Ladder Process on Netzer

The upcoming Release 1.5 will have support for custom computations and serial drivers directly executed on Netzer. The choosen programming dialect is Ladder_logic. The IDE for programming will be ldmicro. This article will cover the progress of the implementations. The final feature set is not completed yet.

Netzer memory organization

Runtime image

Runtime images are actually interpreted.

The interpreter is entirely written in Assembler for runtime issues.

The reasons for interpretation:

- Easier implementation
- Smaller runtime images
- Security issues (images can be uploaded via Netzer webpage).
- The images can be stored anywhere beyond flash also EEPROM, SD card or SRAM would be possible.

At the moment, the runtime image is stored in a 2K flash memory area in the bootloader. The interpreter images stay persistent even during firmware updates. The syntax (opcodes and parameters) is adopted from ldmicro but is optimized for space and runtime issues.

The translation from ldmicro interpreter code to Netzer opcode files is done via free available IDE extension from MoBaCon (see below).

The translator also integrates some meta data (project name, modification date, found opcodes, …) which is displayed on Netzer web interface after upload.

The prepared image can be uploaded via Netzer web interface or with command line tools like **curl**. For custom implementations a preloaded image can be integrated in the firmware image.

After loading or when restarting Netzer the image is always checked for validness and consistency.

Register areas (PABs)

Adopted from ldmicro the runtimes knows about two data types: boolean (Width: Bit) and signed integer (width: 16 bit).

There are two different register areas (called PAB): common PAB and IO PAB.

Common PAB

This PAB is a real SRAM area in the Netzer space. The size is 128 bytes. Therefore 64 integer or 1024 bit variables can be stored. The common PAB is used as scratch area. The process has exclusive access, no other Netzer software module can change the common PAB. Integer and bit variables share the same address area.

IO PAB

This PAB is a virtual SRAM area. The IO PAB is divided into integer and bit variables area. Unlike in common PAB integer and bit variables do not share the same address area. For communication between bit and integer areas a copying via the common PAB can be used.

Network interface

For communication between the network and the process a special SRAM area is introduced (network variables). There are 8 integers available in each direction (address 0x10-0x17).

Receiving data from network Each time the network writes new data, the corresponding mailbox flag in the bit area is set. The process program can poll for this flag and read the value afterwards. Reading clears the flag automatically.

Sending data to network Writing to one of the integers sends data to the network. Afterwards the mailbox flag is set automatically. After the network interface has fetched the data, the mailbox flag is cleared. The process should poll mailbox flags to prevent data loss.

Bit variables

Address	Access	Function	Address	Access	Function
0x00	RW	IO0 latch pin	0x80	RO	IO0 port pin
0x01	RW	IO1 latch pin	0x81	RO	IO1 port pin
0x02	RW	IO2 latch pin	0x82	RO	IO2 port pin
0x03	RW	IO3 latch pin	0x83	RO	IO3 port pin
0x04	RW	IO4 latch pin	0x84	RO	IO4 port pin
0x05	RW	IO5 latch pin	0x85	RO	IO5 port pin
0x06	RW	TX latch pin	0x86	RO	TX port pin
0x07	RW	RX latch pin	0x87	RO	RX port pin
0x08	RW	SPI_CS latch pin	0x88	RO	SPI_CS port pin
0x09	RW	SPI_INT latch pin	0x89	RO	SPI_INT port pin
0x0A	RW	SPI_CLK latch pin	0x8A	RO	SPI_CLK port pin
0x0B	RW	SPI_MI latch pin	0x8B	RO	SPI_MI port pin
0x0C	RW	SPI_MO latch pin	0x8C	RO	SPI_MO port pin
0x0D	RW	Serial TX FiFo ready / flush	0x8D	RO	RTC time is synchronized
0x0E	RW	Serial RX FiFo data pending / flush			

Address	Access	Function	Address	Access	Function
0x0F	RW	Netsocket TX FiFo ready / flush			
0x10	RW	Netsocket RX FiFo data pending / flush			
			0x90-0x97	RO	Mailbox state for incoming network variables
			0x98-0x9F	RO	Mailbox state for outgoing network variables
			0xA0	RO	Start flag, TRUE for the first process cycle after start.

Integer variables

Address	Access	Function
0x00	RW	Latch - All IO port latches in one integer (IO0 is at bit 0 and so on)
0x01	RW	Edge counter (measured at IO0)
0x02	RW	Edge counter (measured at IO1)
0x03	RW	Edge counter (measured at IO2)
0x04	RW	PWM duty cycle / Impulse width (IO3)
0x05	RW	PWM duty cycle / Impulse width (SPI_INT)
0x06	RW	Top of serial FiFo (Reading: RX, Writing: TX)
0x07	RW	Accessing top of net socket FiFo (Reading: RX, Writing: TX)
0x08	RW	Reading delivers the current state of Netzer. Writing can be used for executing commands, i.e. restarting.
0x10-0x17	RW	Network variables
0x18	RW	Read access: Delivers net socket state, write access: Executes commands on net socket.
0x80	RO	Process scratch register. After a division here the modulo result can be found.
0x81	RO	Ports - All IO port pins in one integer (IO0 is at bit 0 and so on)
0x82	RO	ADC (IO4) - Measured value as 10 Bit value
0x83	RO	ADC (IO5) - Measured value as 10 Bit value
0x84	RO	RTC Seconds
0x85	RO	RTC Minutes
0x86	RO	RTC Hours
0x87	RO	RTC Day of the Week
0x88	RO	RTC Day
0x89	RO	RTC Month
0x8A	RO	RTC Year
0x8B	RO	Returns a random value.
0x8C	RO	Edge counter (measured at IO0) - After reading the counter is cleared.
0x8D	RO	Edge counter (measured at IO1) - After reading the counter is cleared.
0x8E	RO	Edge counter (measured at IO2) - After reading the counter is cleared.
0x90	RO	The most significant IP address byte of connected peer. Only valid if net socket state is connected.
0x91	RO	The second most significant IP address byte of connected peer. Only valid if net socket state is connected.

Address	Access	Function
0x92	RO	The second least significant IP address byte of connected peer. Only valid if net socket state is connected.
0x93	RO	The least significant IP address byte of connected peer. Only valid if net socket state is connected.

IDE

The original ldmicro IDE is located here. MoBaCon has GPL compliant adjusted the IDE for some special Netzer features on base of the official release 2.2. The IDE can directly generate Netzer bytecode which later can be uploaded via the Netzer web interface. Furthermore we have extended the project with a CMake toolchain, where building is also possible for different compilers and IDEs. Also building on Linux is possible now.

A patch is posted at the ldmicro forums due the lack of version control - hopefully the patch is integrated in future versions. In the mean time we have started a ldmicro project at github.

Executables (run with Windows and Linux Wine) can be downloaded from here:

LDmicro executable for Windows OS (different languages)

Actually all the features of the IDE which can be compiled into interpretable code can be used.

The ADC, PWM and UART stuff is not supported by ldmicro for interpreter targets - but that is no problem because the Netzer solves this via its IO register set.

For that reason a simple naming convention must be considered.

IO PAB Mapping

Bit variables and integer variables can be mapped directly to IO PAB integer using the @ operator.

To locate integer variable `adc` to the IO location of ADC 4 for example simply rename it to `adc@01`.

To which PAB area (bit or integer) the operator finally maps depends on the variable type.