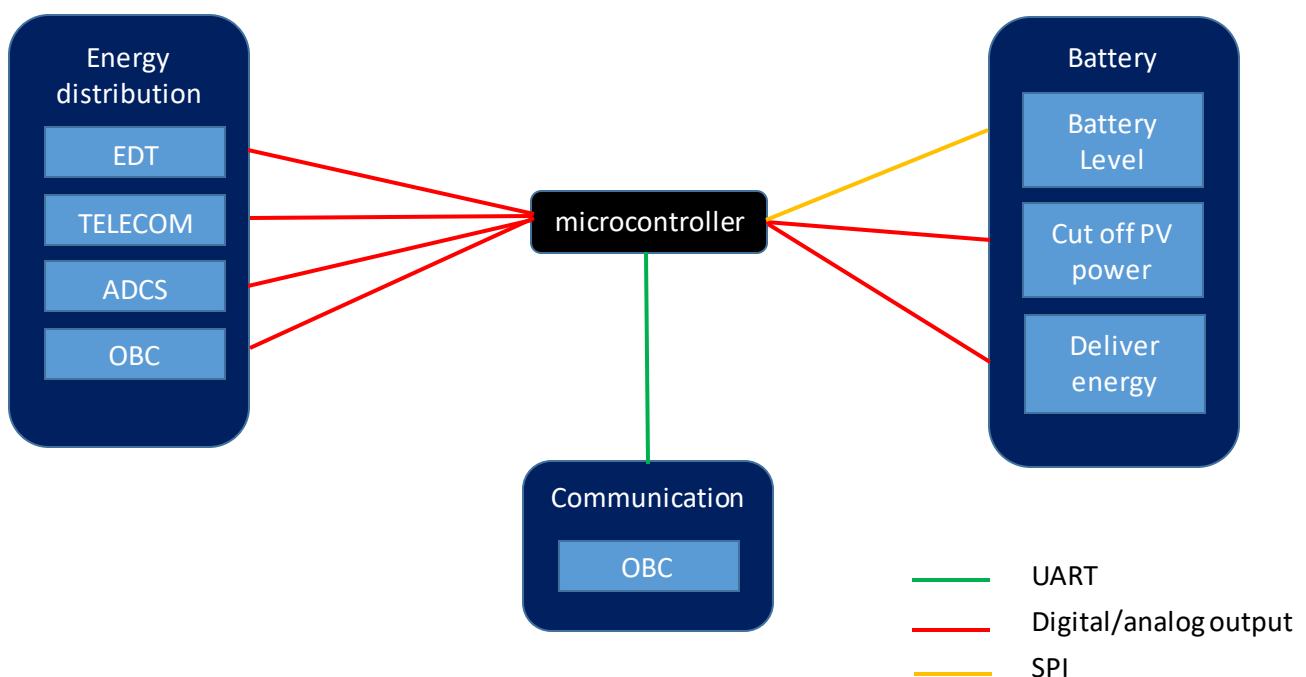# EPS- Microcontrollers Sizing

Specifications

The requirements of microcontrollers depend of the BUS, the other links as digital/analog outputs, the energy consumption, the voltage range and the memory.

BUS

The microcontroller has to handle the energy distribution of the entire CubeSat, and has to communicate with the OBC too. Thus, it needs six digital/analog outputs (EDT, ADCS, Telecom, OBC, two for battery), one BUS with a two-way communication between the microcontroller and the OBC in: UART. And another BUS which is used to send data of the battery level to the microcontroller: SPI.

Energy consumption

Generally, microcontrollers consume few energy, around the mirco ampere for the "Active mode" and around the hundreds of nano ampere for the "Off mode". Others microcontrollers are more economical, they can be used with six different ways.

Voltage range

The voltage range of the microcontroller depends of the output voltage of the battery, which is 3.7V. Almost microcontrollers have a voltage range of 2-3.6V, except for the ATMEGA1281 which has a voltage range of 2.7-5.5V.

Memory

In the light of the functions of the microcontrollers the memory didn't have to be huge. All the microcontrollers are viable.

Comparison of microcontrollers:

Model	Voltage range	Active mode(1MHz,2.2V)	Standby mode	Off mode	Temperature	Technology
MSP430F1611 MSP430F1612 MSP430F1618	1.8/3.6 V	330 uA	1.1 uA	0.2 uA	-40/85°C	USART0(UART or I2C, or SPI) & USART1(UART or I2C OR SPI)
C8051F120	2.7/3.6V or 3/3.6V				-40/85°C	2UART, SPI, I2C
PIC24FJ256GA110	2/3.6V	1mA	2.5uA	100nA	-40/120°C	3SPI, 3I2C, 4UART
DsPIC33FJ256GP710	3/3.6V				-40/85°C	2SPI, 2UART, 2I2C
AT91SAM9G20	1.8/3.3V	8mA	1uA		-40/85°C	4USART, 2UART, 2SPI,
AT91SAM7	3/3.6V	4mA	1uA		-40/85°C	USART, SPI
ATMEGA1281	2.7/5.5V	500uA (1MHz, 1.8V)		0.1uA	-40/85°C	
PX32A	2.7/3.6V				-40/85°C	I2C

Sources

- NASA: https://nepp.nasa.gov/workshops/eeesmallmissions/talks/11%20-%20THUR/1350%20-%20CubesatMicroprocessor_V1.pdf
- NASA : https://nepp.nasa.gov/workshops/etw2015/talks/24%20-%20Wed/1430%20-%20NEPPCubeSatAndMobileProcessors_ETW_V3.pdf