AN0055
Application Note

AT32 EMAC Wake on LAN

Introduction

As required by the development of IoT, devices including chips are designed with the ability to connect to the Internet. In response to this demand, AT32 microcontrollers support EMAC feature.

This application note, taking AT32F407 series as an example, gives examples to help users develop features as needed.

Applicable products:

Part number	AT32 MCUs with EMAC feature

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1 Overview

This example demonstrates how to use Magic Packet to wake up MCU through Ethernet. Based on this function, users can develop their own applications.

1.1 Hardware requirements

1) DM9162 Ethernet module
2) AT-START-F407 V1.0 evaluation board
3) Ethernet cable
4) External 25 MHz crystal on PHY

1.2 Software requirements

- wake_on_lan, remote wakeup resource program, waking up MCU by using Magic Packet

2 AT32 wake on LAN program settings

2.1 Pin settings

Table 1. Pin configuration

EMAC signal	Pin
EMAC_MDC	PC1
EMAC_MDIO	PA2
EMAC_RMII_REF_CLK	PA1
EMAC_RMII_CRS_DV	PD8
EMAC_RMII_RXD0	PD9
EMAC_RMII_RXD1	PD10
EMAC_RMII_TX_EN	PB11
EMAC_RMII_TXD0	PB12
EMAC_RMII_TXD1	PB13

2.2 LwIP settings

Hardware handles signals from PHY to MAC only. For further development, users need to implement TCP/IP protocol stack. In this example, LwIP protocol stack is used to reduce memory usage and program code size so that the LwIP can be used for resource-limited platforms (such as embedded systems). For more details, please visit the official website.
The protocol stack is completely integrated into the code; therefore, users only need to set the IP address and date address according to the network segments. These two global variables are declared in netconf.c.

Figure 1. Configure RX pins

```
52  static uint8_t local_ip[ADDR_LENGTH]   = {192, 168, 81, 37};
53  static uint8_t local_gw[ADDR_LENGTH]   = {192, 168, 81, 187};
54  static uint8_t local_mask[ADDR_LENGTH] = {255, 255, 255, 0};
```

2.3 Wake on LAN project settings

In this example, after the LwIP is configured, the program is ready to enter SLEEP mode; therefore, except for the receiver, all features such as transmitter and DMA must be disabled. Then, detect the Magic Packet and configure external triggers. The interrupt line 19 is used for EMAC remote wakeup.

Figure 2. Configure external triggers and detect magic packet

```
void emac_wake_on_lan_init(void)
{
  exint_init_type exint_init_structure;

  nvic_priority_group_config(NVIC_PRIORITY_GROUP_4);
  nvic_irq_enable(EMAC_WKUP_IRQn, 2, 0);

  emac_dma_operations_set(EMAC_DMA_OPS_START_STOP_TRANSMIT, FALSE);
  emac_trasmitter_enable(FALSE);

  emac_receiver_enable(FALSE);
  emac_dma_operations_set(EMAC_DMA_OPS_START_STOP_RECEIVE, FALSE);

  exint_init_structure.line_select = EXINT_LINE_19;
  exint_init_structure.line_enable = TRUE;
  exint_init_structure.line_mode = EXINT_LINE_INTERRUPUT;
  exint_init_structure.line_polarity = EXINT_TRIGGER_BOTH_EDGE;
  exint_init(&exint_init_structure);

  emac_magic_packet_enable(TRUE);

  emac_power_down_set(TRUE);

  emac_receiver_enable(TRUE);

  SysTick->CTRL = FALSE;
  SysTick->VAL = FALSE;

  crm_periph_clock_enable(CRM_PWC_PERIPH_CLOCK, TRUE);
  exint_flag_clear(EXINT_LINE_19);

  pwc_voltage_regulate_set(PWC_REGULATOR_LOW_POWER);
  pwc_deep_sleep_mode_enter(PWC_DEEP_SLEEP_ENTER_WFI);
}
```

2.4 Host PC settings

1. Set the host IP address, network mask and gate. The IP address and gate should be in the same network segment as the chip.
2. Open WakeMeOnLan on PC to send the magic packet. Then, manually input MCU IP.
3. After the MCU is waken up, LED starts to blink.

Figure 3. Set PC IP, network mask and gate

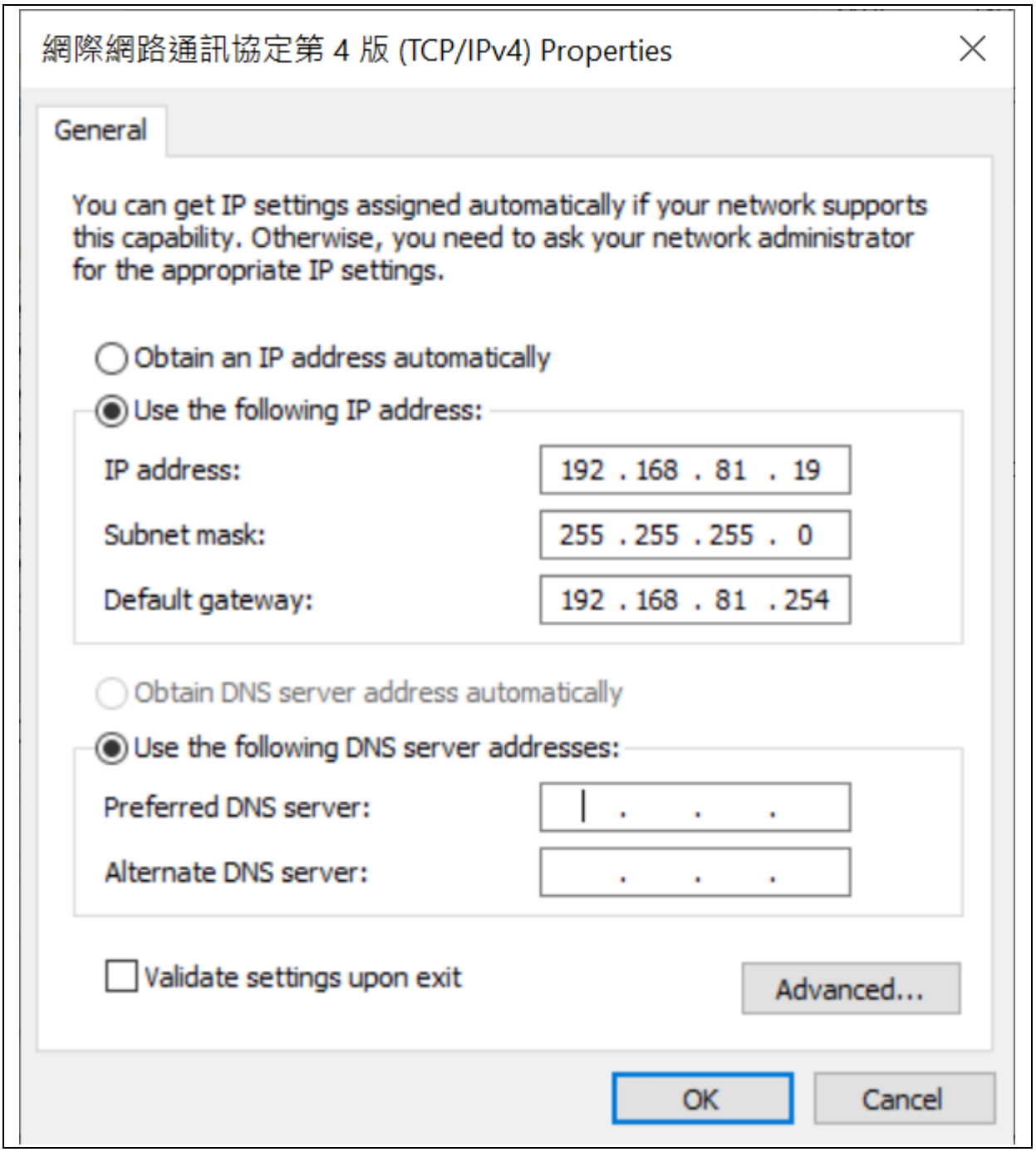
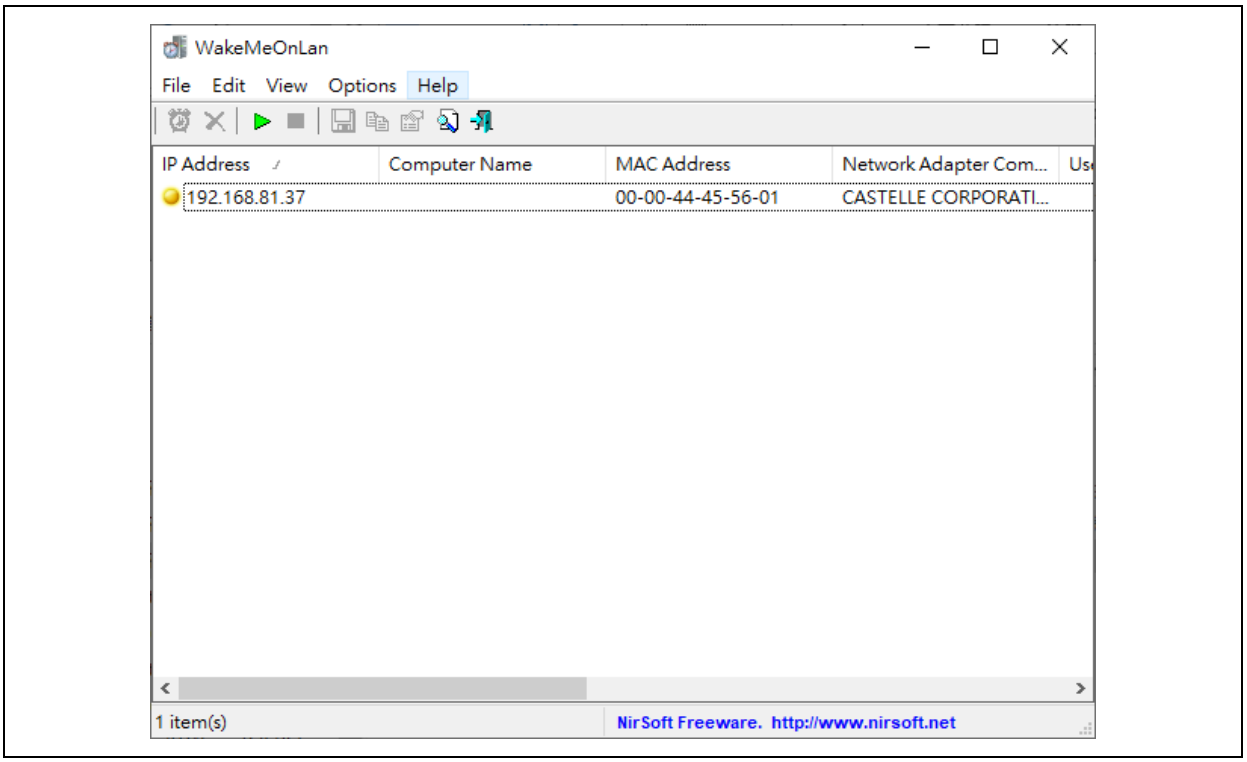


Figure 4. Open WakeMeOnLan



3 Revision history

Table 2. Document revision history

Date	Version	Revision note
2021.09.06	2.0.0	Initial release.

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