Computer control of the NaCs experiment

Yichao Yu

Ni Group/Harvard

October 19, 2014

Without precise timing

- Vapor pressure
- MOT loading
- Objective alignment

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Measurements that require precise timing

- Polarization gradient cooling
- Temperature calibration
- ODT loading
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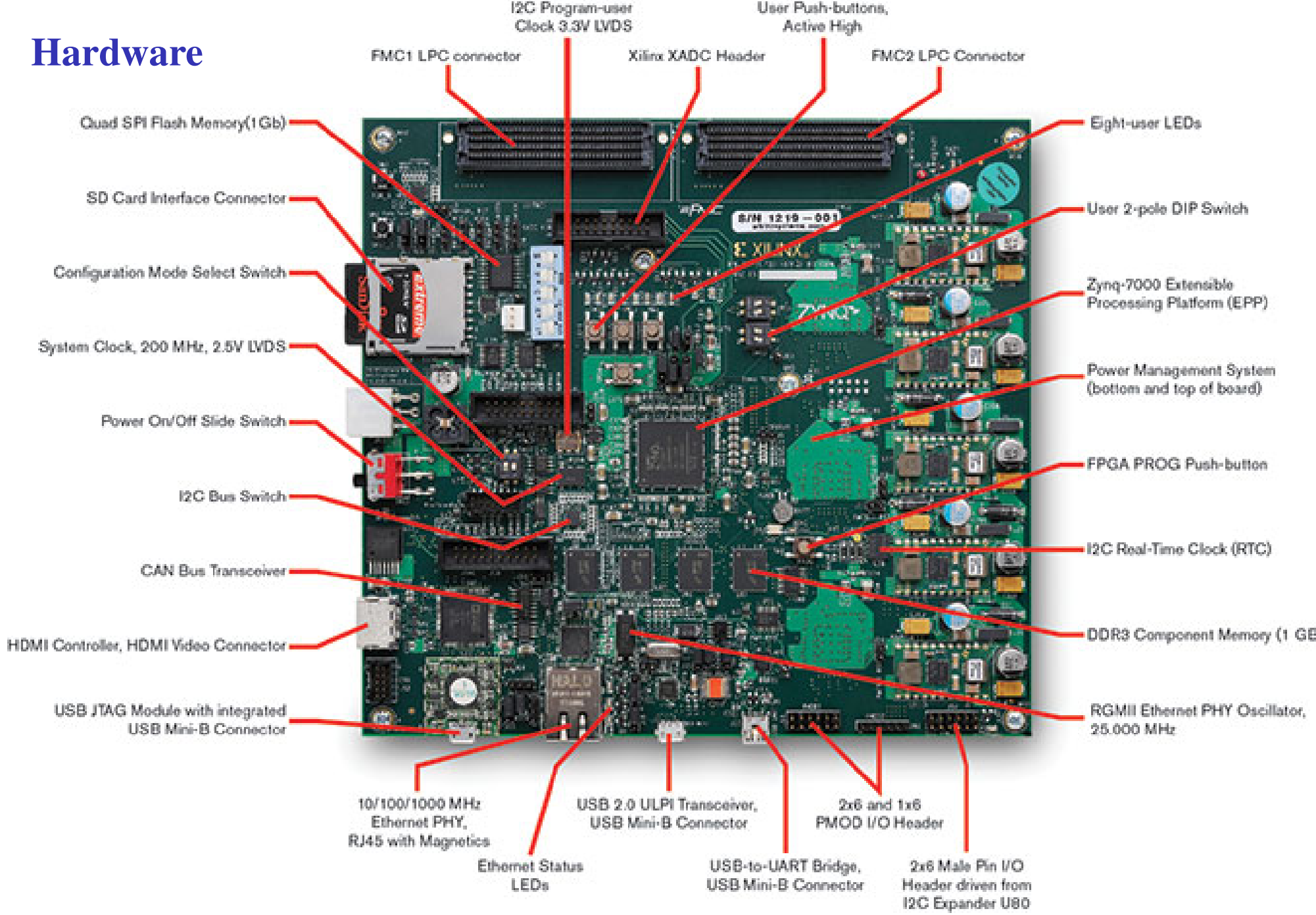
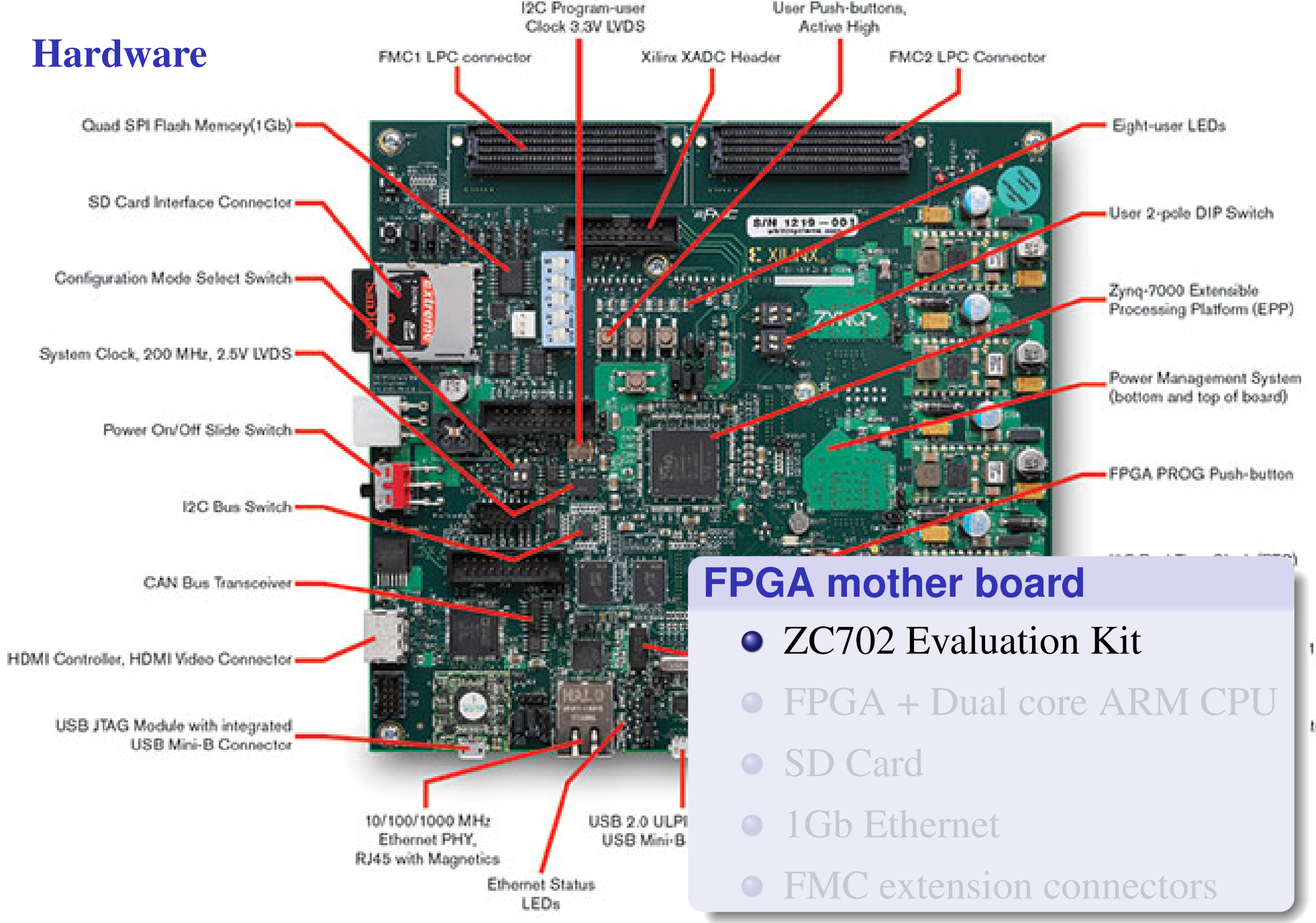
Hardware


I2C Program-user Clock 3.3V LVDS
User Push-buttons, Active High
FMC1 LPC connector
Xilinx XADC Header
FMC2 LPC Connector
Quad SPI Flash Memory(1 Gb)
Eight-user LEDs
SD Card Interface Connector
User 2-pole DIP Switch
Configuration Mode Select Switch
Zynq-7000 Extensible Processing Platform (EPP)
System Clock, 200 MHz, 2.5V LVDS
Power Management System (bottom and top of board)
Power On/Off Slide Switch
FPGA PROG Push-button
I2C Bus Switch
I2C Real-Time Clock (RTC)
CAN Bus Transceiver
DDR3 Component Memory (1 GB
HDMI Controller, HDMI Video Connector
USB JTAG Module with integrated USB Mini-B Connector
RGMII Ethernet PHY Oscillator, 25.000 MHz
10/100/1000 MHz Ethernet PHY, RJ45 with Magnetics
USB 2.0 ULPI Transceiver, USB Mini-B Connector
2x6 and 1x6 PMOD I/O Header
Ethernet Status LEDs
USB-to-UART Bridge, USB Mini-B Connector
2x6 Male Pin I/O Header driven from I2C Expander U80

Hardware



FPGA mother board

- ZC702 Evaluation Kit
- FPGA + Dual core ARM CPU
- SD Card
- 1Gb Ethernet
- FMC extension connectors

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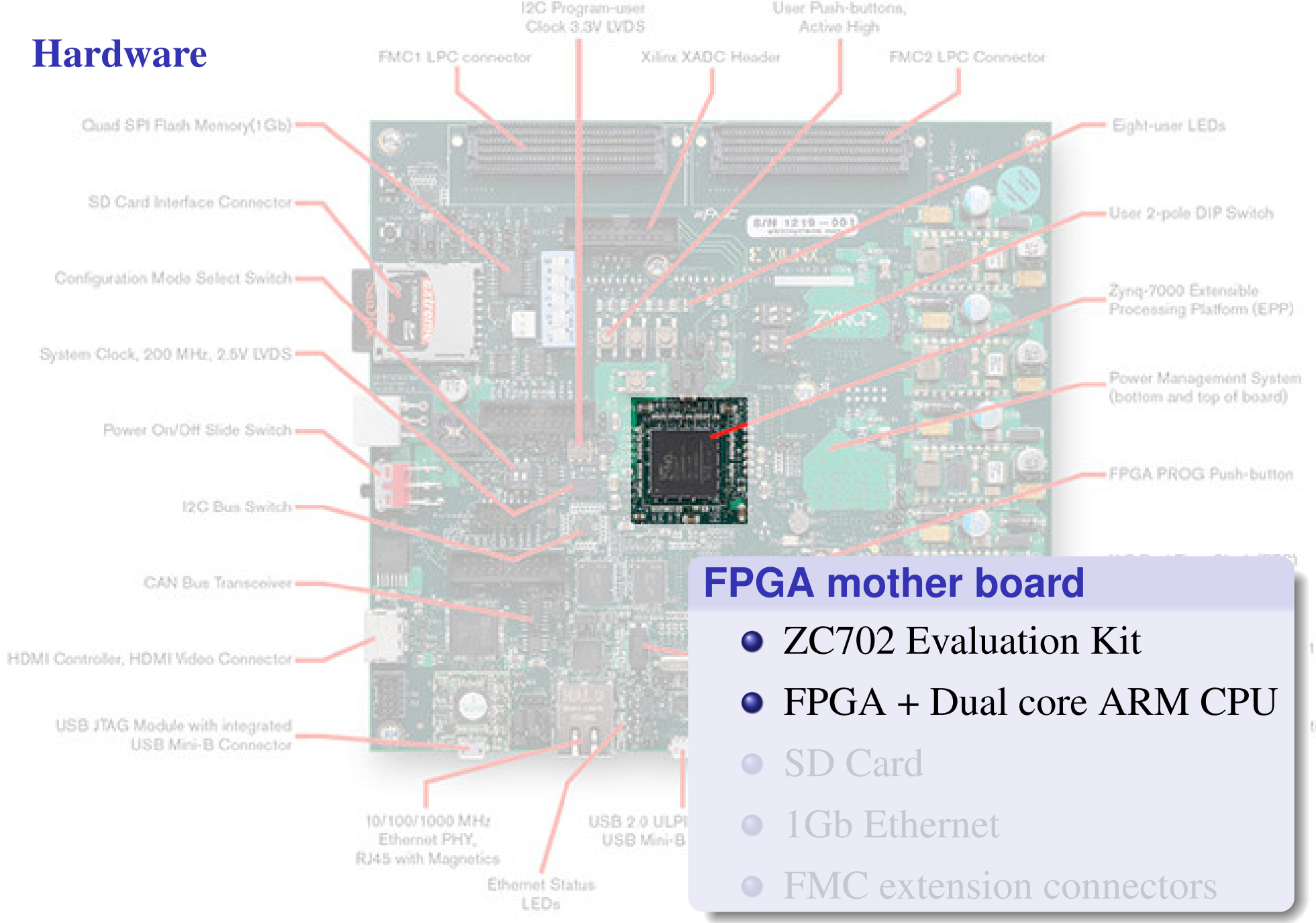

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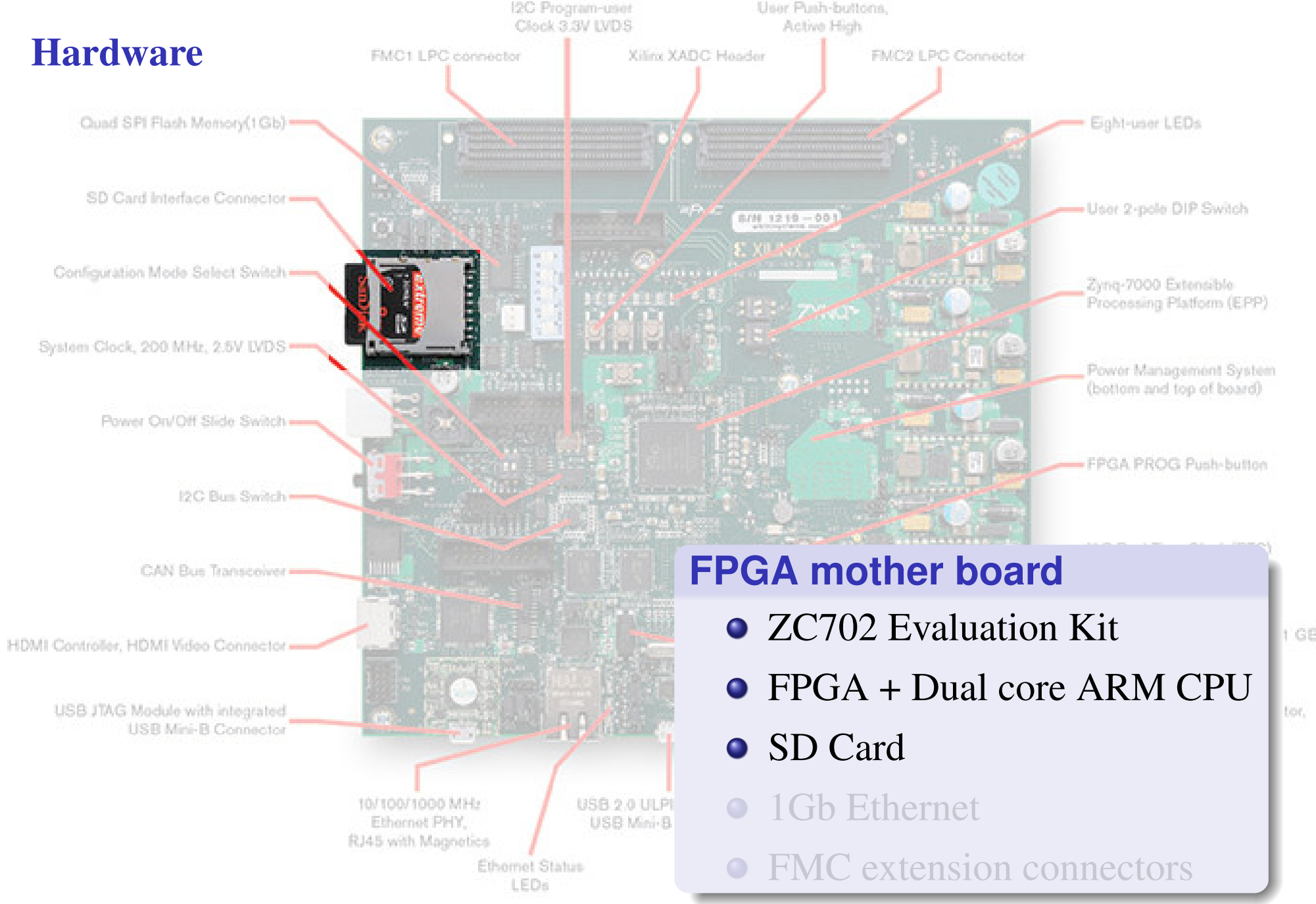

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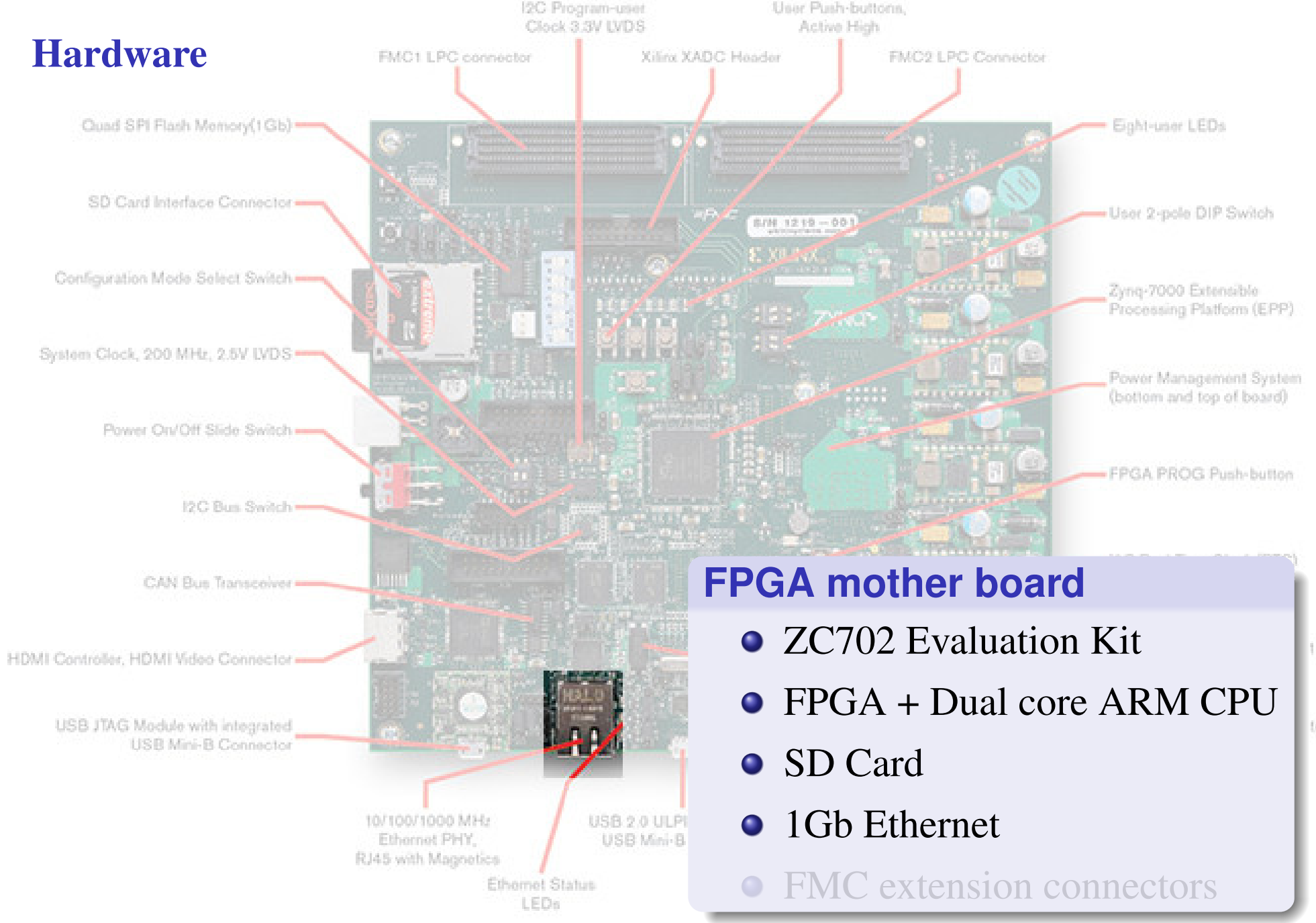

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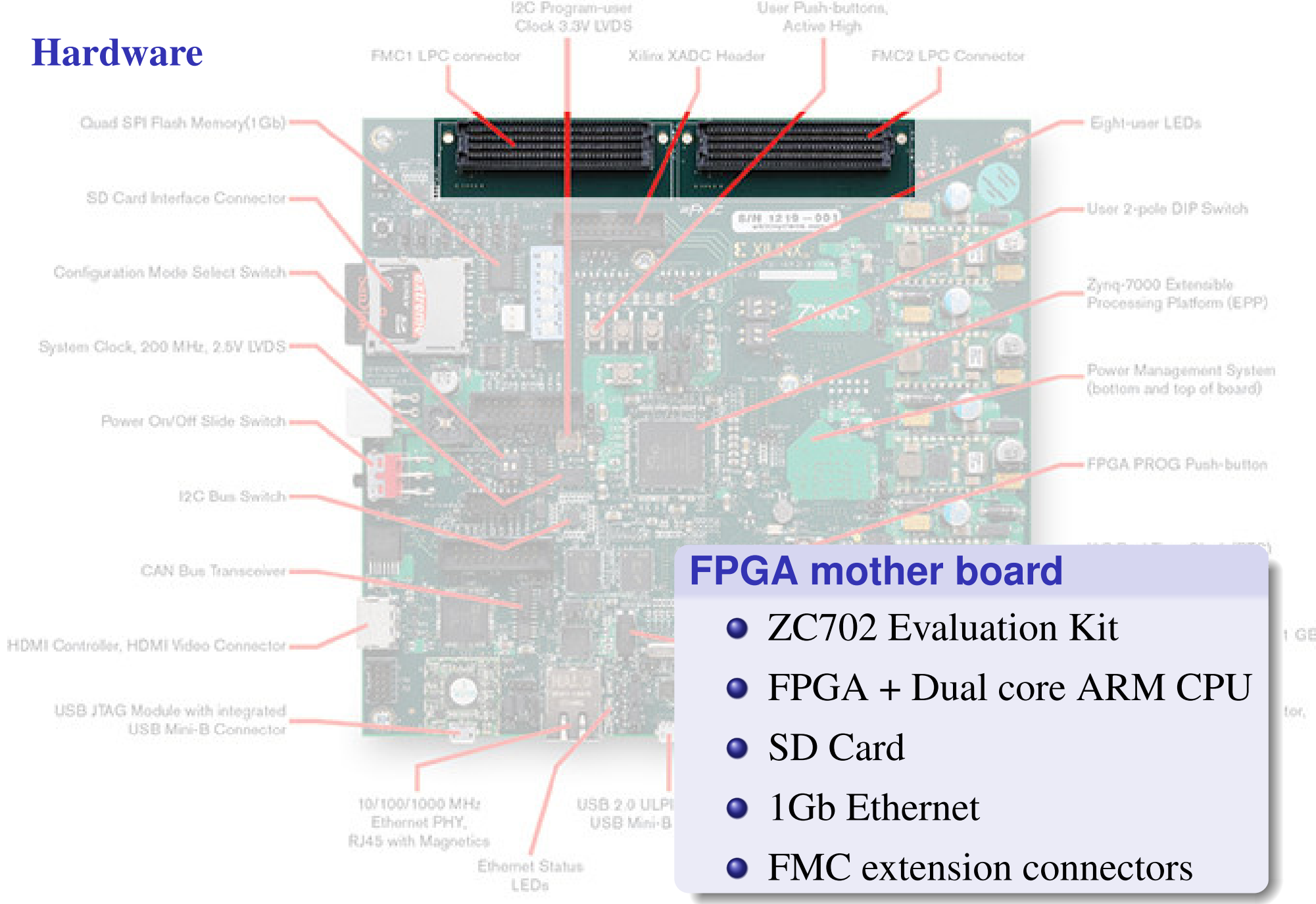

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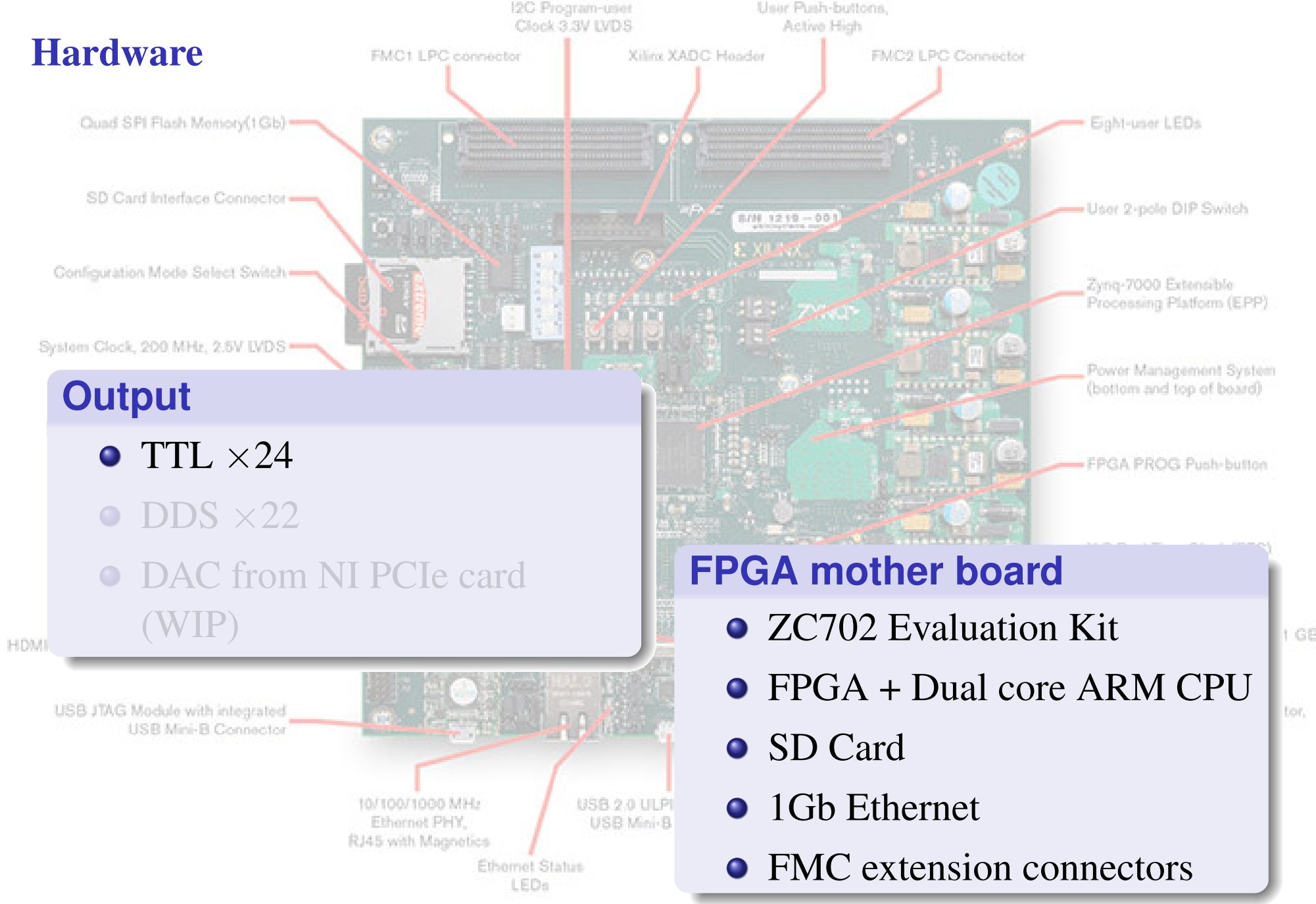

Output

- TTL $\times 24$
- DDS $\times 22$
- DAC from NI PCIe card (WIP)

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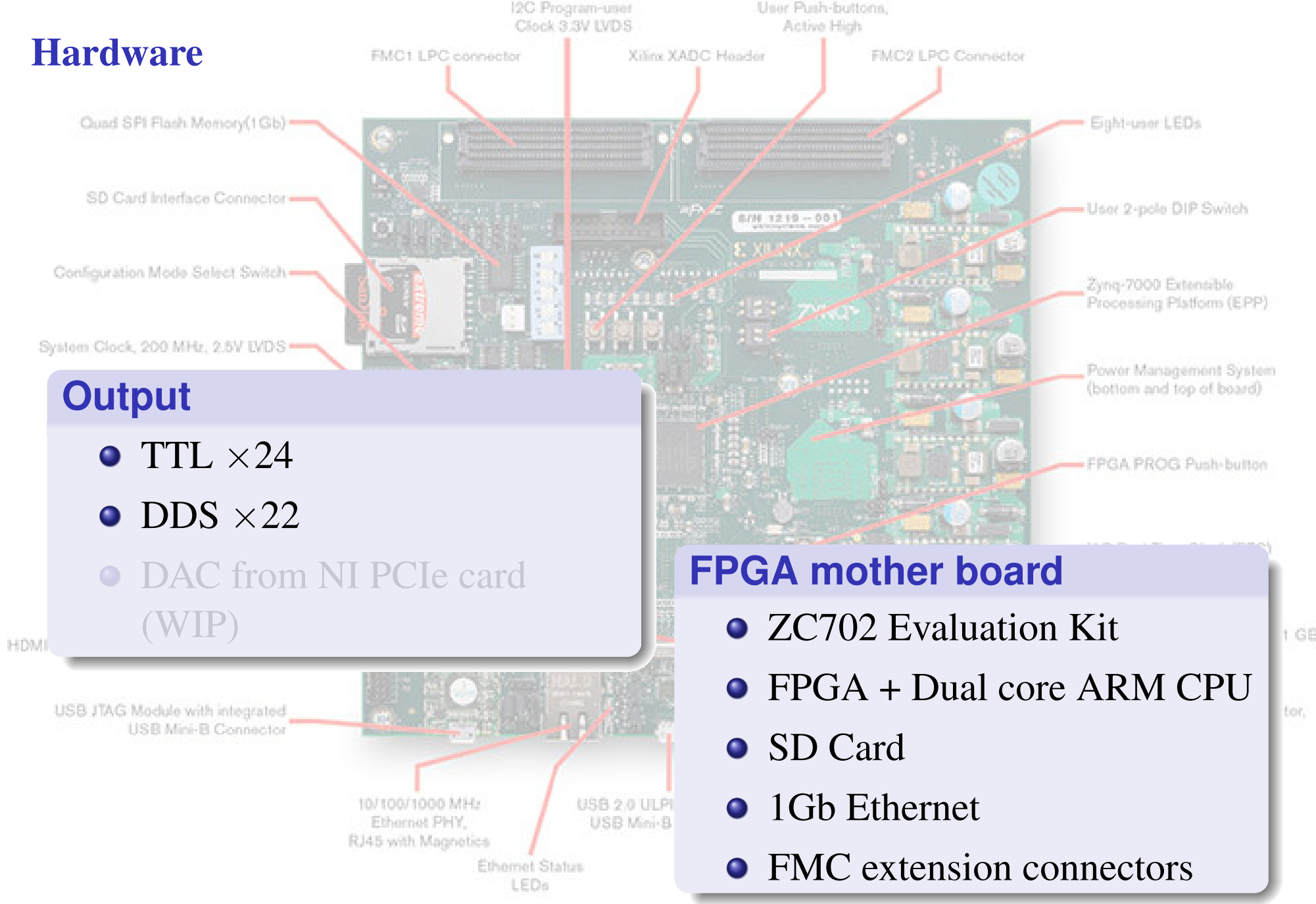

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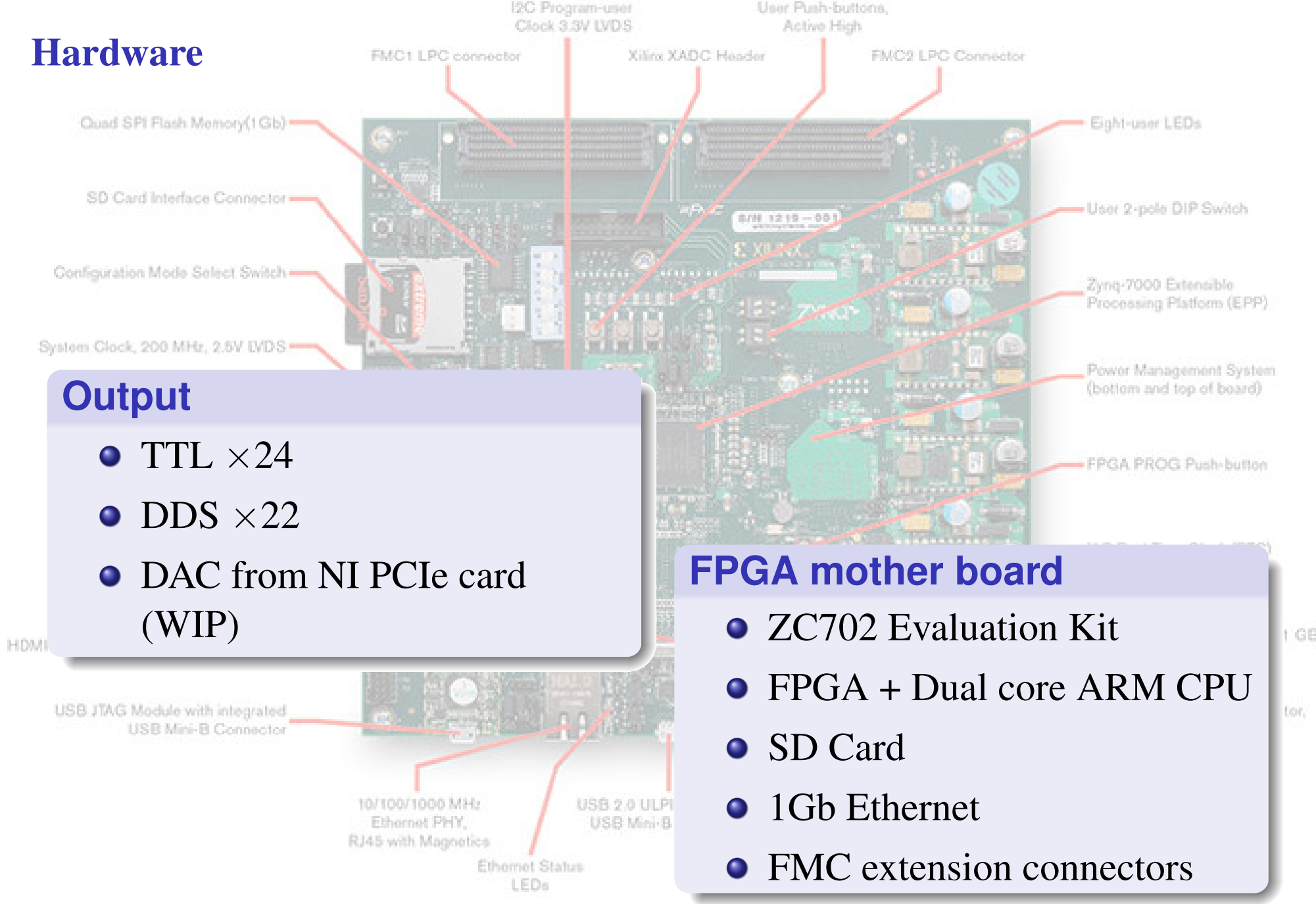

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MOT temperature

MOT temperature

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#Enter pulse sequence here
#TTL 21 is camera
#TTL 22 is B field
#amp16 is Cs MOT RP (max. 0.3, use 0.1 for MOT)
#amp18 is Cs MOT (max. 0.3, use 0.1 for MOT)

dt = 10 us, TTL(all) = 0
dt = 10 us, amp(16) = 0
dt = 10 us, amp(18) = 0

#load MOT 10s
dt = 1 us, amp(16) = .1
dt = 1 us, amp(18) = .1
dt = 10000000 us, TTL(22) = 1

#trig camera for 50 us, wait 300ms
dt = 50 us, TTL(21) = 1
dt = 300000 us, TTL(21) = 0

#flash MOT off for a dt = 3ms
dt = 1 us, TTL(22) = 0
dt = 1 us, amp(16) = 0
dt = 3000 us, amp(18) = 0

#flash MOT back on
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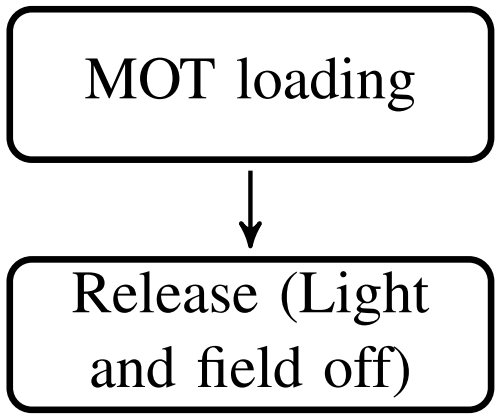

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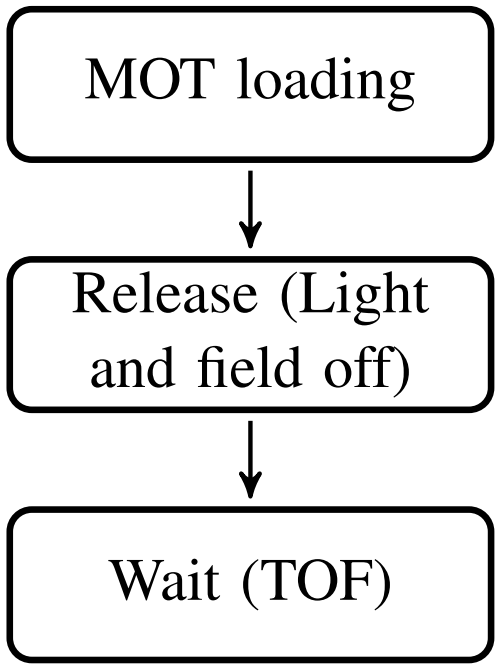

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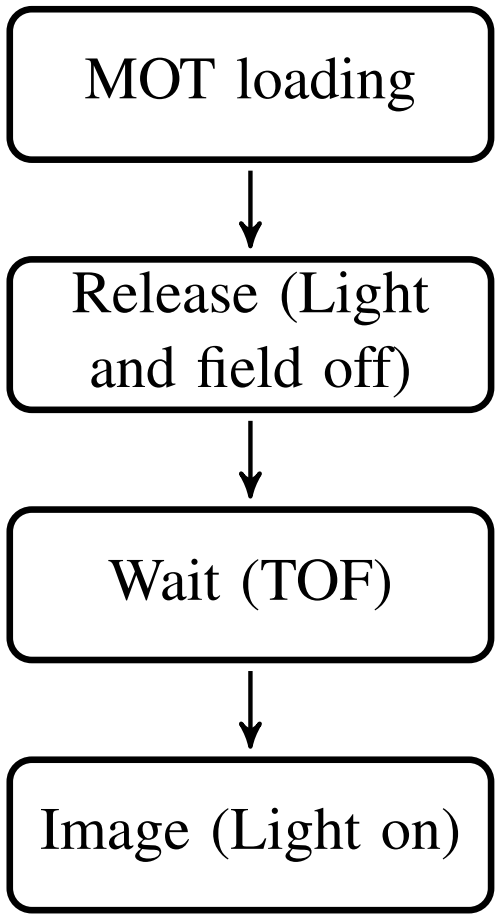
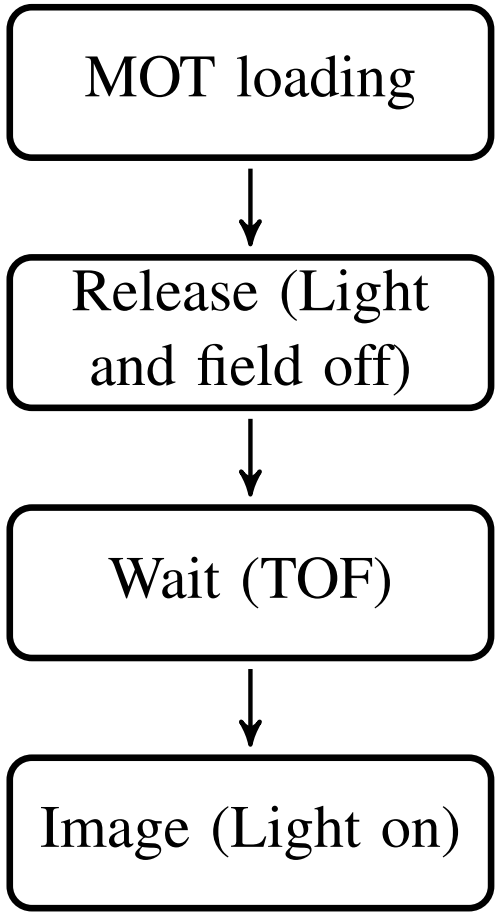


MOT temperature

Cesium MOT temperature

- $TOF \approx 3\text{ms}$
- $T \approx 1\text{mK}$



Looking for single atom in the ODT

- Looking for single atom in the video
- Background fluctuation
- Background subtraction and averaging
- Release MOT (WIP?)

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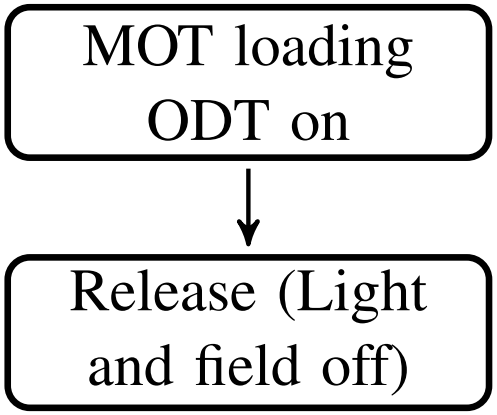

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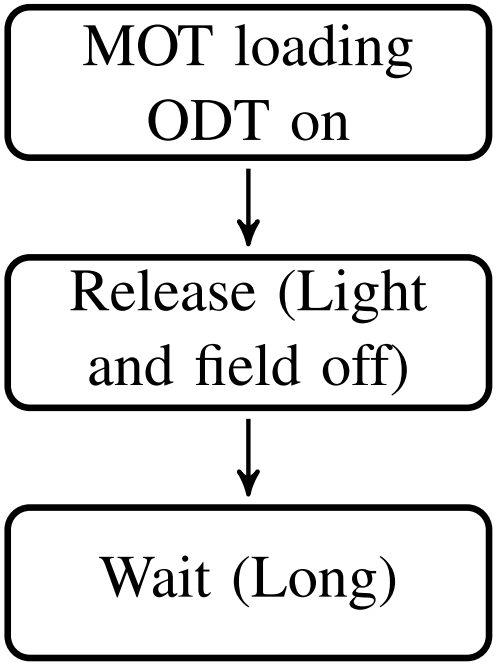

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