Protocolos de comunicación entre microcontroladores. Caso de estudio: Protocolo CAN

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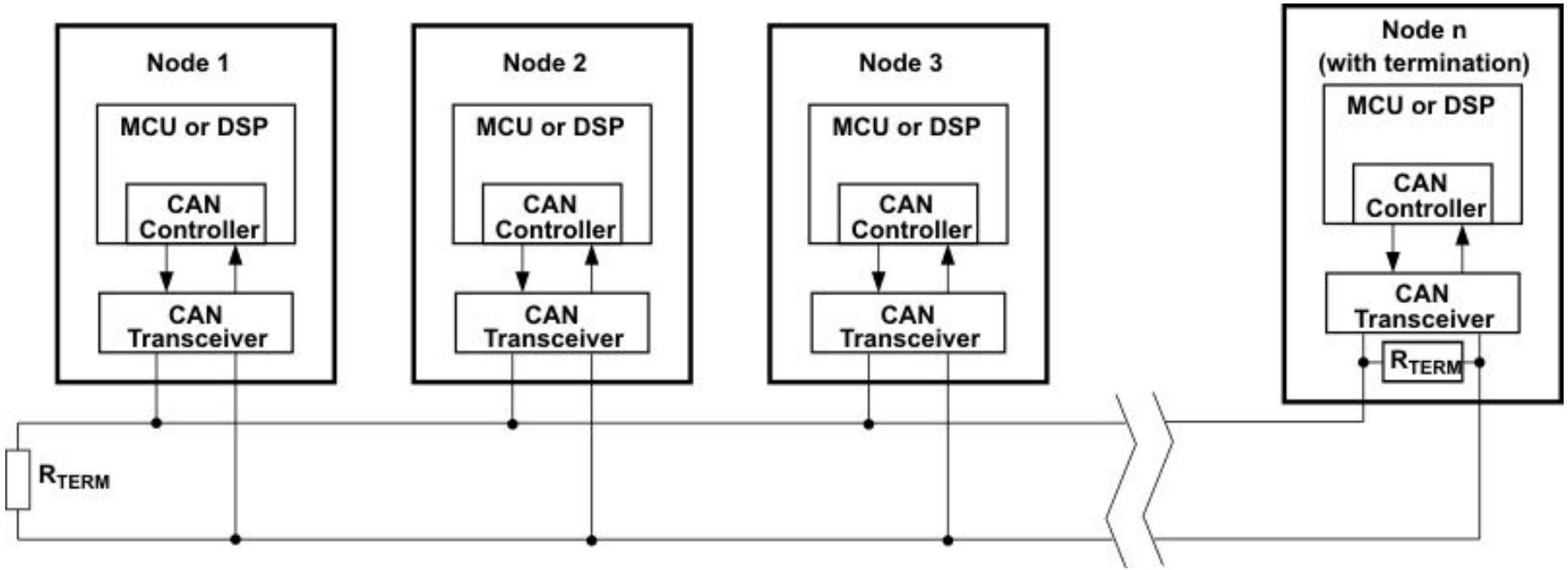
Agenda

- Motivación
- Protocolo CAN
- Hardware utilizado
- Caso de estudio.
- Conclusiones

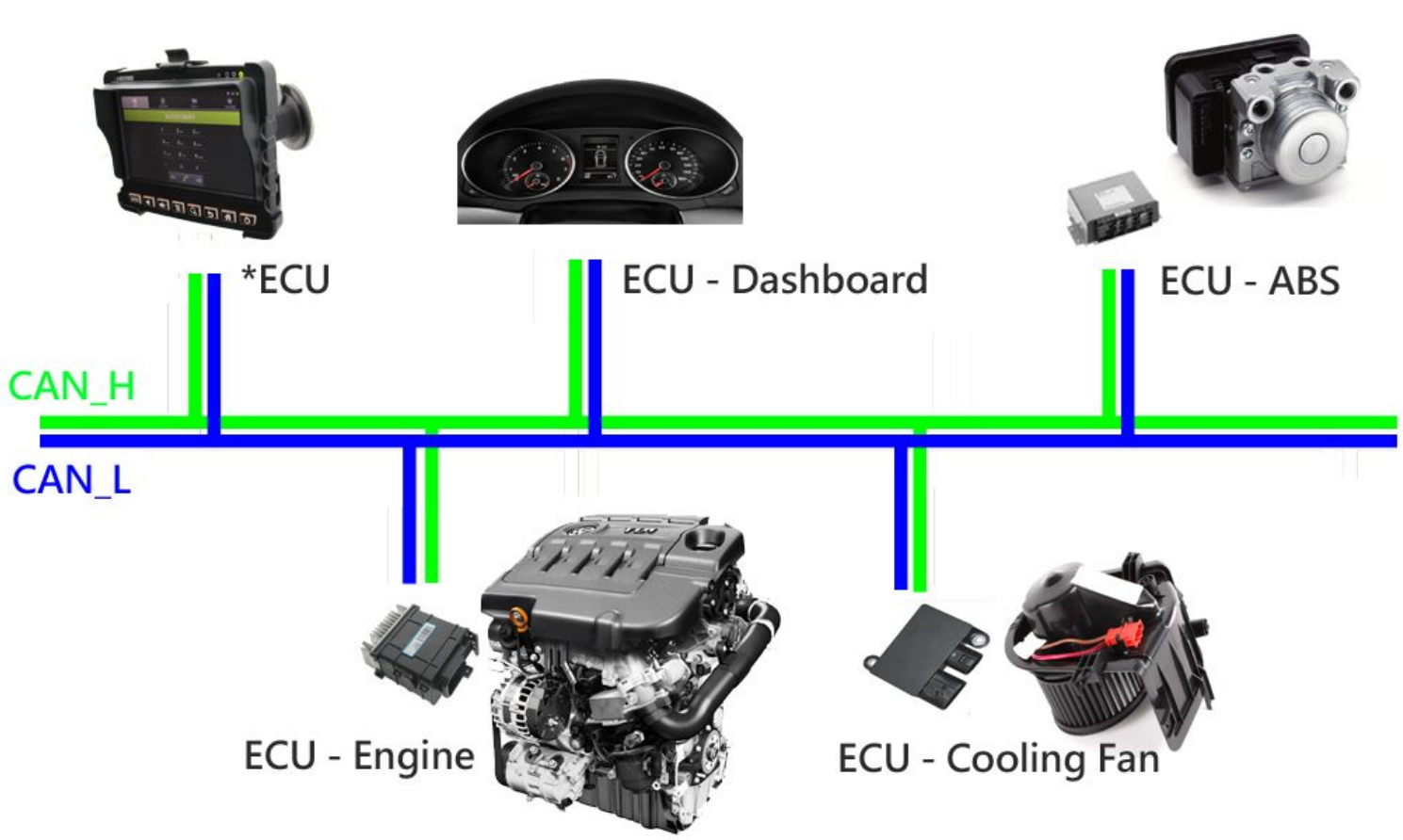
Motivación

Protocolo CAN

Bus CAN


Node 1
MCU or DSP
CAN Controller
CAN Transceiver
Node 2
MCU or DSP
CAN Controller
CAN Transceiver
Node 3
MCU or DSP
CAN Controller
CAN Transceiver
Node n
(with termination)
MCU or DSP
CAN Controller
CAN Transceiver
RTERM
RTERM

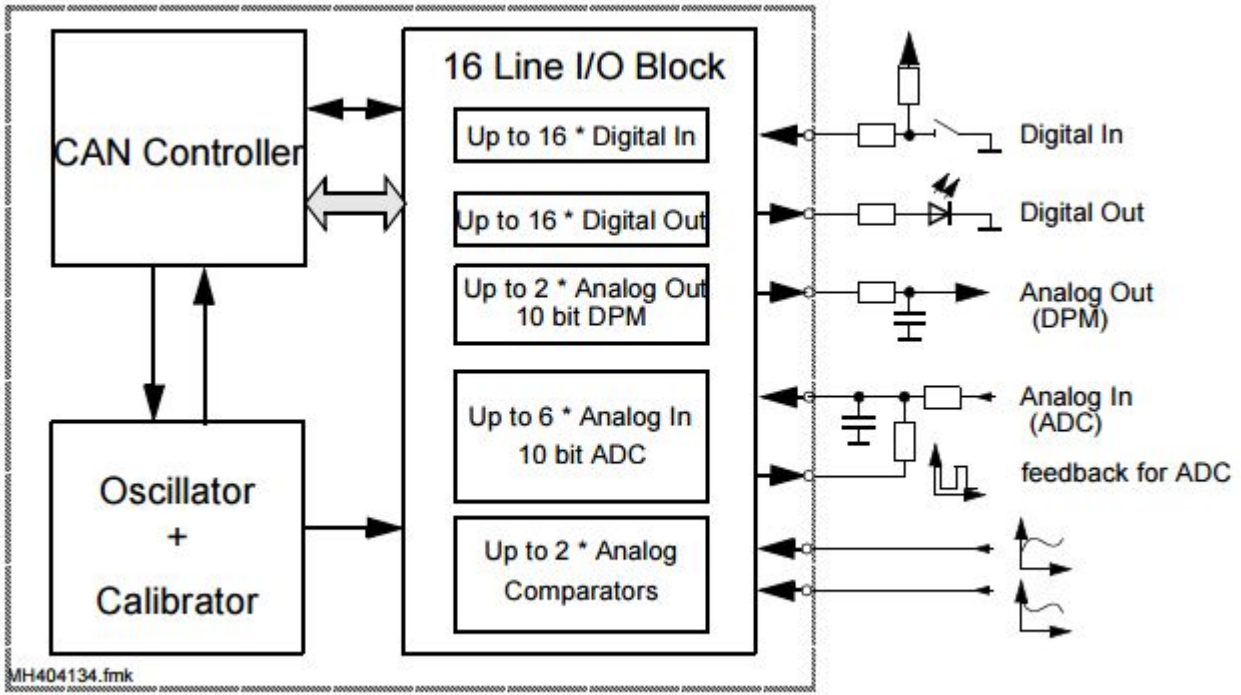
Bus CAN


*ECU
ECU - Dashboard
ECU - ABS
CAN_H
CAN_L
ECU - Engine
ECU - Cooling Fan

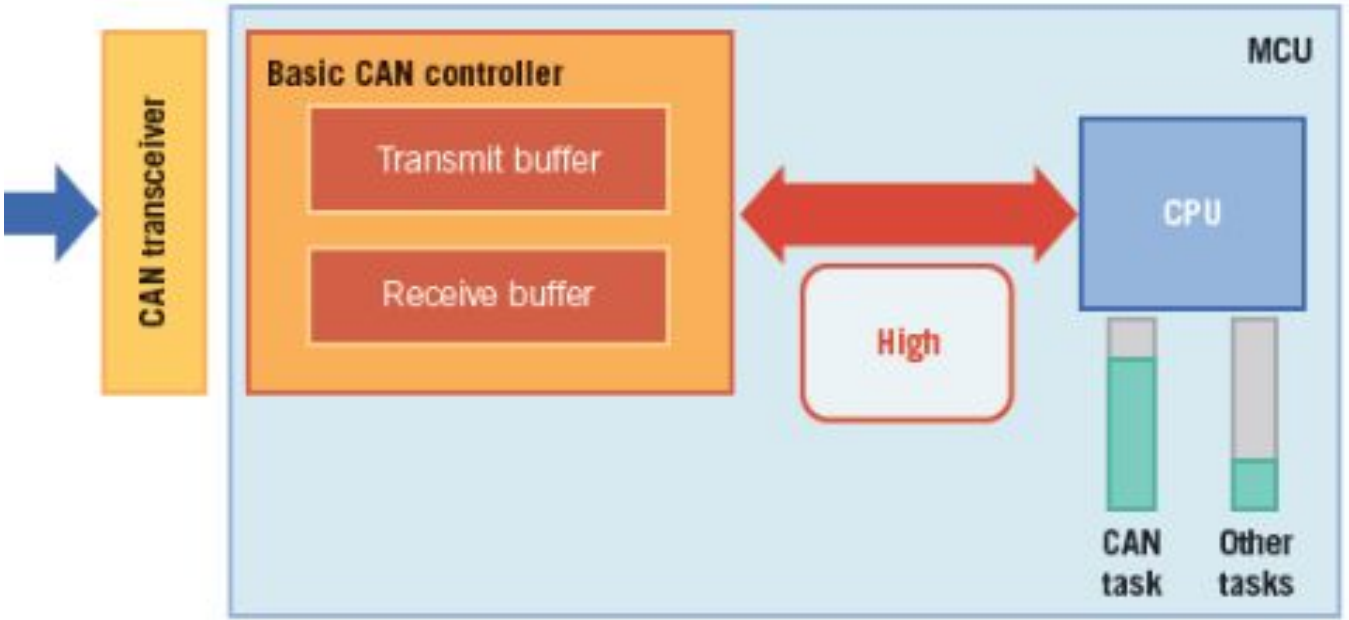
Implementaciones.

P82C150

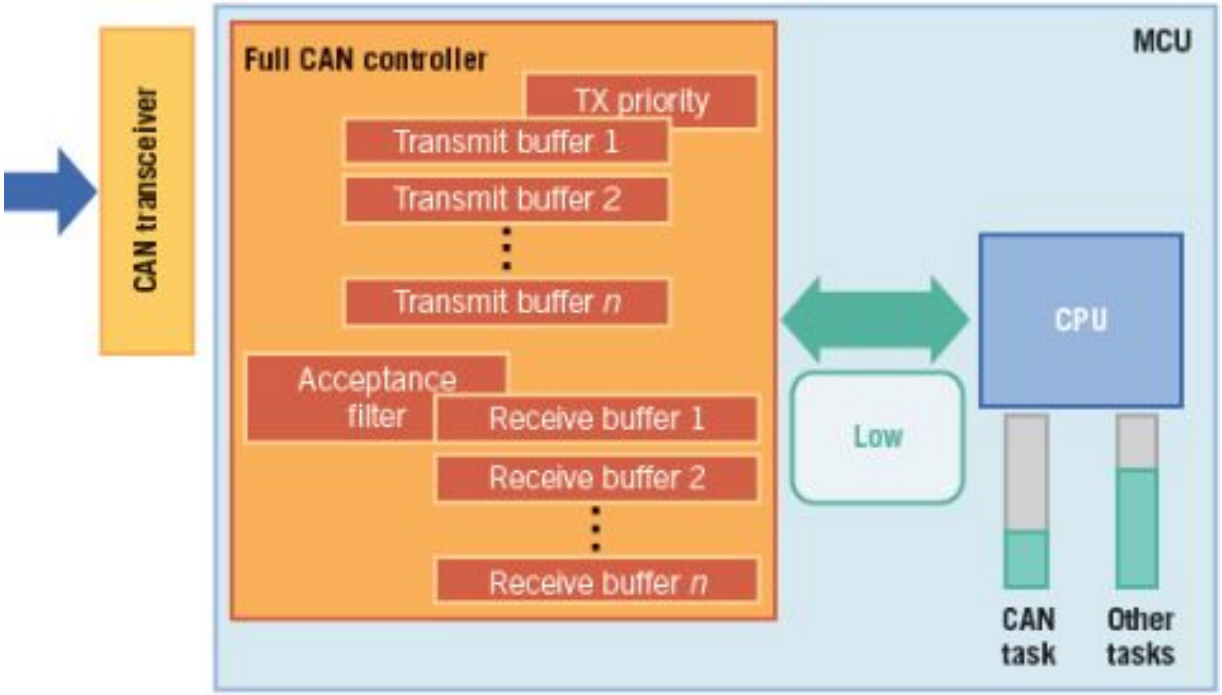
Serial Linked I/O (SLIO)



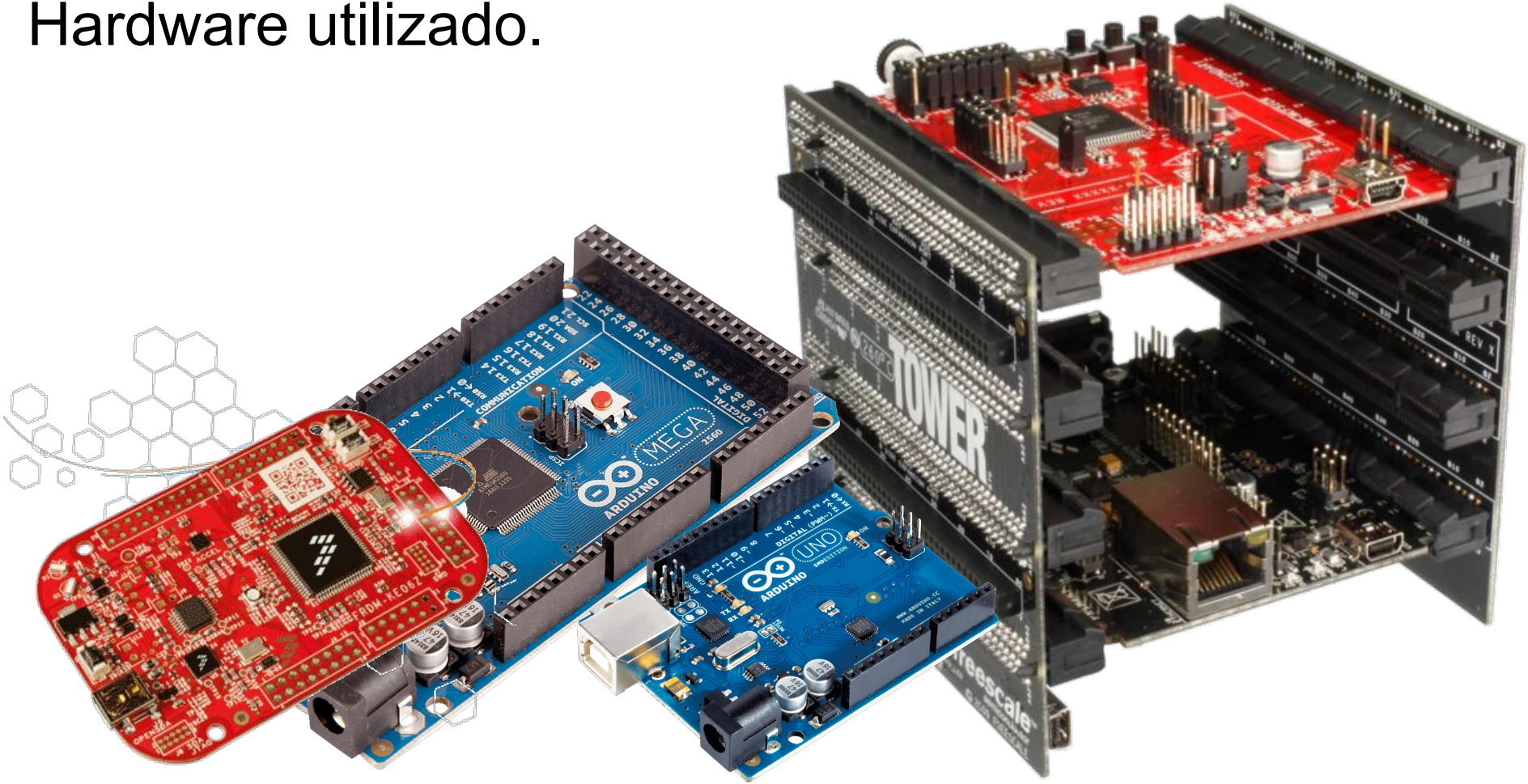
Implementaciones.



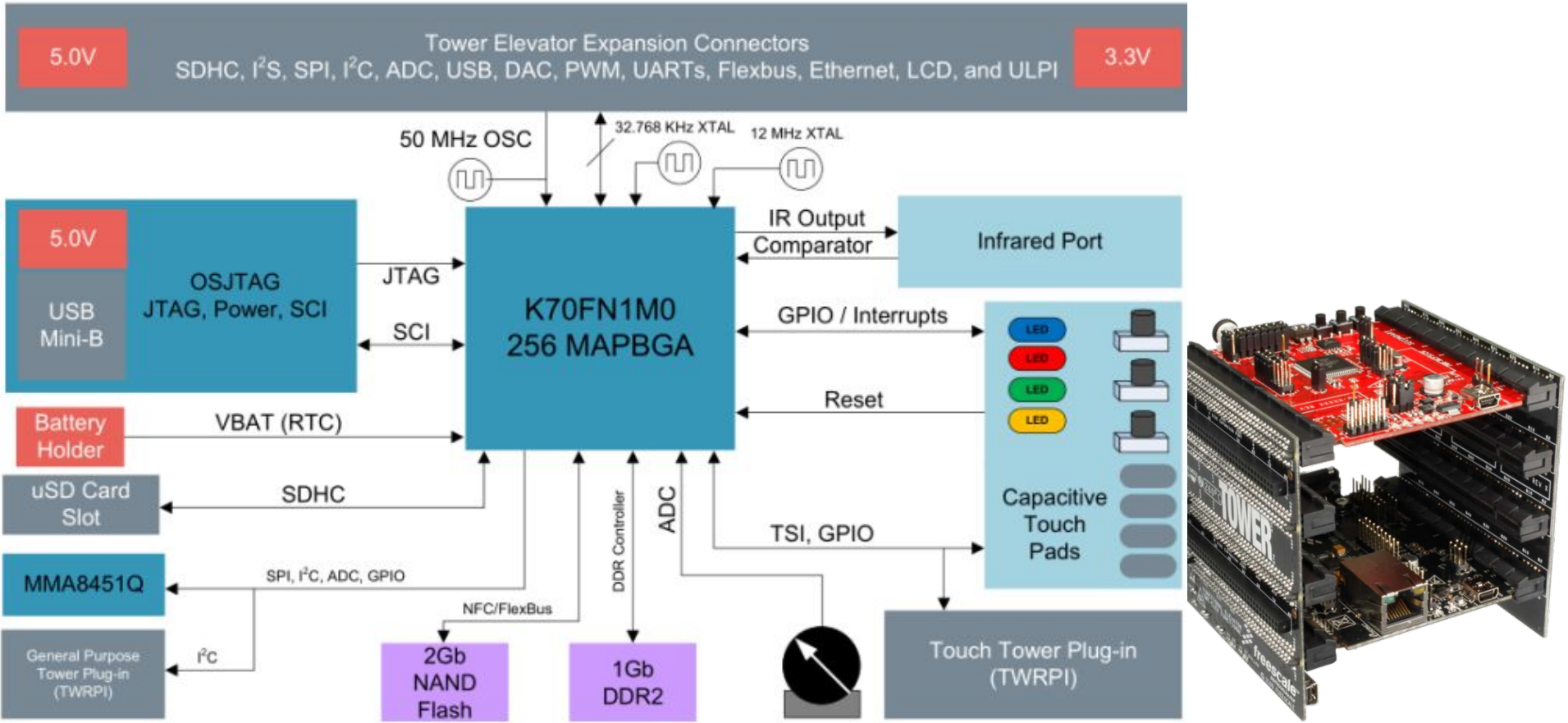
Implementaciones.



Hardware utilizado.

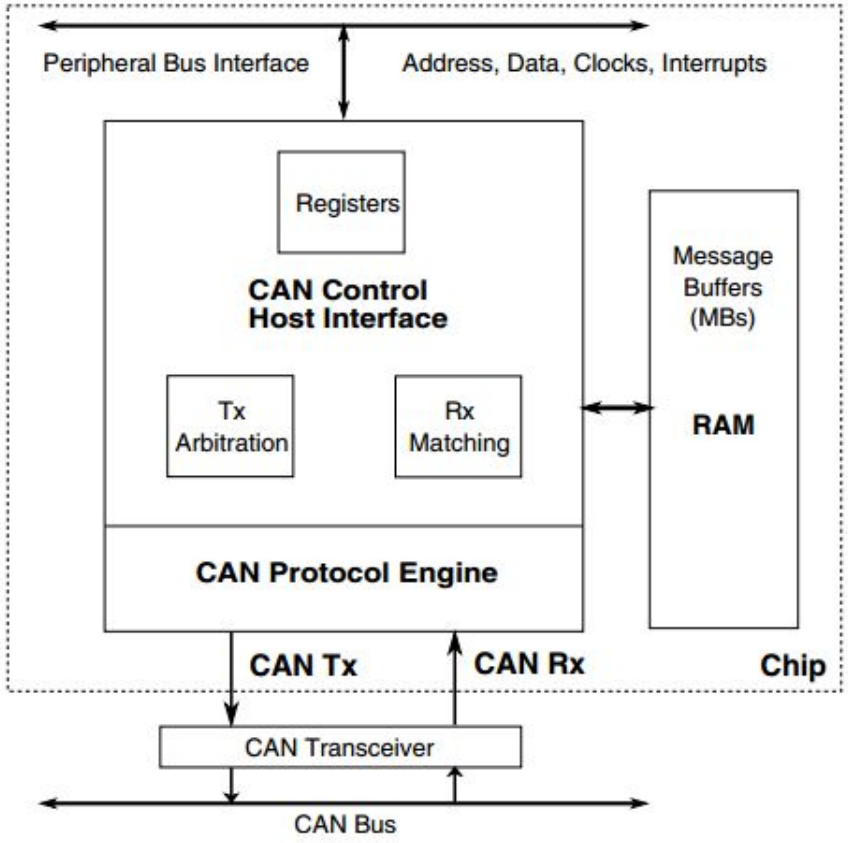


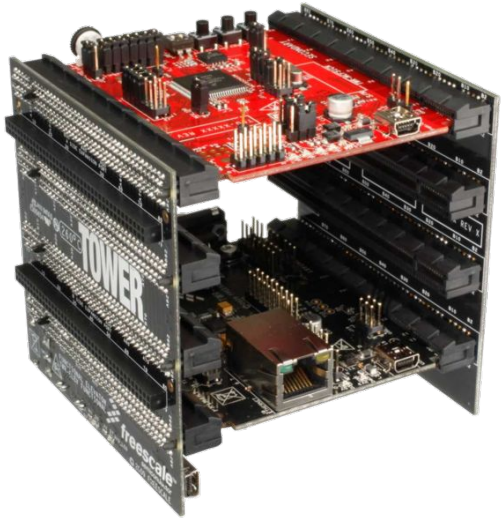
Placa Tower


5.0V
Tower Elevator Expansion Connectors
SDHC, I²S, SPI, I²C, ADC, USB, DAC, PWM, UARTs, Flexbus, Ethernet, LCD, and ULPI
3.3V
50 MHz OSC
32.768 KHz XTAL
12 MHz XTAL
5.0V
USB Mini-B
OSJTAG
JTAG, Power, SCI
JTAG
SCI
K70FN1M0
256 MAPBGA
IR Output
Comparator
Infrared Port
GPIO / Interrupts
Reset
LED
LED
LED
LED
Capacitive Touch Pads
Battery Holder
VBAT (RTC)
uSD Card Slot
SDHC
MMA8451Q
SPI, I²C, ADC, GPIO
NFC/FlexBus
DDR Controller
ADC
TSI, GPIO
General Purpose Tower Plug-in (TWRPI)
I²C
2Gb NAND Flash
1Gb DDR2
Touch Tower Plug-in (TWRPI)

TOWER
freescale

Placa Tower


Peripheral Bus Interface
Address, Data, Clocks, Interrupts
Registers
CAN Control
Host Interface
Message
Buffers
(MBs)
Tx
Arbitration
Rx
Matching
RAM
CAN Protocol Engine
CAN Tx
CAN Rx
Chip
CAN Transceiver
CAN Bus


TOWER
freescale

Placa KE06

Timers
- One 6-Channel FlexTimer/PWM
- Two 2-Channel FlexTimer/PWM
- One 2-Channel Periodic Interrupt Timer
- RTC
- One Pulse Width Timer

System
- Power Management Module
- Watchdog
- Low-Voltage Detection
- Cyclic Redundancy Check
- Serial Wire Debug
- Bit Manipulation Engine

Core Complex
- ARM® Cortex®-M0+ Up to 48 MHz
- Single-Cycle 32-bit x 32-bit Multiplier
- Single-Cycle I/O Access Port

Analog
- 1 x 12-bit ADC
- 2 x Analog Comparator

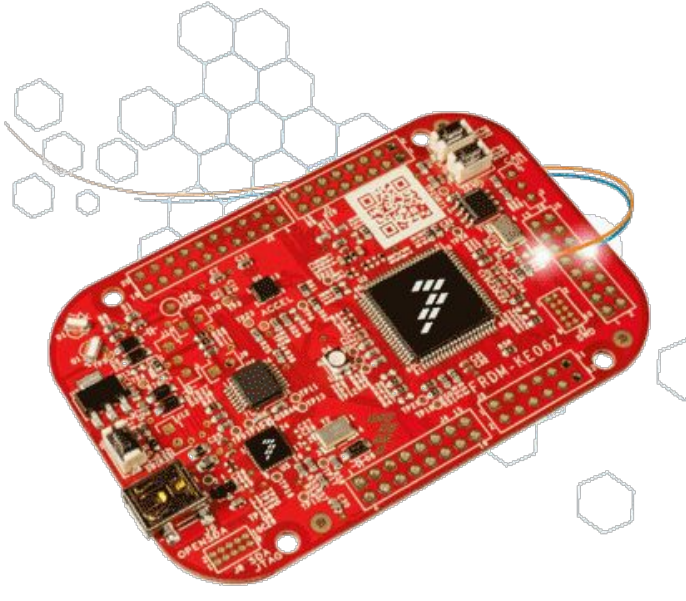
Clocks
- Internal Oscillator
- Internal Reference Clocks
- Frequency-Locked Loop

Memory Interfaces
- Up to 128 KB Flash
- Up to 16 KB RAM

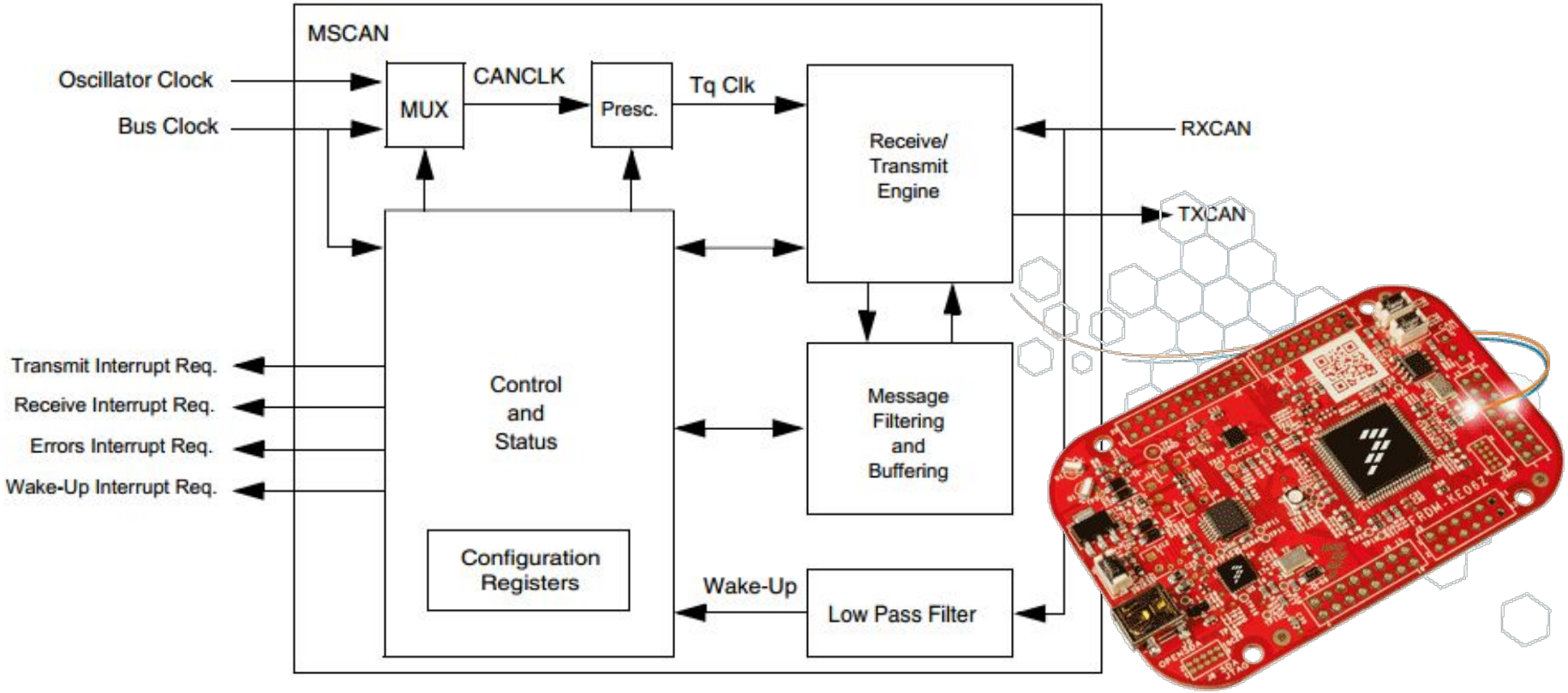
HMI
- Up to 71 GPIO
- 2 x KBI
- Up to 8 High-Current Pins (20mA)

Security
- 64-bit Unique Identification (ID) Number

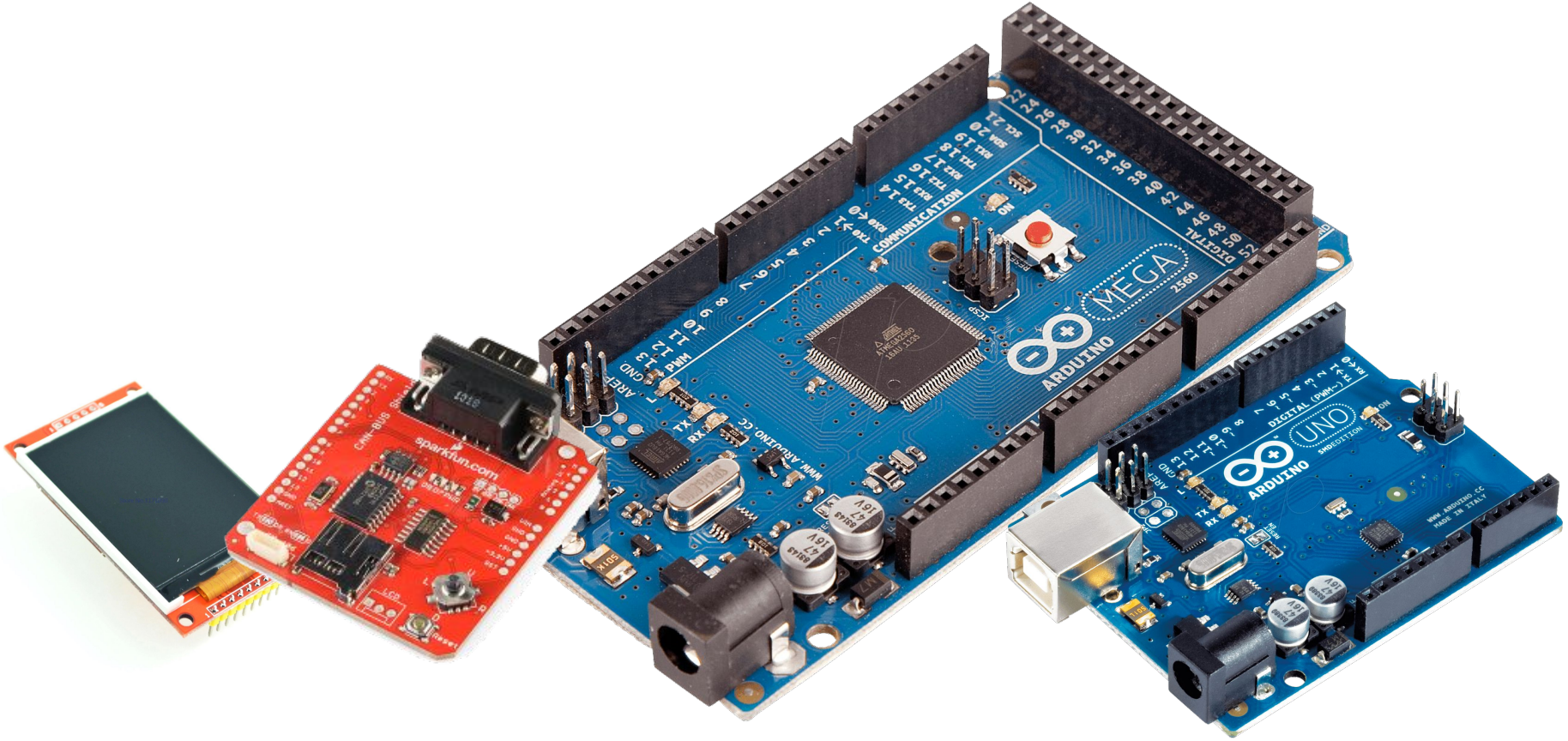
Communications
- 3 x UART
- 2 x SPI
- 2 x I²C
- 1 x CAN



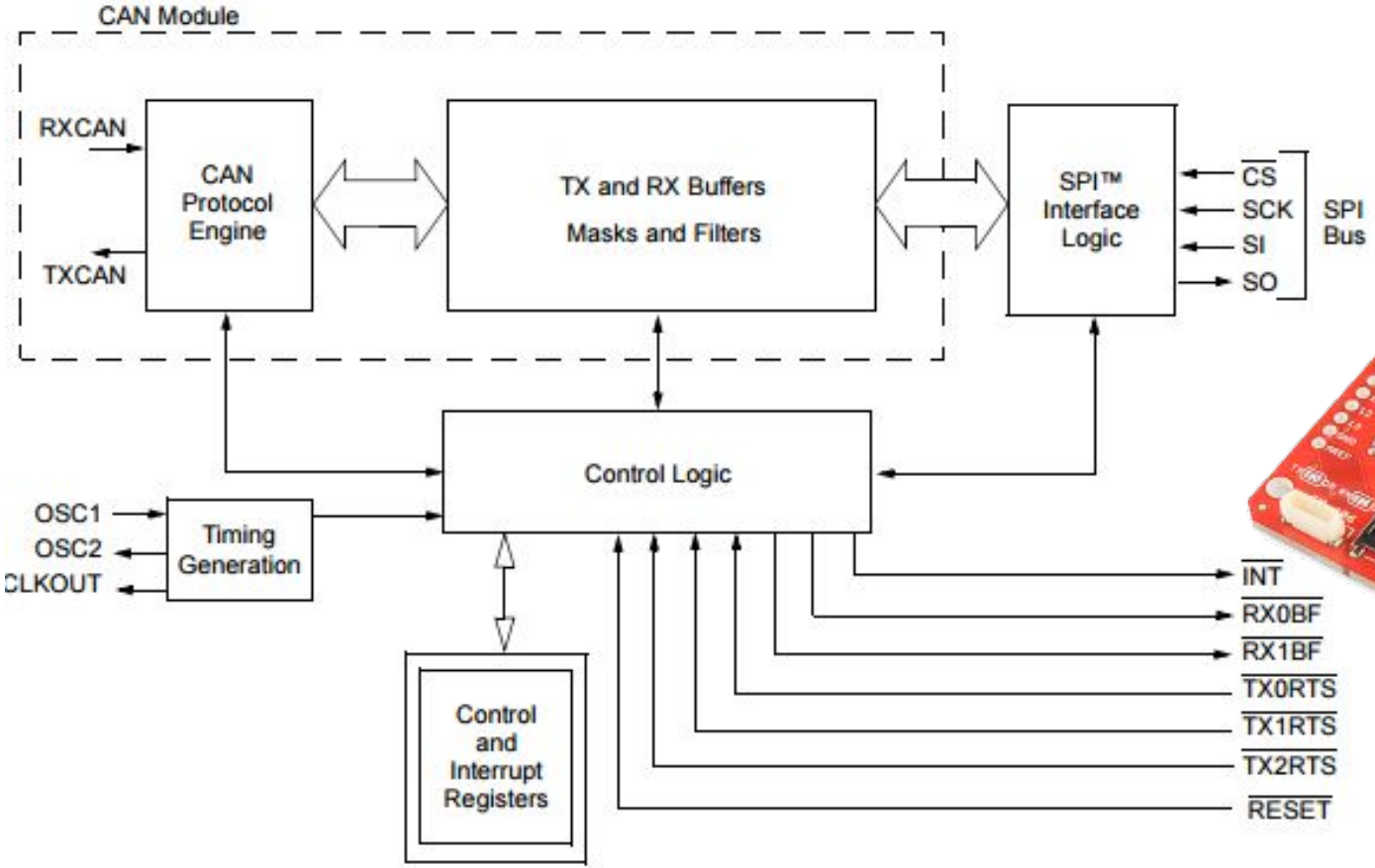
Placa KE06

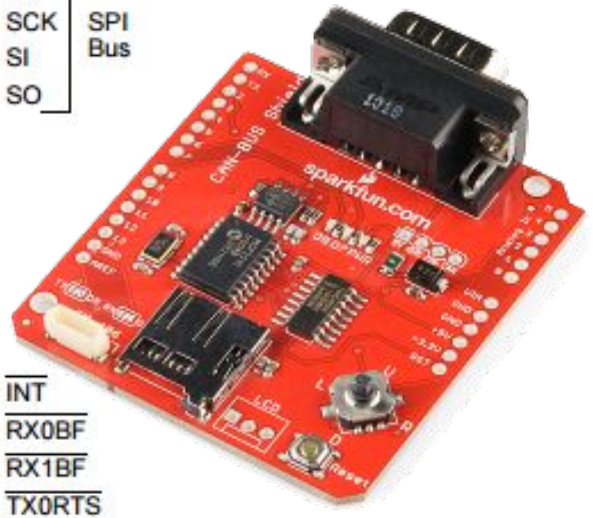

MSCAN
Oscillator Clock
Bus Clock
MUX
CANCLK
Presc.
Tq Clk
Receive/
Transmit
Engine
RXCAN
TXCAN
Transmit Interrupt Req.
Receive Interrupt Req.
Errors Interrupt Req.
Wake-Up Interrupt Req.
Control
and
Status
Message
Filtering
and
Buffering
Configuration
Registers
Wake-Up
Low Pass Filter

Familia Arduino

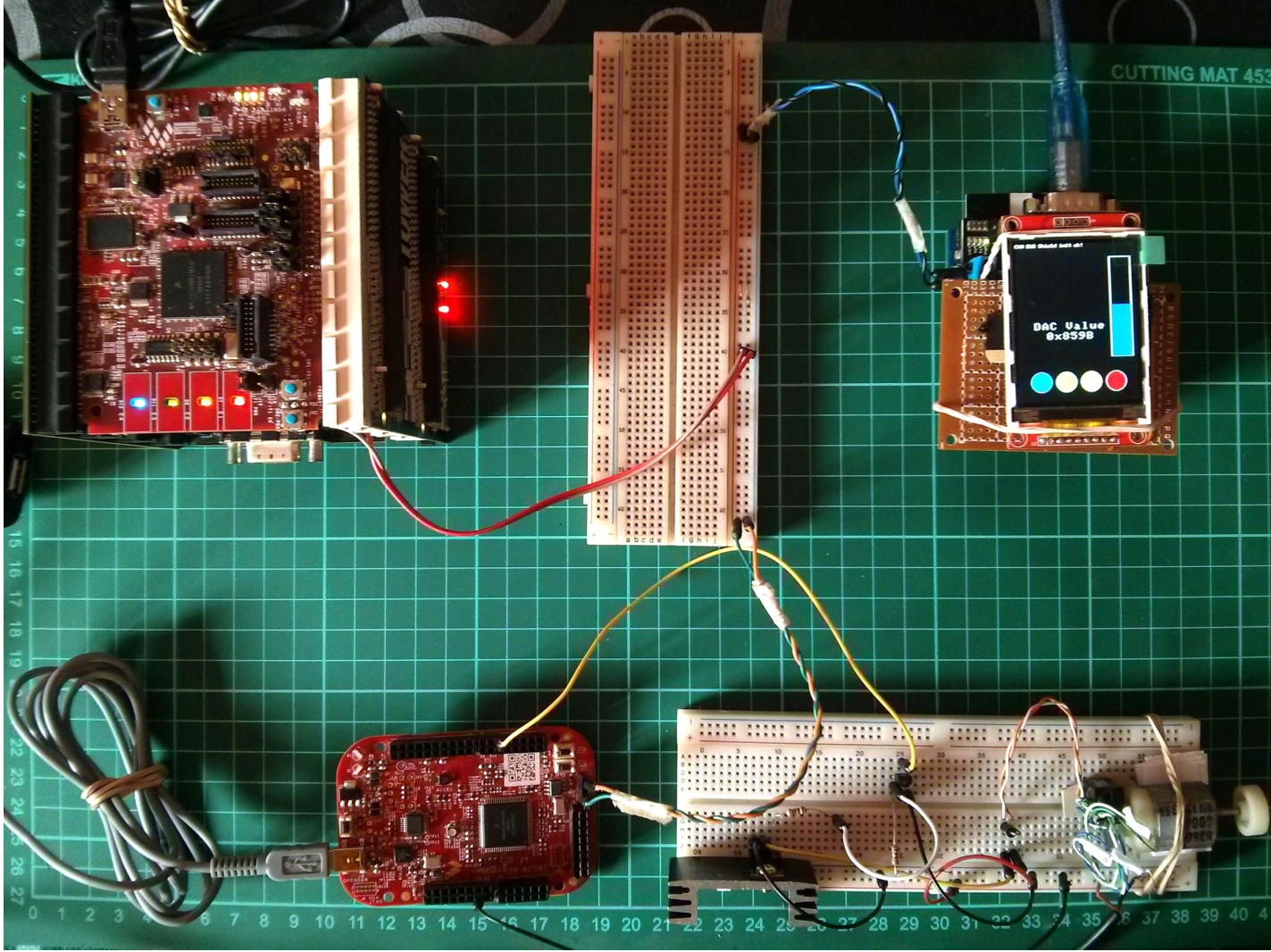


Arduino CAN Shield

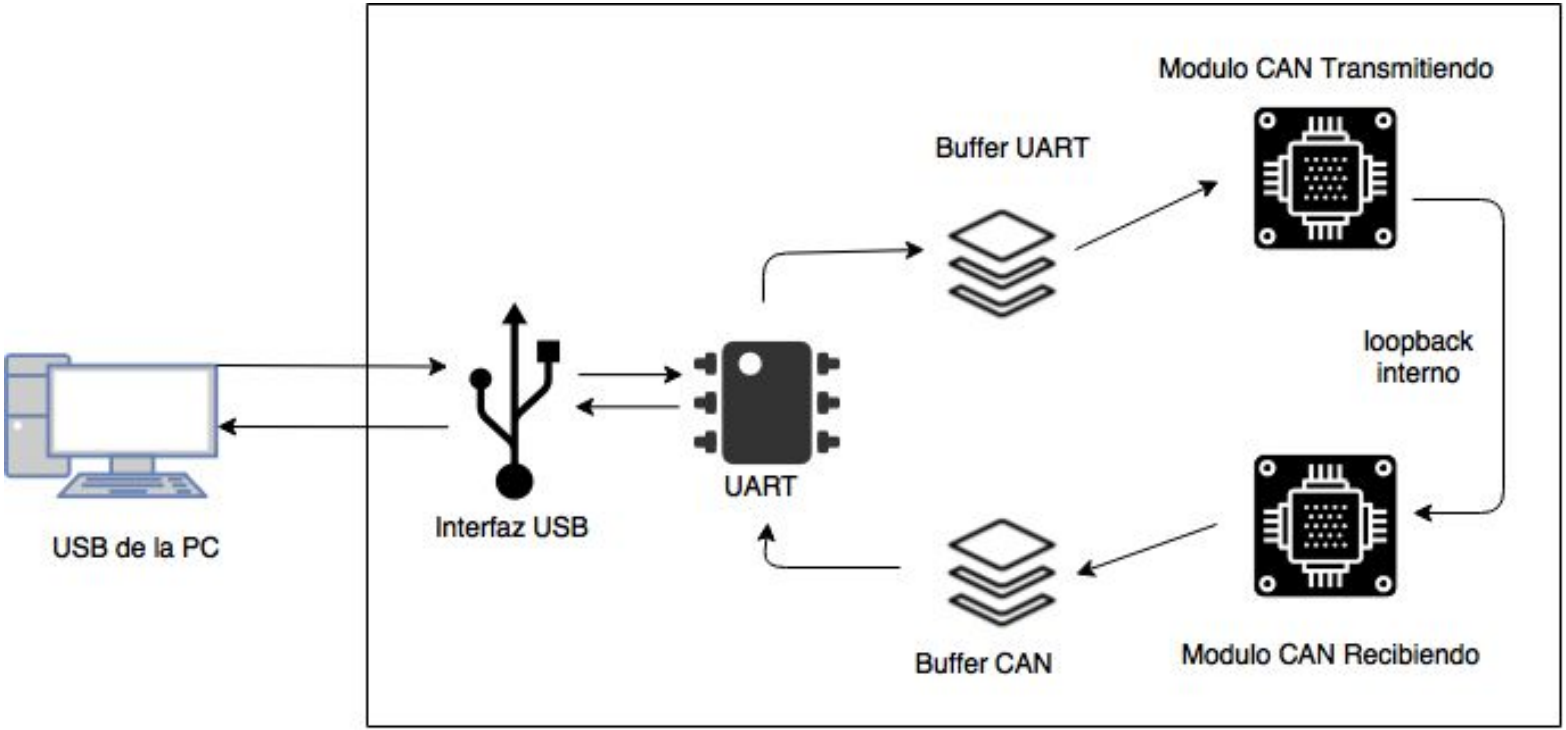




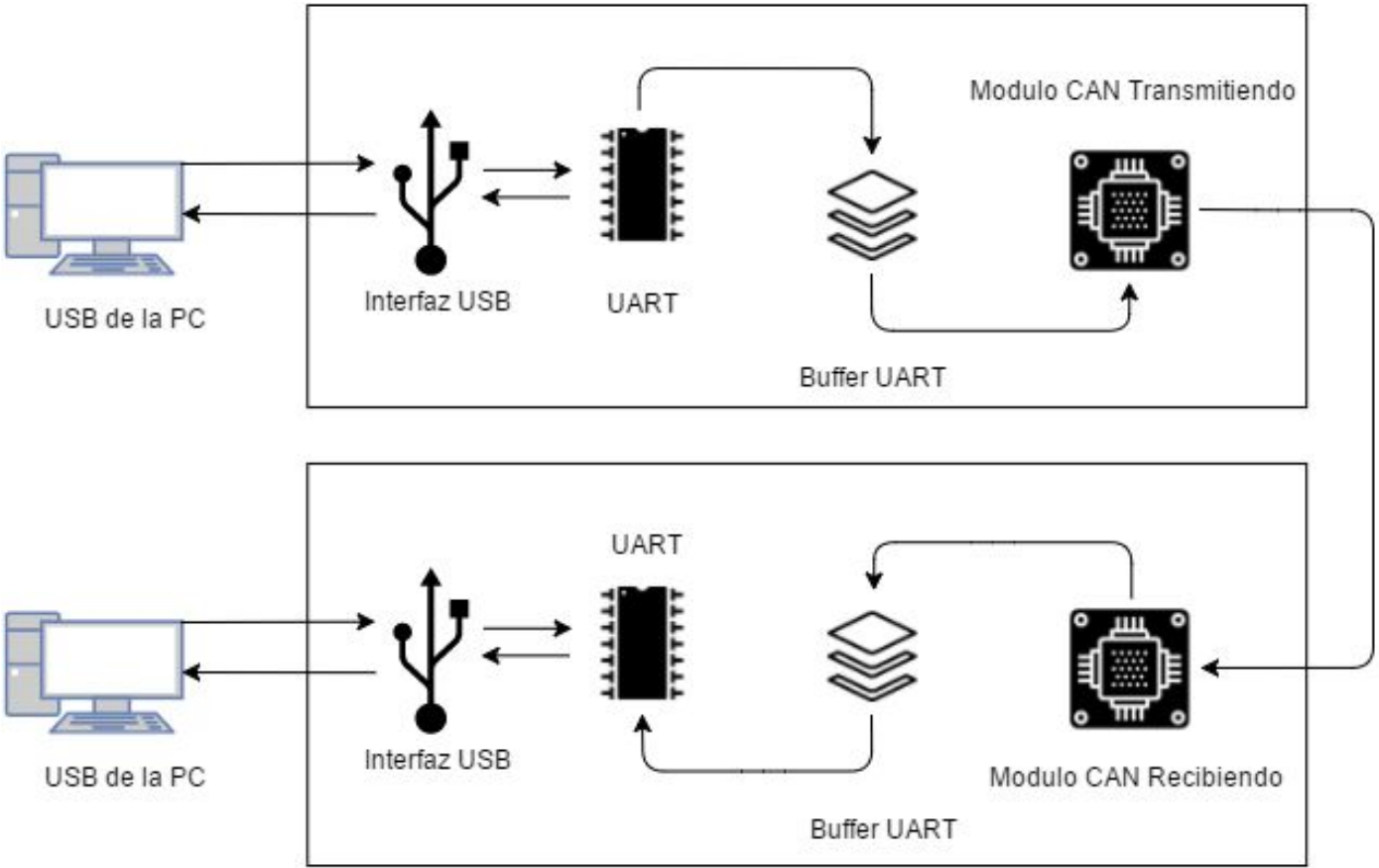
¡Ejemplos!



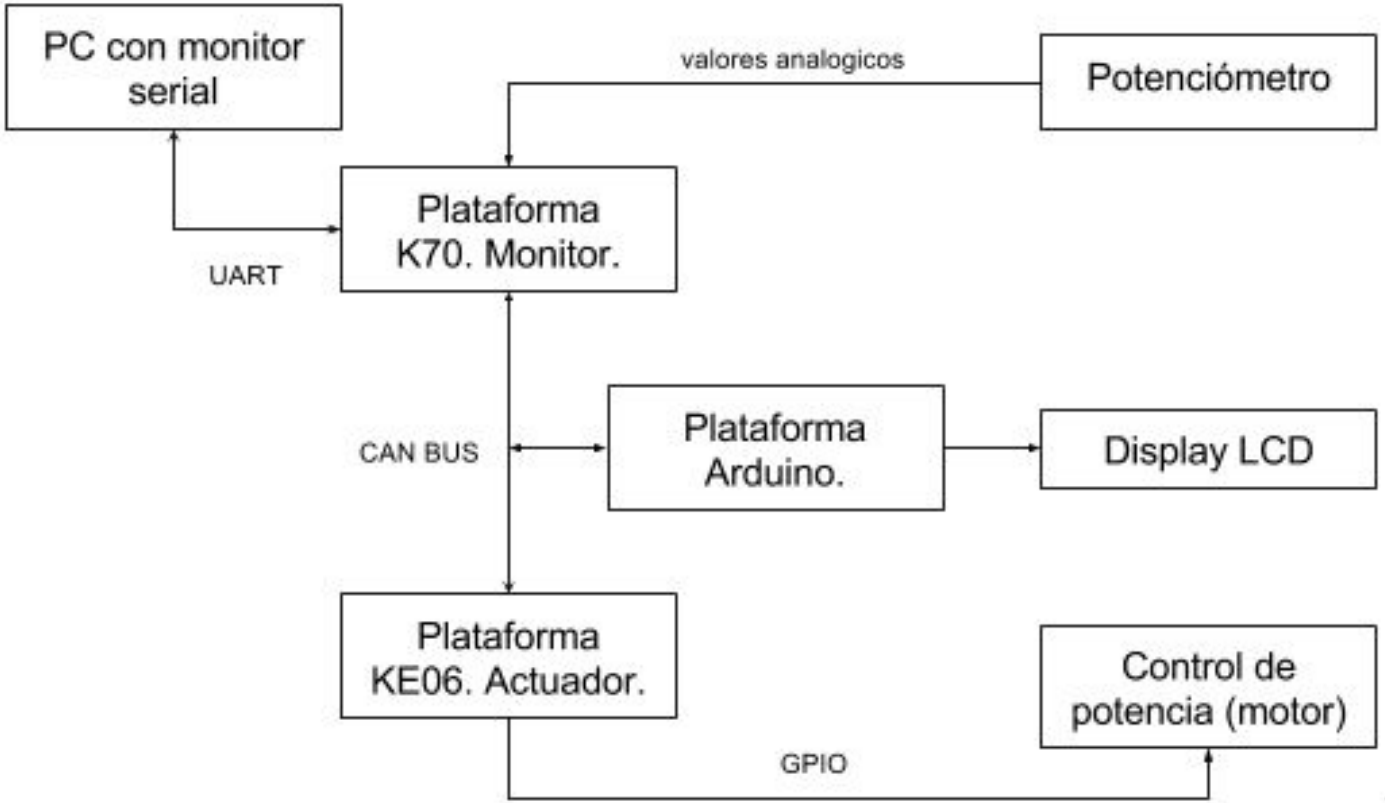
Hello World.


Modulo CAN Transmitiendo
Buffer UART
loopback
interno
UART
Interfaz USB
USB de la PC
Buffer CAN
Modulo CAN Recibiendo

Emisor y receptor CANBUS

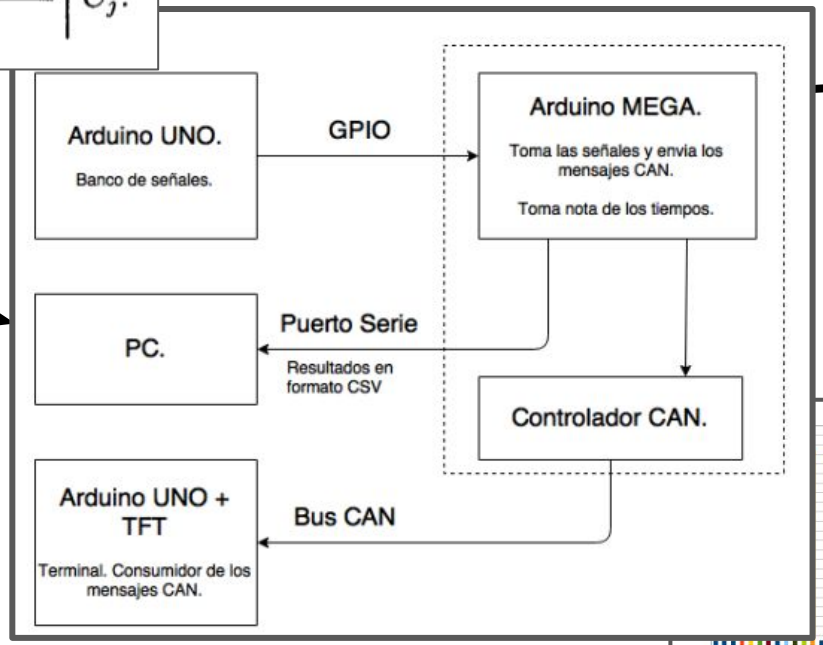


Panel de control CAN

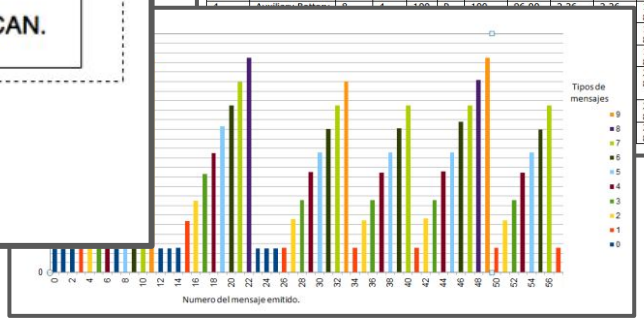


Cálculo de tiempos CAN

$$t_m^{n+1} = B + \sum_{\forall j \in hp(m)} \left\lceil \frac{t_m^n + J_j + \tau_{bit}}{T_j} \right\rceil C_j.$$



Signal	Signal Description	Size /bytes	J/ms	T/ms	P/S	D/ms	D – J	Ck	Bm	tm	Rm
0	Brake Pressure, Line	4	4	30	P	30	6,00	2,184	2,26	2,260	4,444
1	Accelerator Position	8	4	100	P	100	96,00	2,26	2,26	4,444	6,704
2	Brake Pressure, Master Cylinder	8	4	100	P	100	96,00	2,26	2,26	6,704	8,964
3	Auxiliary Battery Current	8	4	100	P	100	96,00	2,26	2,26	11,148	13,408
										13,408	15,668
										15,668	17,928
										17,928	20,054
										22,238	24,498
										24,498	26,758
										26,758	29,018




FINISH

START

FINISH


Gracias