board
- Develop and contribute to open part libraries
- For drafters of future versions of established copyleft licenses
 - Allow for mask works and other applicable legal structures
 - Treat physical hardware like "binaries": require source

Questions?