

Software concepts for hardware developers



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Software concepts for hardware developers

Outline:

- HW versus SW
- Exploring Linux
- To Linux or not to Linux?
- Use case: video pipeline



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1) HW versus SW

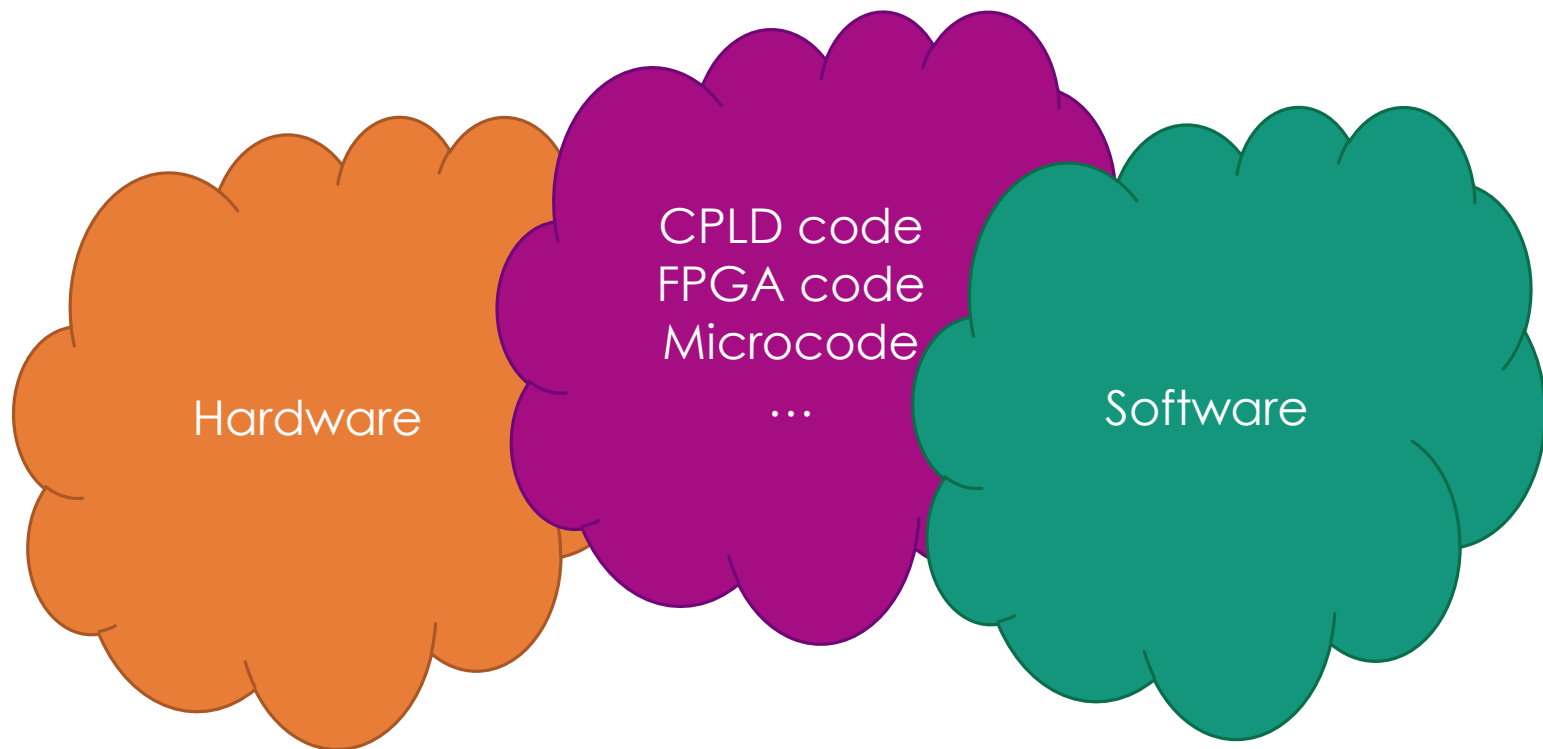


```
except socket.error, (errno, strerror):  
    print "ncfiles: Socket error (%s) for host %s (%s)" % (errno,  
        print "ncfiles: %s" % msg  
        print "ncfiles: %s" % msg  
for h3 in page.findAll("h3"):  
    value = (h3.contents[0])  
    if value != "Afdeling":  
        print >> txt, value  
        import codecs  
        f = codecs.open("alle.txt", "r", encoding="utf-8")  
        text = f.read()  
        f.close()  
        # open the file again for writing  
        f = codecs.open("alle.txt", "w", encoding="utf-8")  
        f.write(value+"\n")  
        # write the original contents  
        f.write(text)  
        f.close()
```



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Changing the meaning of “embedded”



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Hardware (-oriented)

- Analog + Digital I/O
- Serial communication
- Limited cycles, memory
- Limited power
- State machine
- Real-time
- Robust

Software (-oriented)

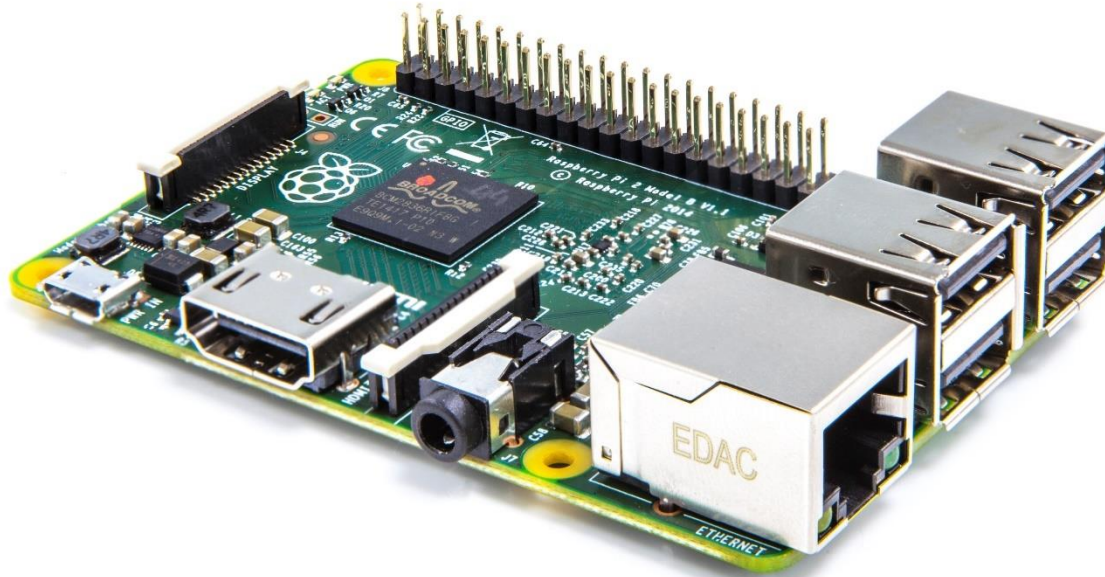
- UI
- Web
- Scripting
- Rapid prototyping
- Run-time code path



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2) Enter the high-level SW developer



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High-level SW dev comfort zone

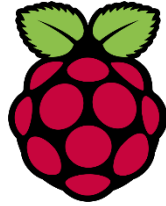
- Resources++ => on-target debugging
- Resources++ => OS, pre-installed tools, ...
- Reuse, rapid prototyping/development, ...
- I/O access



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<https://raspberrypi.org/downloads/>

<https://openelec.tv/>

...



Software (-oriented)

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Hardware (-oriented)

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Bare-metal (“pure embedded”, ...)

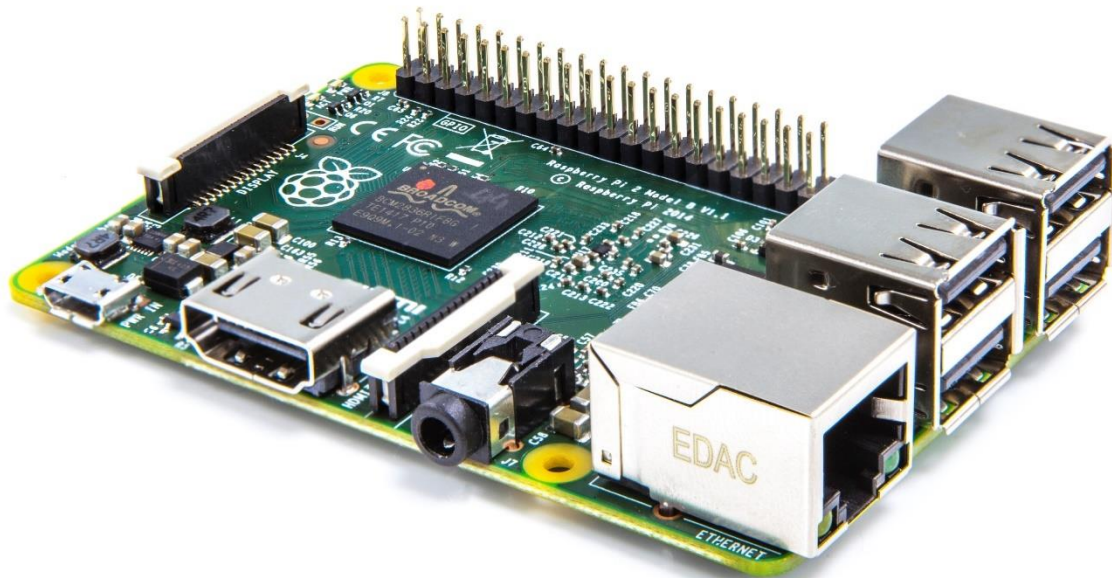
GitHub: [dwelch67/raspberrypi](https://github.com/dwelch67/raspberrypi)

GitHub: [PeterLemon/RaspberryPi](https://github.com/PeterLemon/RaspberryPi)



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3) To Linux or not to Linux?



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Bare metal

- ☐ Deterministic + repeatable
- ☐ Compile-time/static
 - memory allocation
 - Scheduling
- ☐ Limited extensibility & scalability
- ☐ Debugging: chip support
- ☐ Complex in interweaving
- ☐ +- DIY
- ☐ Maximum effect per cycle, if you're a guru

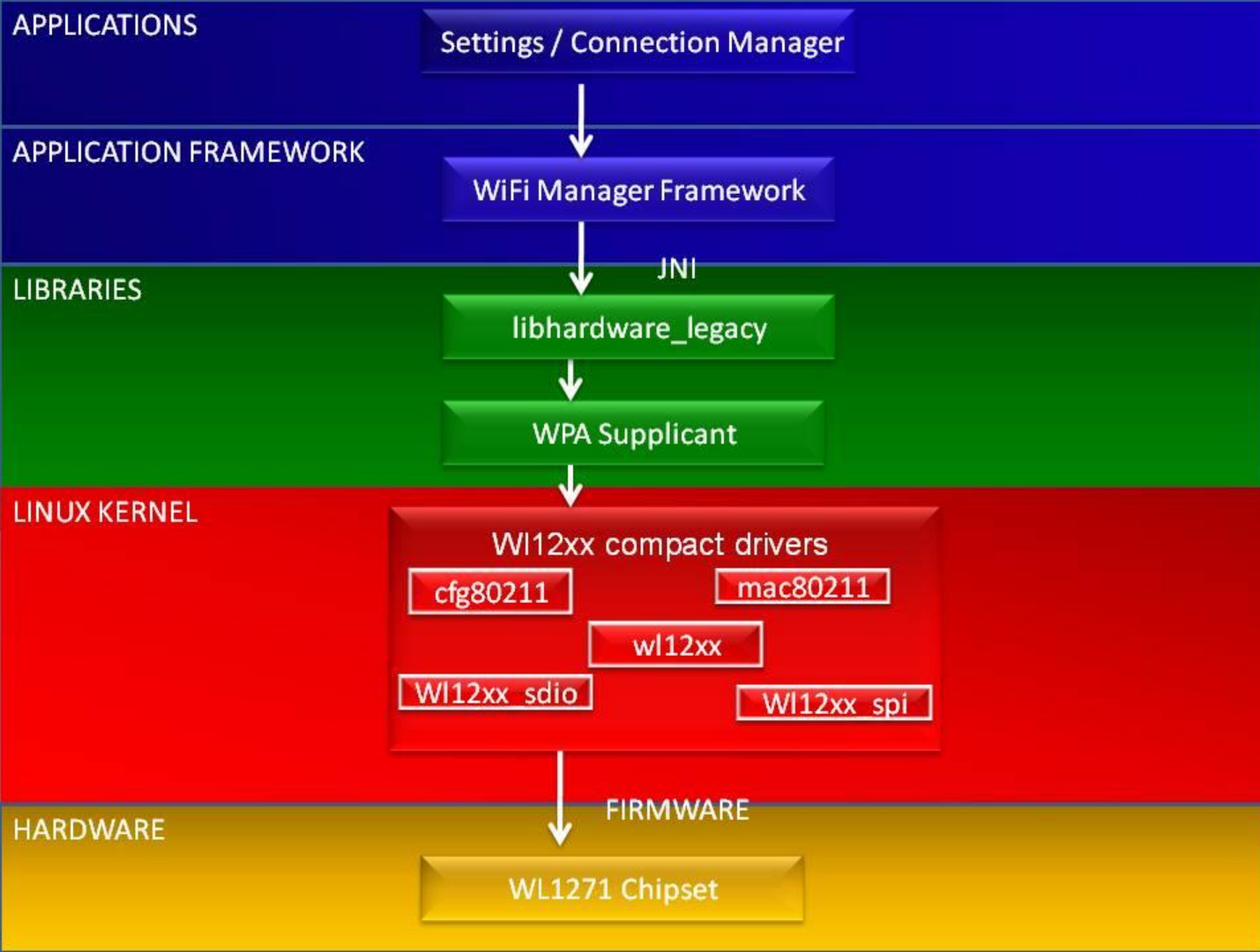
OS-supported

- Stochastic
- Run-time/dynamic
 - memory allocation
 - Scheduling
- Extremely extensible & scalable
- Debugging: OS support
- Complex in building block count
- +- Energy can go to porting
- Overhead

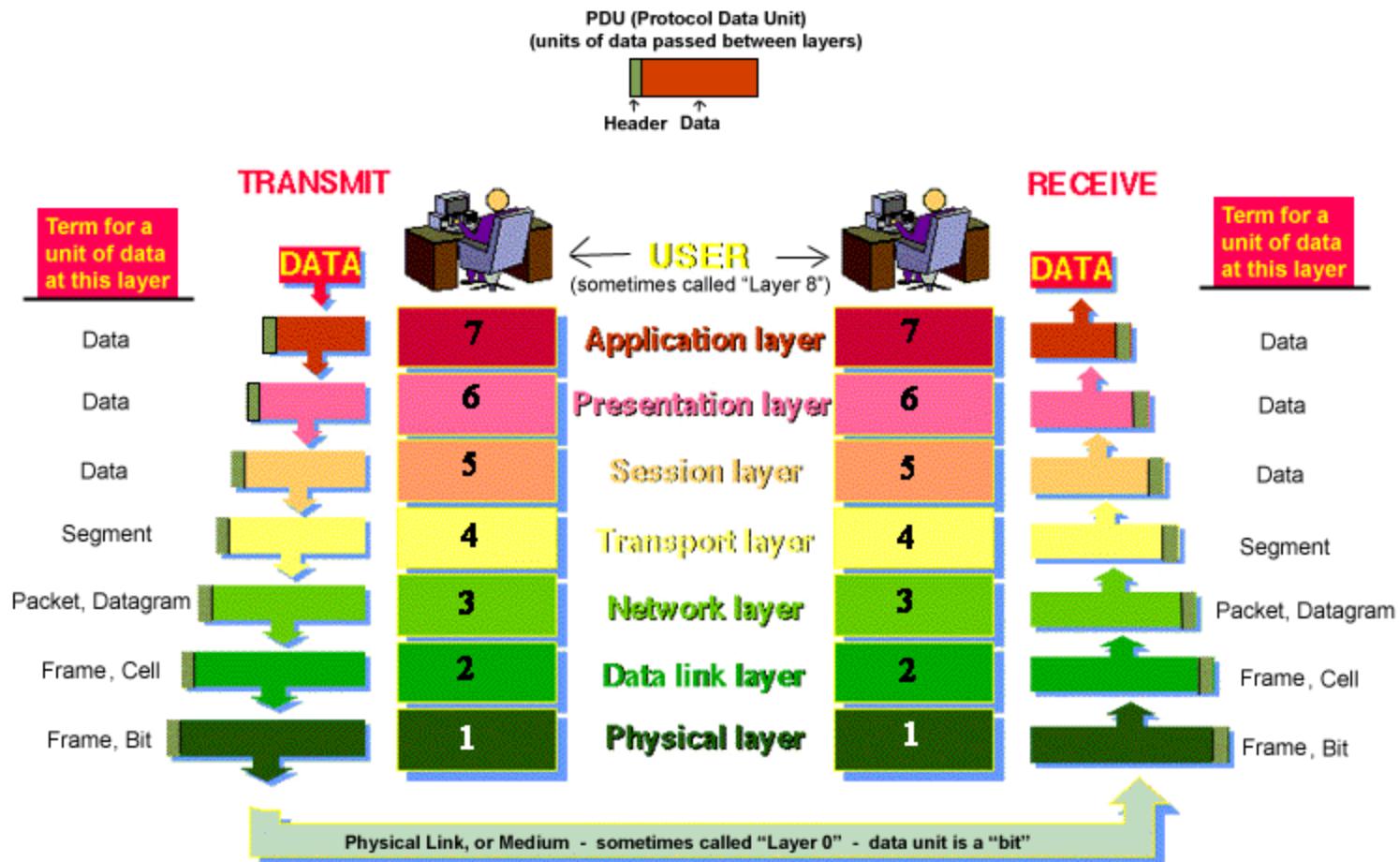


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THE 7 LAYERS OF OSI



APPLICATIONS

Home

Contacts

Phone

Browser

...

APPLICATION FRAMEWORK

Activity
Manager

Window
Manager

Content
Providers

View
System

Notification
Manager

Package
Manager

Telephony
Manager

Resource
Manager

Location
Manager

XMPP
Service

LIBRARIES

Surface
Manager

Media
Framework

SQLite

OpenGL|ES

FreeType

WebKit

SGL

SSL

libc

ANDROID RUNTIME

Core
Libraries

Dalvik Virtual
Machine

LINUX KERNEL

Display
Driver

Camera
Driver

Bluetooth
Driver

Flash Memory
Driver

Binder (IPC)
Driver

USB
Driver

Keypad
Driver

WiFi
Driver

Audio
Drivers

Power
Management

It's the API, stupid!

- Because:
- Enables re-use of the interfaced code
 - Provided code
 - Self-written code too
- API's force you to design better
- Designing a good API is important design work



API – overhead?

- Both yes and no
- Are you making:
 - Extremely low power?
 - Very high volumes?
- If not: then add the extra memory, and upgrade to the faster SoC



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4) Real world use case



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- Multi-camera – multi-display system
- + other features
- Latency requirement



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- Linux
 - i.MX libraries
 - GStreamer-i.MX
 - GStreamer
- Datasheet
 - # possible configurations
 - How does...
 - What is the impact when...
 - ... is not the optimal way of



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Recap: to Linux or not to Linux?

- Yes, it allows for rapid prototyping/feasibility tests
- Yes, it comes with loads of reusable components
- Yes, it offers good API's
- Yes, you can adapt whatever you like
- Hmm, not everything is super documented
- No, if you need extreme low power
- No, if the extra € of HW cost will really increase total cost
- Maybe/maybe not, if you have real-time constraints



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Conclusion

- HW / SW have become intertwined
- Abstraction (API) is a good thing
- Challenges:
 - Rigid & old company structures, processes, ...
 - Documentation / complexity
 - Expertise



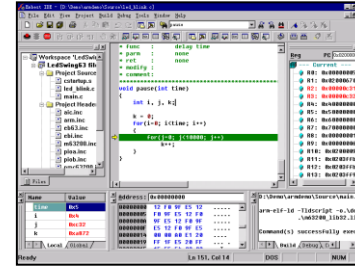
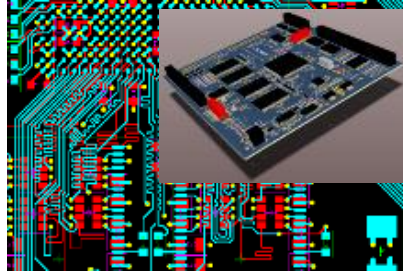
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Prototypes



PCB design 2D/3D and mechanical integration

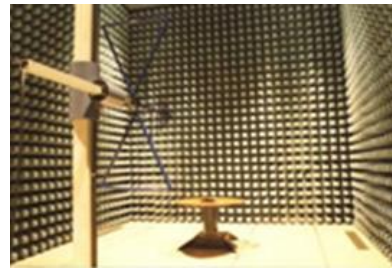


Firmware / Software

Electronic design: analog/digital



EMC testing



Manufacturing

Mechanical engineering and production



Stand 7C085

Stefaan De Roeck



Your consultancy partner in high-tech
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