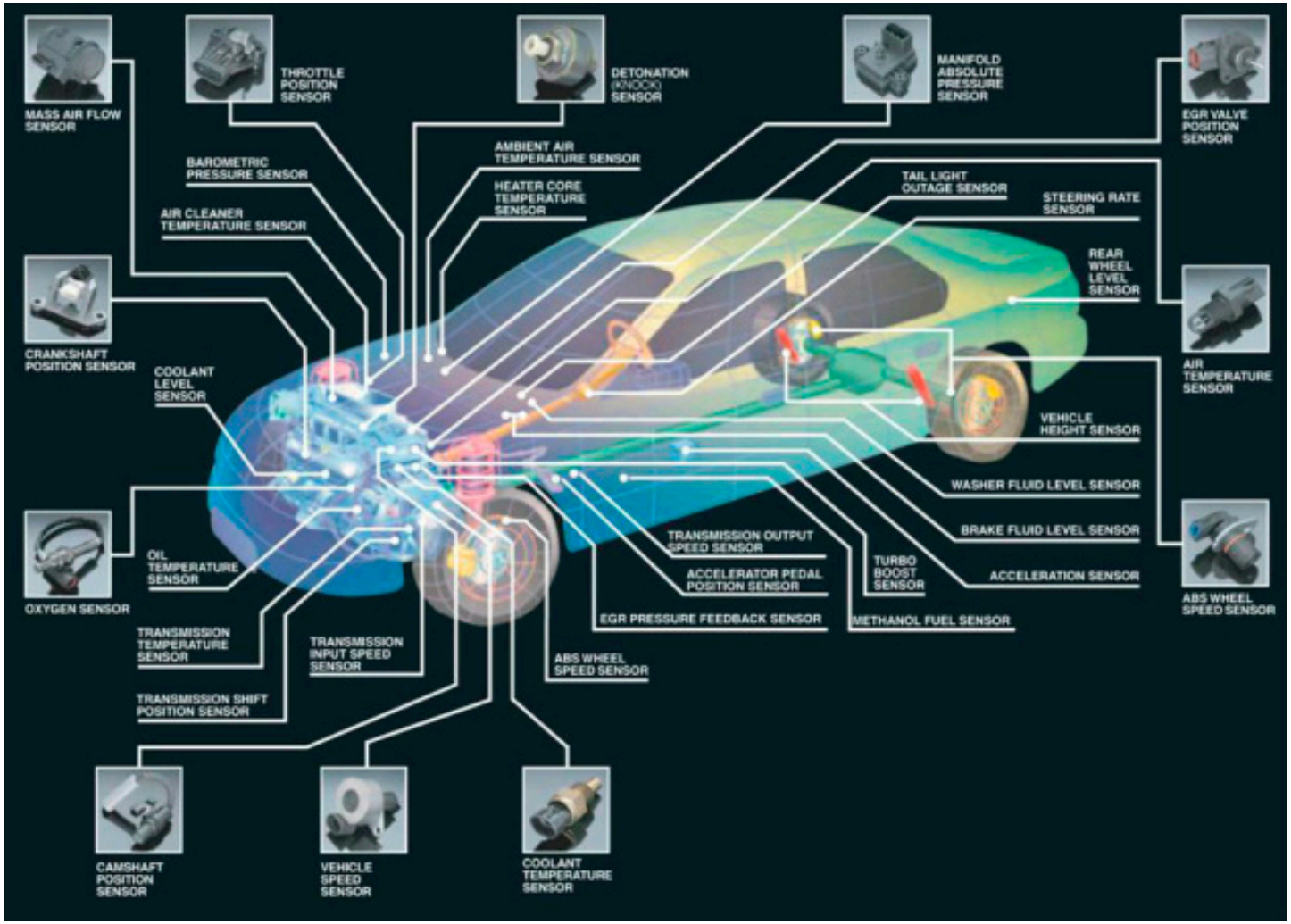
EE 49
Electronics for IoT

Microcontroller Unit

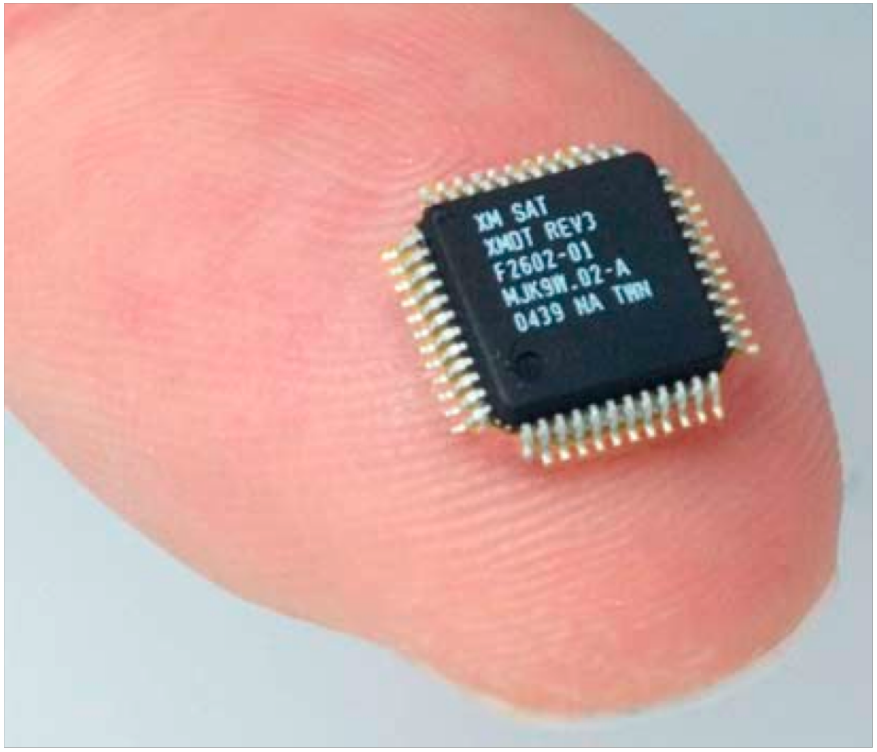
Computer

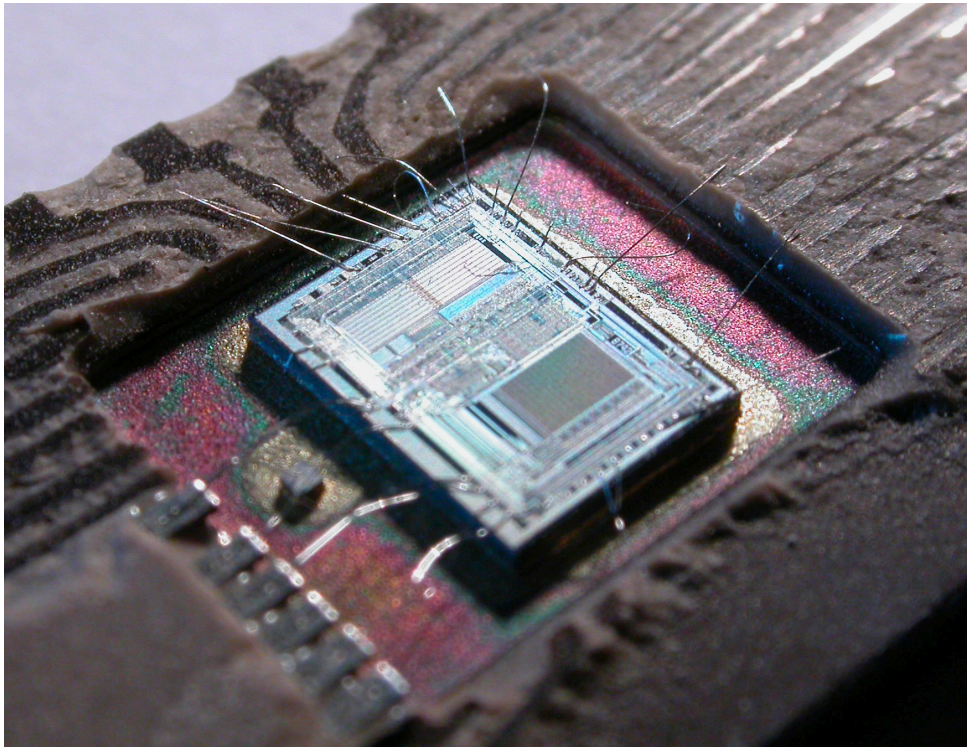
More Computers



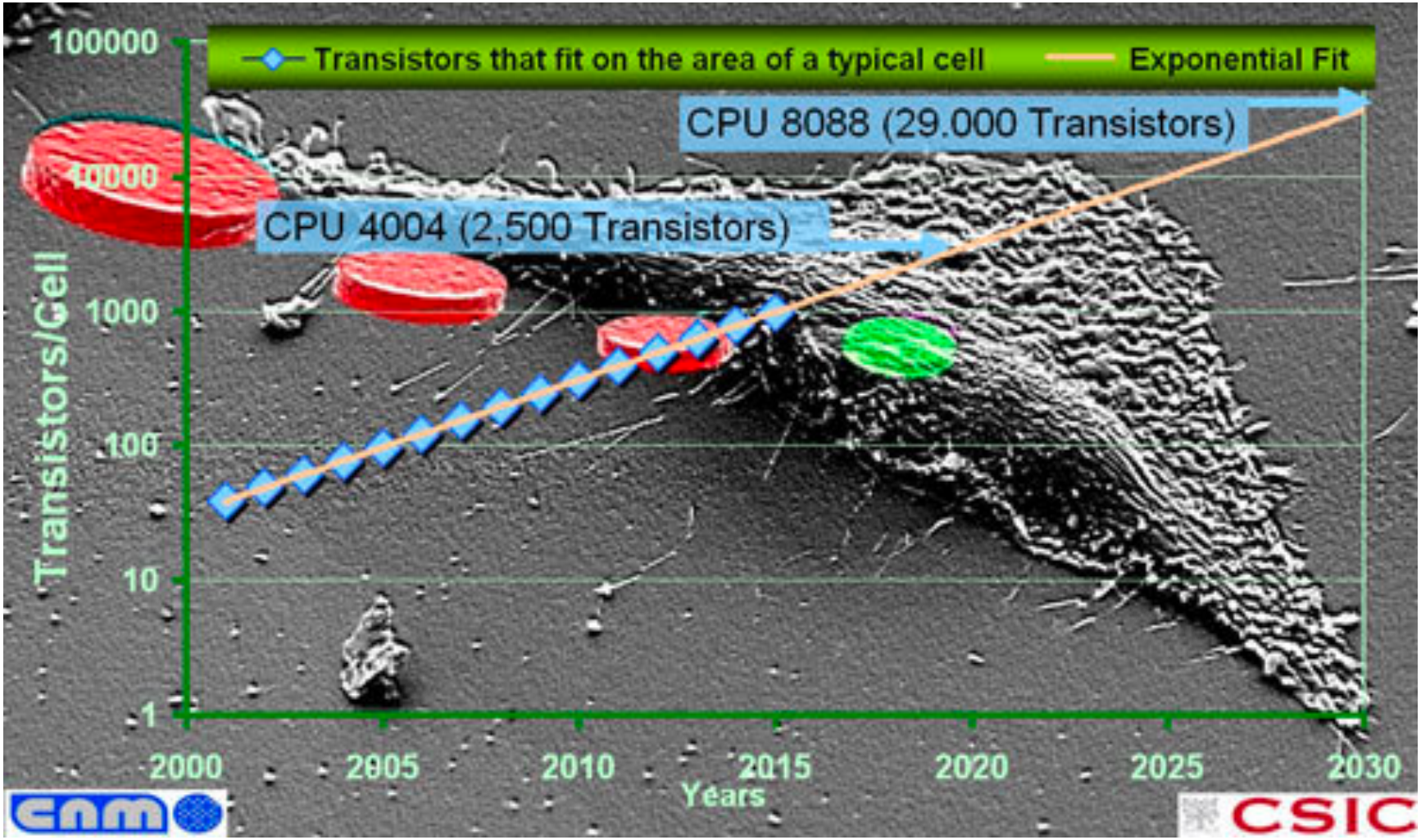
Microcontroller

A complete computer on a “chip”!





Transistor

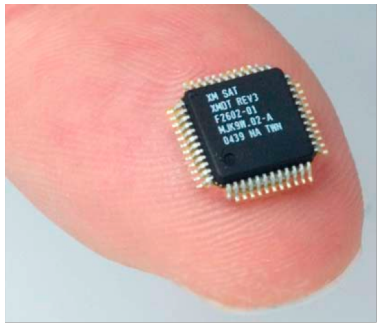

Transistors that fit on the area of a typical cell
Exponential Fit
CPU 8088 (29.000 Transistors)
CPU 4004 (2,500 Transistors)
Transistors/Cell
100000
10000
1000
100
10
1
2000
2005
2010
2015
2020
2025
2030
Years
CSIC

Microcontroller Blockdiagram

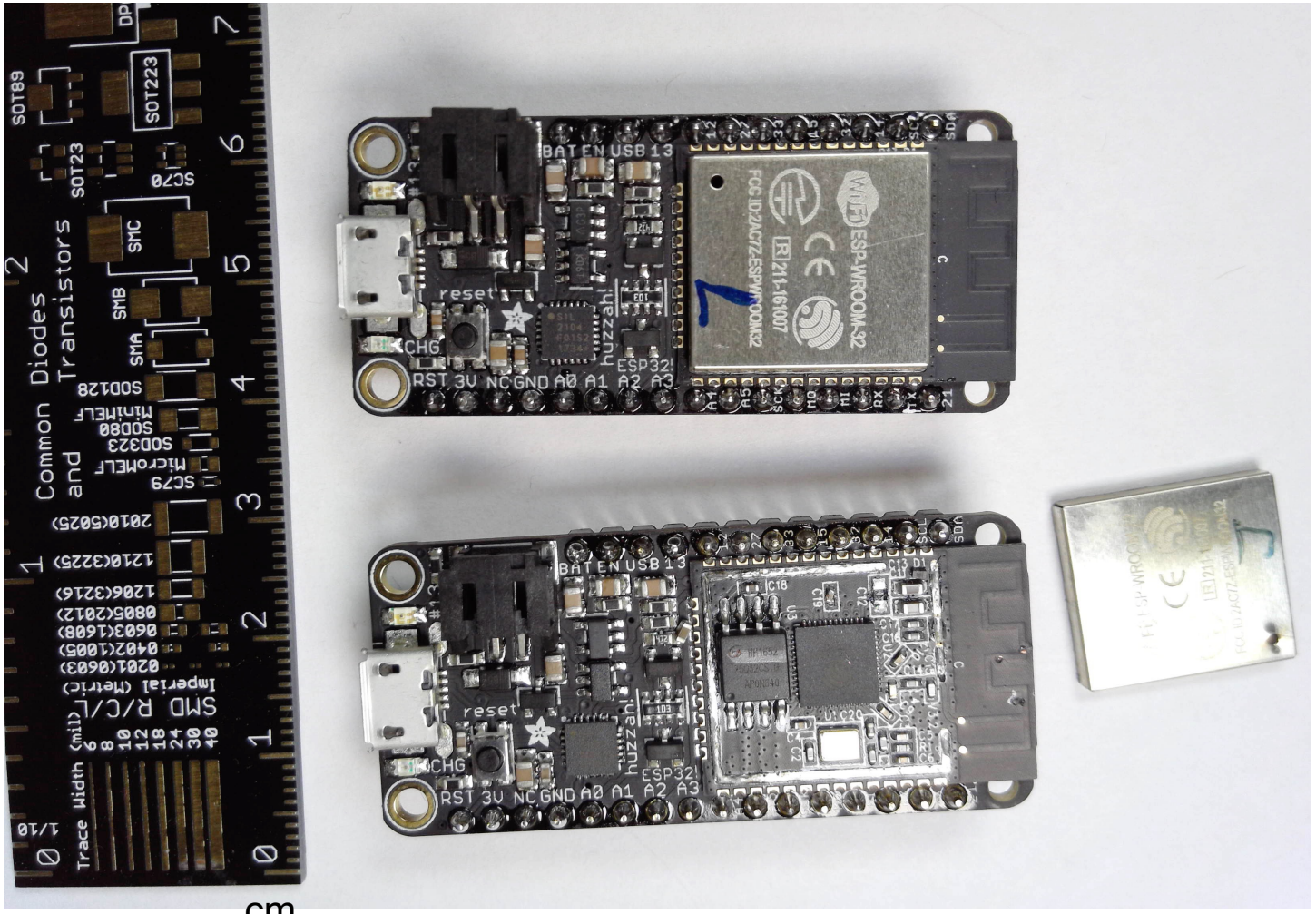
MCU

- Microcontroller Unit consists of
  - Datapath (compute)
  - Memory
  - IO

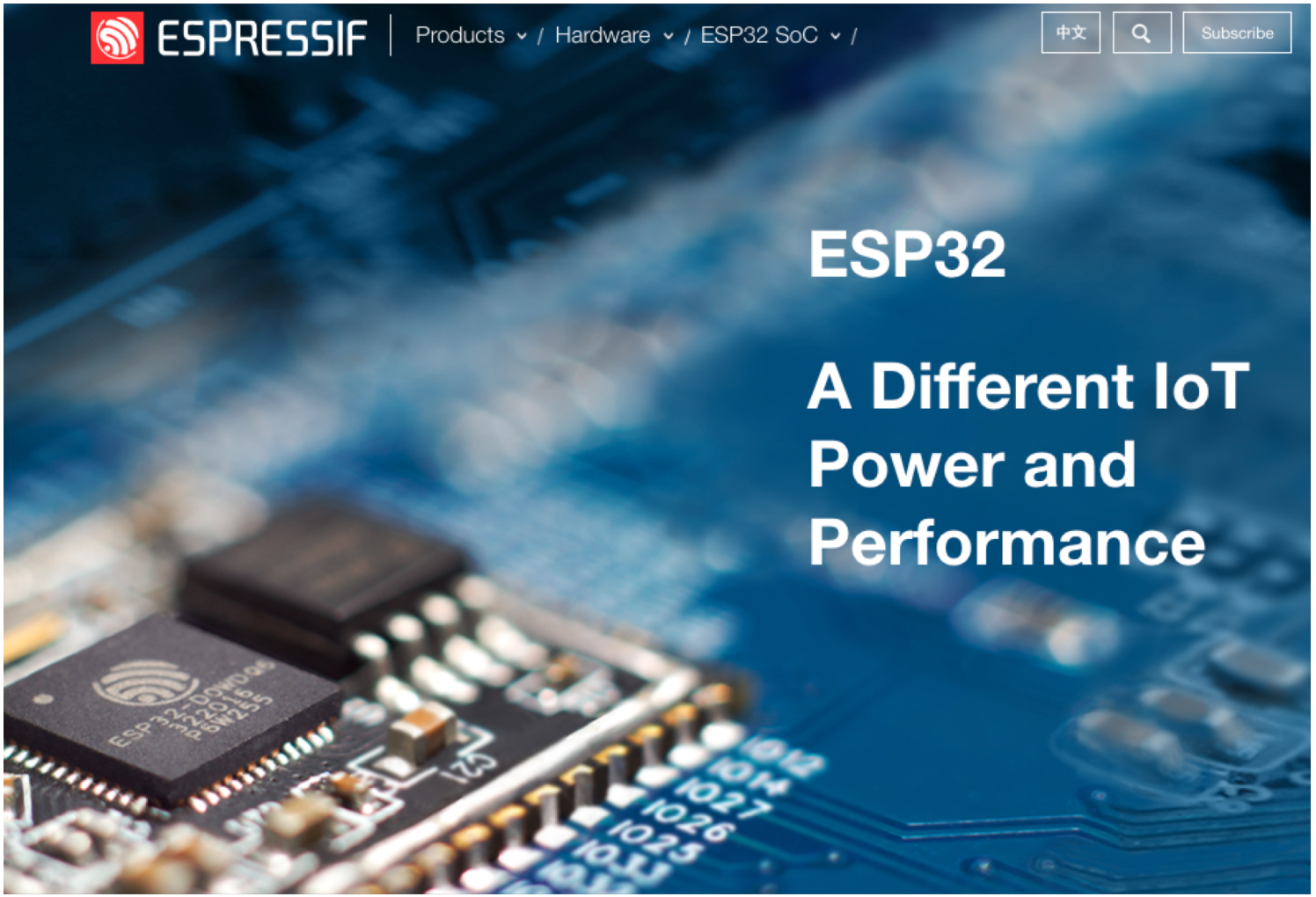
- MCU



EE49 MCU


Common Diodes and Transistors
SOT89
SOT223
SOT23
SC70
SMC
SMB
SMA
SOD128
MiniMELF
SOD80
SOD323
MicroMELF
SC79
2010(5025)
1210(3225)
1206(3216)
0805(2012)
0603(1608)
0402(1005)
0201(0603)
Imperial (Metric)
SMD R/C/L
Trace Width (mil)
cm
BAT EN USB 13
reset
CHG
RST 3V NC GND A0 A1 A2 A3
huzzah!
ESP32!
ESP-WROOM-32

Espressif – ESP32



ESP32 Datasheet

Memory

Random Access Memory (RAM)

Flash Memory

Bit

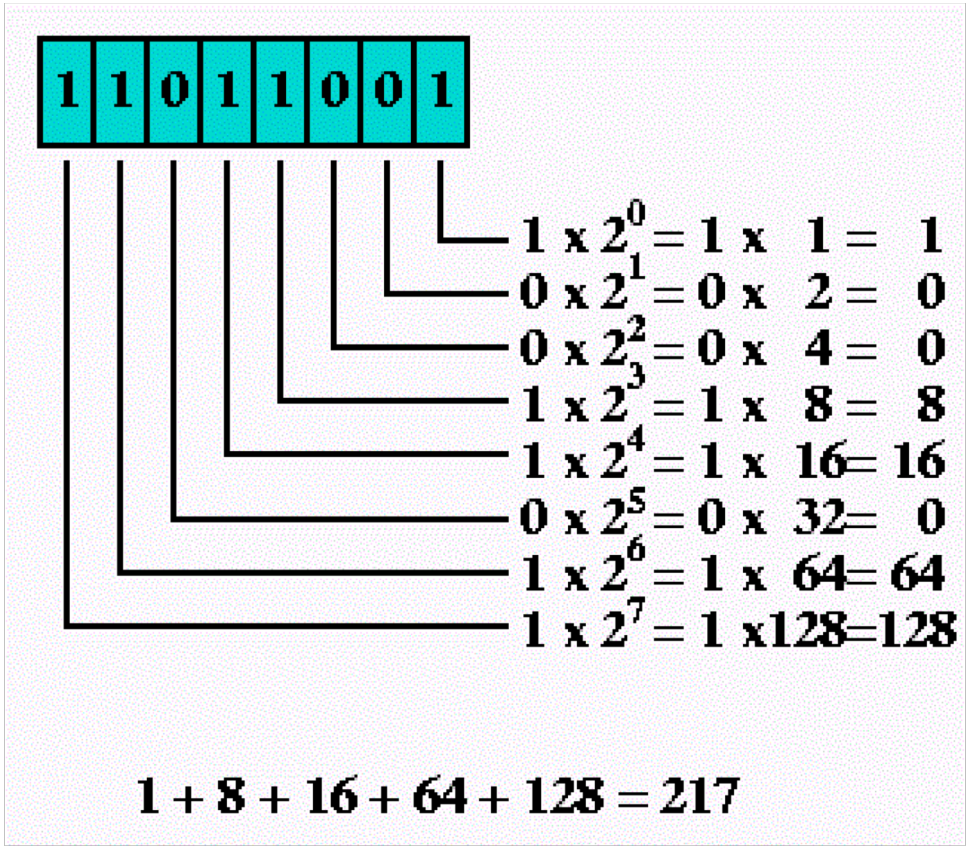
Binary Number

Byte, Word

Binary vs Decimal

Decimal Number	Binary Number
0	0
1	1
2=2^1	10
3	11
4=2^2	100
5	101
6	110
7	111
8=2^3	1000
9	1001
10	1010
11	1011
12	1100
13	1101
14	1110
15	1111
16=2^4	10000
17	10001
18	10010
19	10011
20	10100
21	10101
22	10110
23	10111
24	11000
25	11011
26	11100
27	11011
28	11100
29	11101
30	11110
31	11111
32=2^5	100000

Conversion



https://www.tutorialspoint.com/computer_fundamentals/computer_number_conversion.htm

Hexadecimal

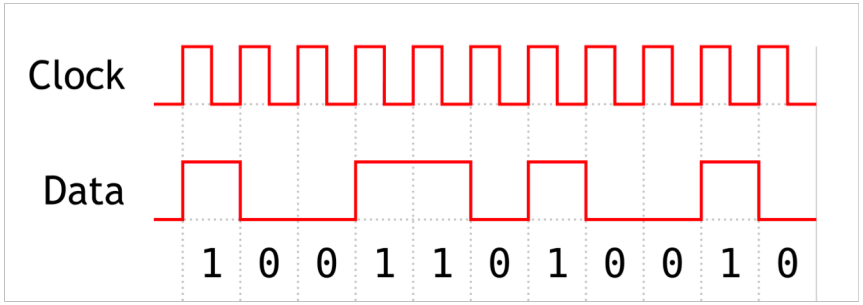
$$890234_{10} = 11011001010101111010_2$$

Decimal	Hexadecimal	Binary
0	0	0
1	1	1
2	2	10
3	3	11
4	4	100
5	5	101
6	6	110
7	7	111
8	8	1000
9	9	1001
10	A	1010
11	B	1011
12	C	1100
13	D	1101
14	E	1110
15	F	1111

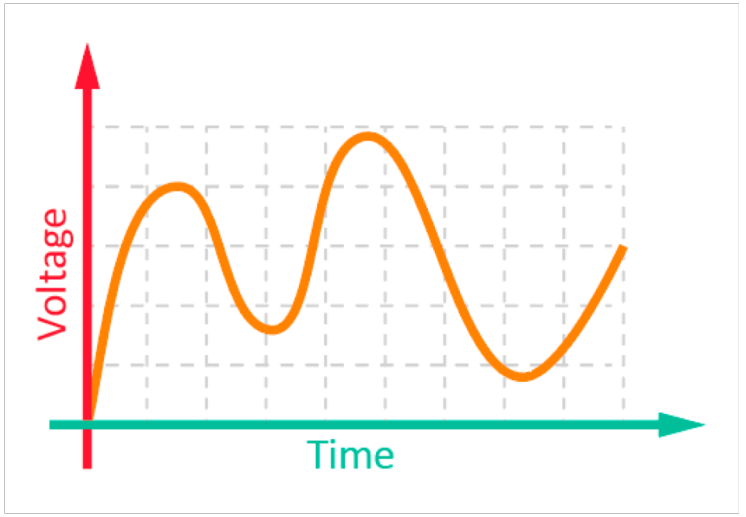
Volts and Bits

Digital versus Analog

Digital Signal



Analog Signal



Programming

MicroPython

- Python 3.4 syntax
- Same “core” libraries (e.g. math functions)
- Different specialty libraries
  - Talk to sensors
  - No functions for graphical user interface

Programming Setup