XMC4700 / 4800 IoT Client Example

Getting Started
Version 1.0



1. Overview and requirements
2. Setup
3. Implementation of the application
4. Configuration options
5. How to test

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1 Overview and requirements

2 Setup

3 Implementation of the application

4 Configuration options

5 How to test

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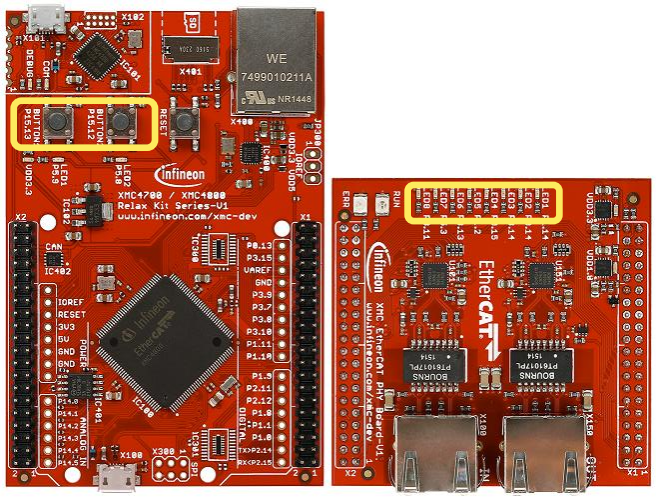
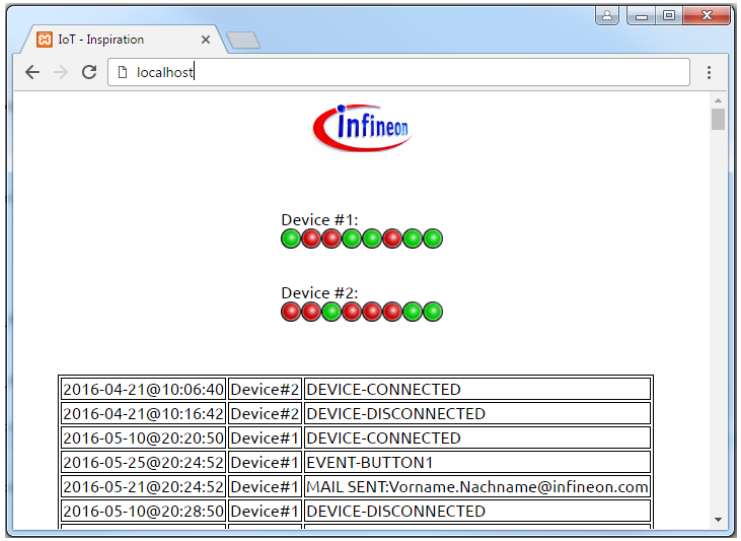
Overview





This example demonstrates the implementation of IoT client(s) on XMC4700/4800 and describes the setup of an environment which allows you to experience the IoT client(s) in action.
Depending on your equipment/possibilities, the server implementation is either installed on your web server or locally on your laptop.

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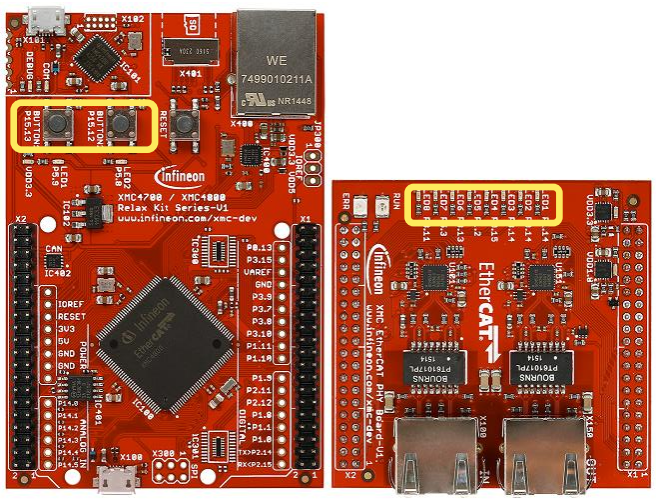
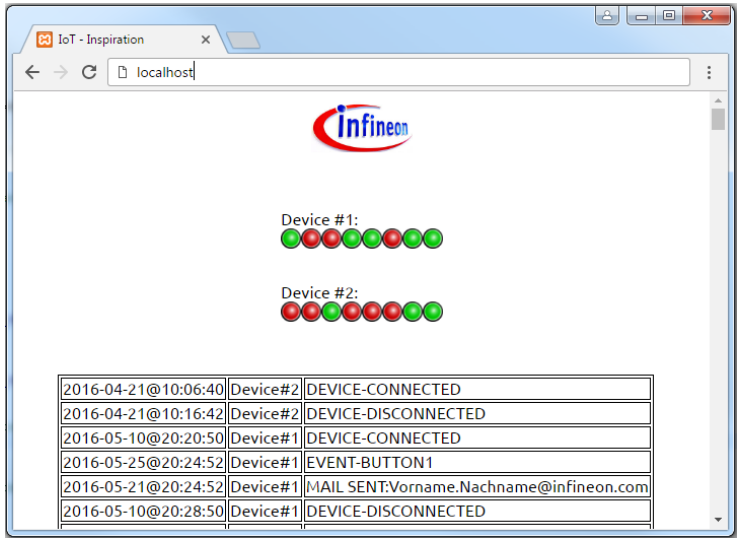
Overview





Once the connection to the server is established, the IoT client will change its „8bit-state" every 500ms and display it on the 8 LEDs of the XMC4800 Relax Kit extension board.
In parallel the „8bit-state" will be sent to the server and can be monitored from remote on a web-page worldwide. Furthermore connection/disconnection events of the client to the server will be logged and displayed on the webpage.
Once a button on relax kit is pushed, an email will be sent to an email address of your choice.

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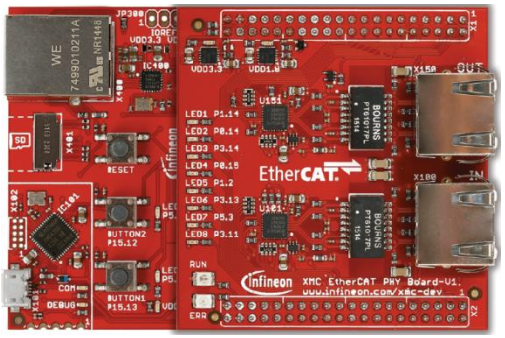
Requirements



XMC4800 Relax EtherCAT Kit
(optional: XMC4700 Relax Kit
you only will miss the 8-bit status LEDs)



RJ45 Ethernet Cable



Windows Laptop installed

- DAVE v4 (Version4.3.2 or higher)
- XAMPP WebServer



Micro USB Cable (Debugger connector)

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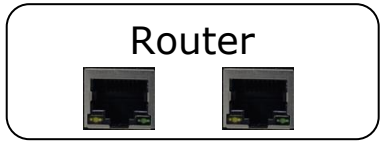
Requirements



Router (optional)



XAMPP
installed local on laptop
Link: Download XAMPP

or



Web Hosting Service

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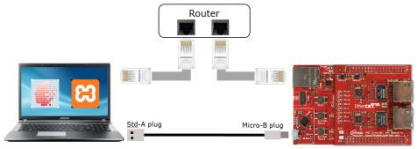
There are three different scenarios supported by this example:

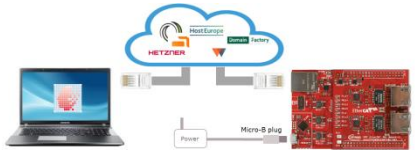
direct



via local router



via cloud



After you have read section „Implementation of the application“, proceed with section „Configuration options“ to configure your setup.

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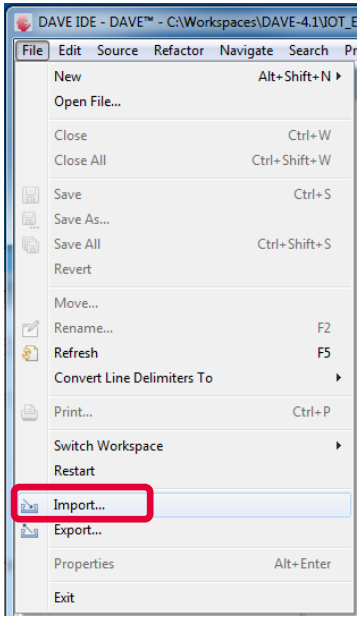
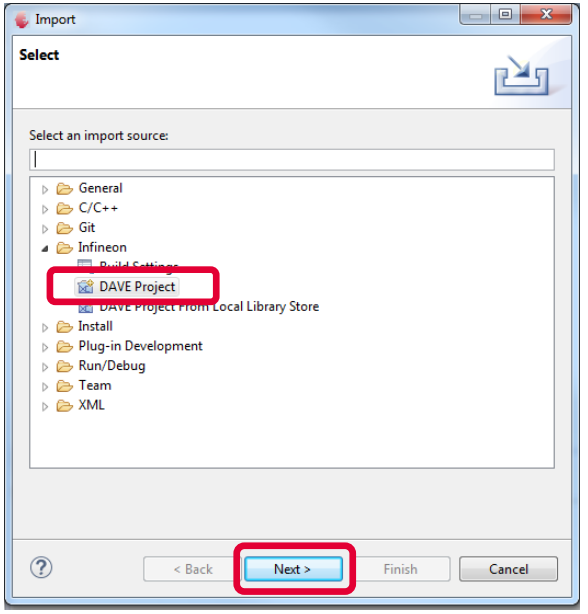
Setup – Import the example project into DAVE

1



2



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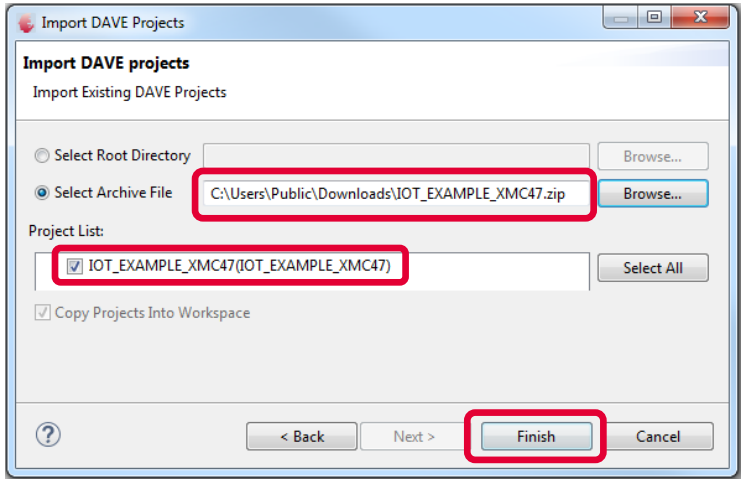

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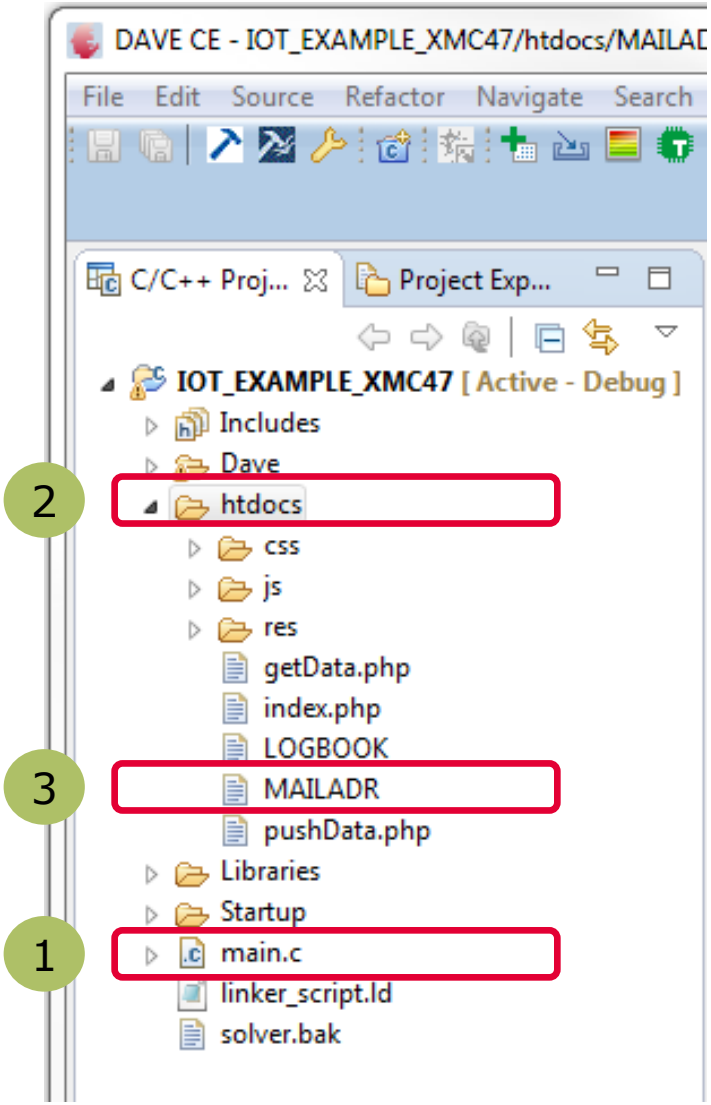
Setup – Imported application example



After the project import, you will find the project to build the application executable:

1. The main.c source file used to implement the IoT client.
2. The htdocs folder for the server side implementation. Copy the content of this folder to your local XAMPP server (default location: C:\xampp\htdocs) or upload the content via ftp to your hosting provider. ATTENTION: Make sure the htdocs folder is writable for php scripts.
3. Inside this file you define the mail address on which you want to receive the notifications once a button on the IoT client is pushed.

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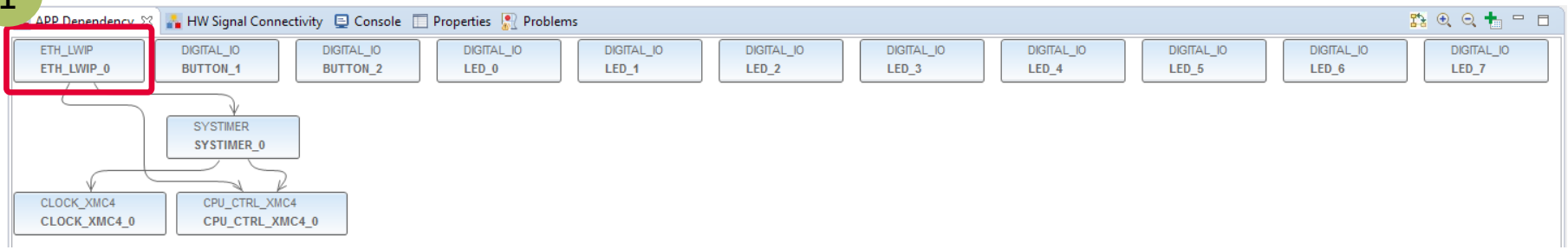
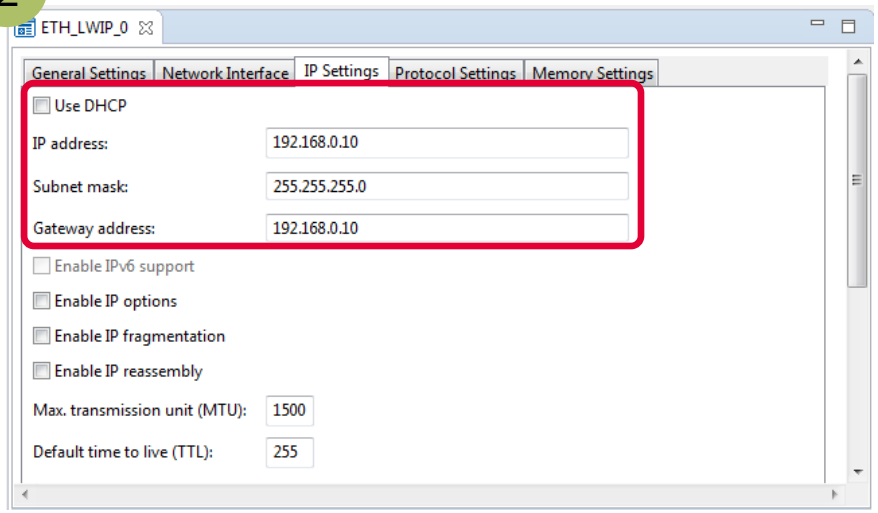
Application – Ethernet and lwip configuration

1



2



1 The TCP/IP stack is implemented by ETH_LWIP APP.
The IoT device uses the API of this APP to send http headers to the server.

2 By default DHCP is disabled for the ETH_LWIP APP and a fixed IP is assigned.

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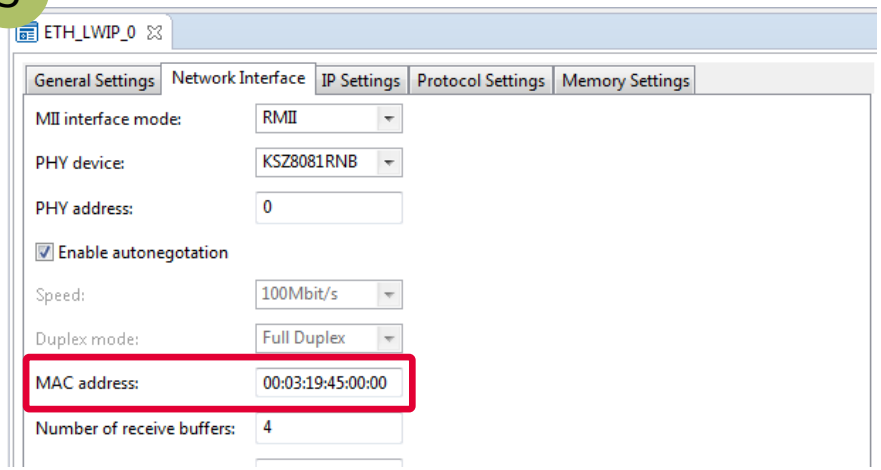
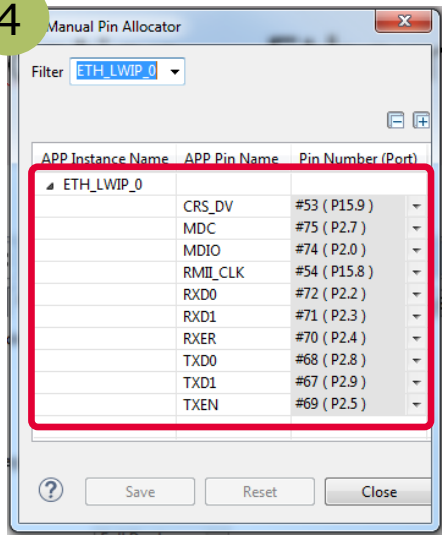
Application – Ethernet and lwip configuration

3

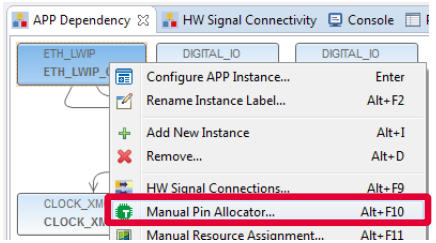


4



3 ETH_LWIP is configured with the default MAC address of the APP.

4 Right click the ETH_LWIP APP and select "Manual Pin Allocator" to define the pinning which fits to the XMC 4800 / 4700 Relax Kit:



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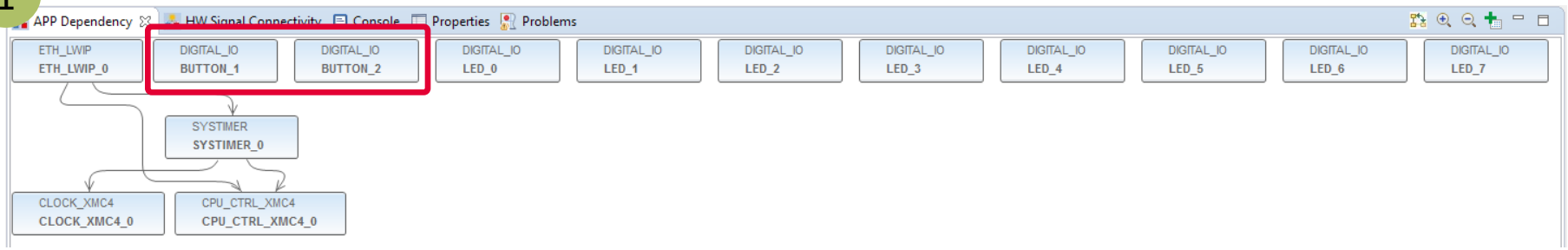
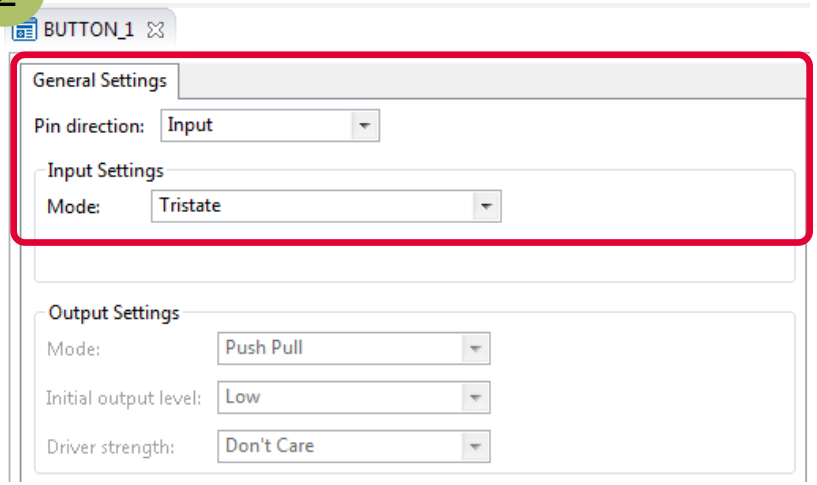
Application – Input port configuration

1



2



1 The DIGITAL_IO APPs initialize the ports for the two input buttons.

2 The ports are configured for input.

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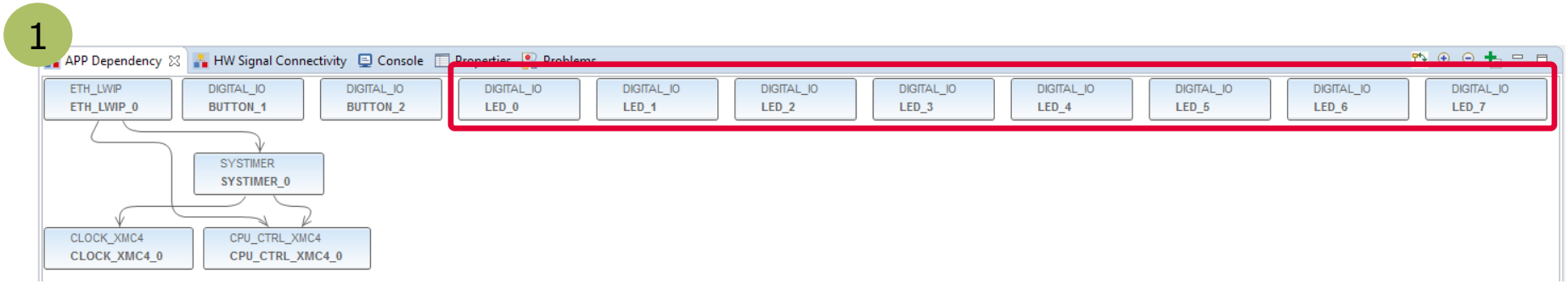
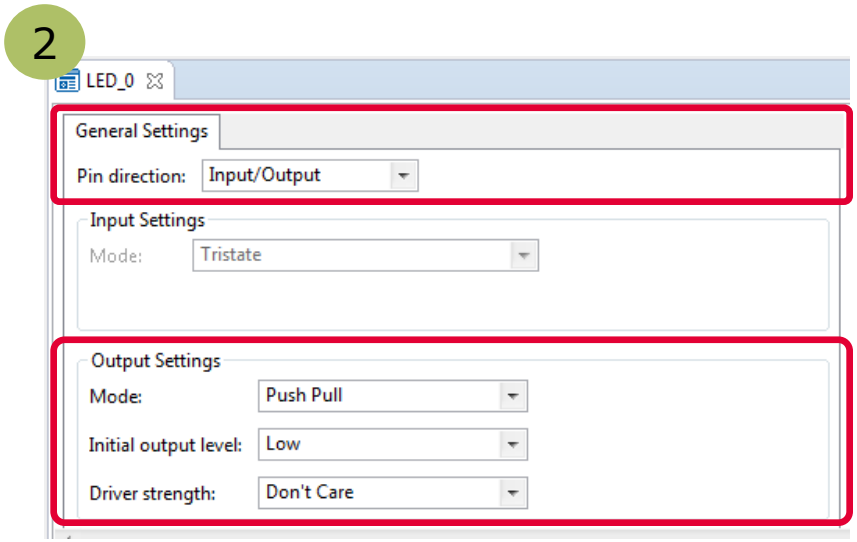
Application – Output port configuration





1 The DIGITAL_IO APPs initialize the ports for the eight output LEDs.

2 The ports are configured for output.

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Application – Initialization inside main.c

main.c

```
365 int main(void)
366 {
367   DAVE_STATUS_t status;
368   uint32_t timer_systimer_lwip, timer_systimer_counter;
369   uint8_t button1=0,button2=0;
370   uint8_t counter_old=0;
371
372   status = DAVE_Init(); /* Initialization of DAVE APPs  */
373   if(status != DAVE_STATUS_SUCCESS)
374   {
375     /* Placeholder for error handler code.
376      * The while loop below can be replaced with an user error handler. */
377     XMC_DEBUG("DAVE APPs initialization failed\n");
378     while(1U)
379     {
380     }
381   }
382
383   /* Initialize and start lwip system timer */
384   timer_systimer_lwip = SYSTIMER_CreateTimer(100000,
385                                              SYSTIMER_MODE_PERIODIC ,
386                                              tim_sys_check_timeouts_wrap,0);
387   SYSTIMER_StartTimer(timer_systimer_lwip);
388
389   /* Initialize and start client state counter timer */
390   timer_systimer_counter = SYSTIMER_CreateTimer (500000,
391                                                  SYSTIMER_MODE_PERIODIC ,
392                                                  tim_counter_increment,0);
393   SYSTIMER_StartTimer(timer_systimer_counter);
394
395   while(1)
396   {
397     /* Check if client state counter was incremented.
398      * If yes, send next header (incl. state counter, button1/2 state */
399     if (counter!=counter_old)
400     {
401       /* Connection already/still active? */
402       if ((connection_ready==0)&&(pcb_valid==0))
403       {
404 #if DHCP_ENABLED==1
405         /* IP address via DHCP already valid? */
406         if ((xnetif.dhcp->state) == DHCP_BOUND)
407 #endif
408         /* Re-Initialize TCP/IP connection */
409         client_init();
410       }
411       else
412       {
413         check_buttons_released(&button1, &button2, 1 /*reset released state*/);
414         send_data(button1, button2, counter);
415       }
416       counter_old=counter;
417     }
418     check_buttons_released(&button1, &button2, 0 /*reset released state*/);
419   }
420 }
```

1. Initialize DAVE™ system including all APPs
2. Initialize timers for
   1. lwip administration callback and
   2. „8bit-state“ counter increment.
3. Send new http header every time „8 bit-state“ counter is incremented.
   Initialize TCP/IP connection if needed.
   Check button states of relax-kit.
   (DHCP disabled by default)

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Application – Prepare and send http header

main.c

```
229 void send_data(uint8_t button1, uint8_t button2, uint8_t counter_state)
230 {
231   static uint32_t connect_WD=0;
232   char http_header[1024];
233   sprintf(http_header,"GET /pushData.php?"
234                       "device=%i&value=%i&button1=%i&button2=%i HTTP/1.1\r\n"
235                       "Host: %s\r\n"
236                       "Connection: keep-alive\r\n"
237                       "Pragma: no-cache\r\n"
238                       "Cache-Control: no-cache\r\n"
239                       "Accept: text/html,application/xhtml+xml,"
240                       "application/xml;q=0.9,image/webp,*/*;q=0.8\r\n"
241                       "Accept-Encoding: gzip, deflate, sdch\r\n\r\n"
242                       ,DEVICE_ID, counter_state, button1, button2, DOMAIN_NAME);
243
244   if ((connection_ready==1)&&(pcb_send!=0))
245   {
246     connection_ready=0;
247     connect_WD=0;
248     tcp_sent(pcb_send, client_sent);
249     tcp_write(pcb_send, (char*)&http_header, sizeof(http_header), 0);
250     tcp_output(pcb_send);
251     for (uint8_t bit=0; bit<8; bit++)
252     {
253       if (counter_state&(1<<bit))
254         DIGITAL_IO_SetOutputLow(LED_X[bit]);
255       else
256         DIGITAL_IO_SetOutputHigh(LED_X[bit]);
257     }
258   }
259   else
260   {
261     /* Connection watchdog triggered
262      * --> reset Protocol Control Block
263      */
264     connect_WD++;
265     if (connect_WD==10)
266     {
267       client_close(pcb_send);
268       pcb_valid=0;
269     }
270   }
271 }
```

1. Prepare http header.
2. Send header and set „8-bit state“ LEDs.
3. Connection timed out. Invalidate protocol control block to initiate reconnect.

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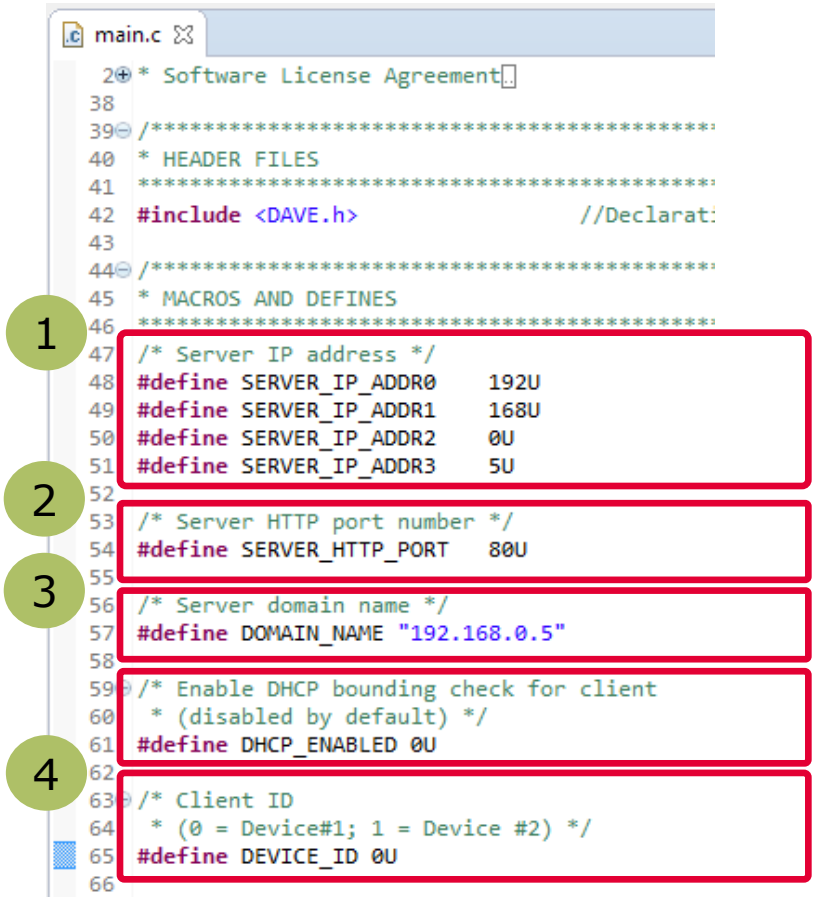
Application – Configurations inside main.c



1. IP address of the server
2. http port of the server
3. Domain name of the server (use IP if no name available)
4. Enable/Disable DHCP of IoT client
5. Device ID oif IoT client; Server implementation of this example supports up to two devices.

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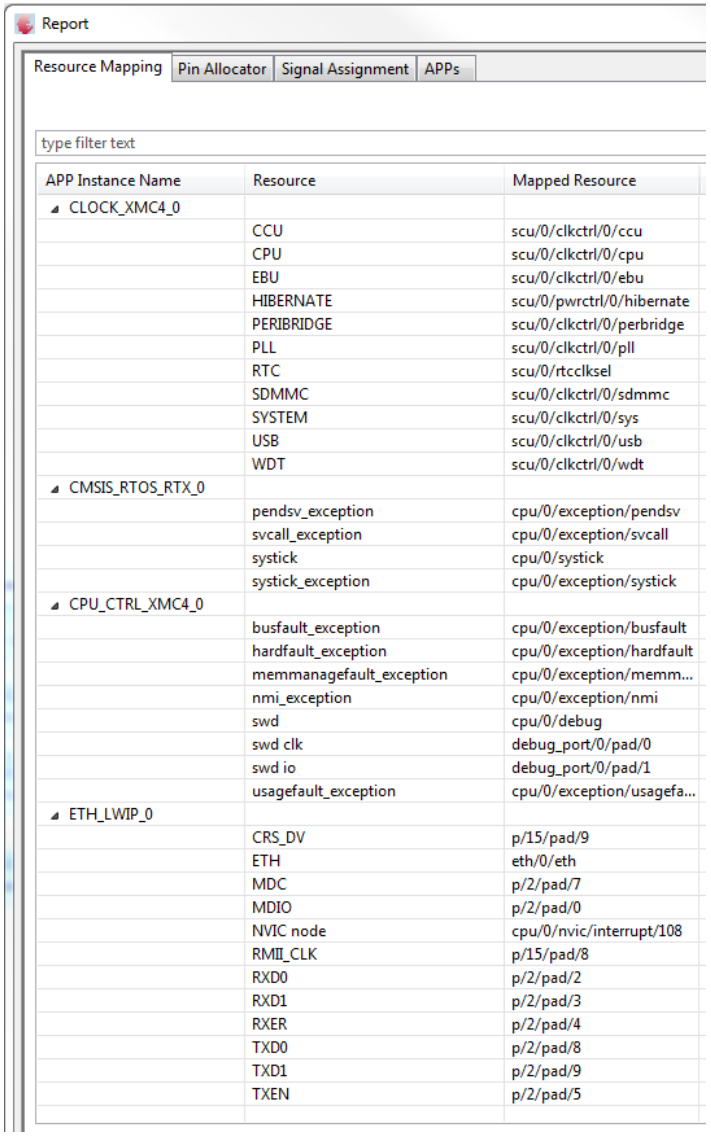
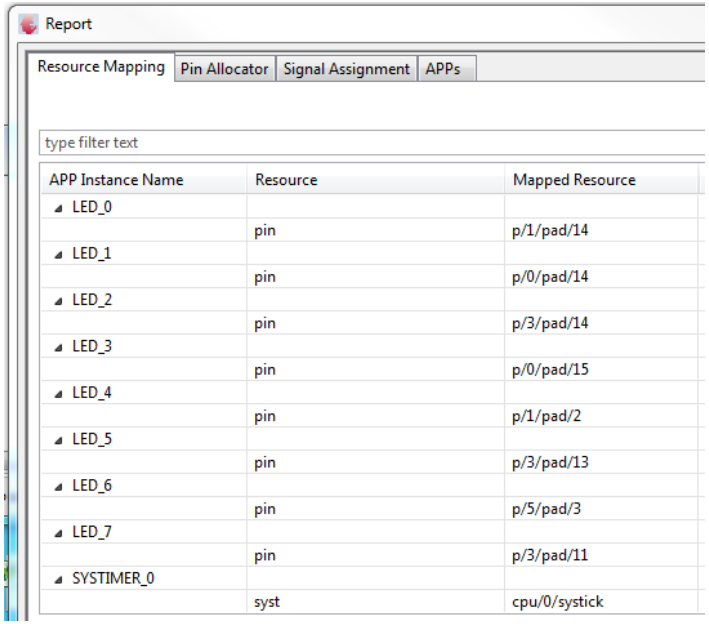
Application – Overview on used HW resources



APP Instance Name	Resource	Mapped Resource
CLOCK_XMC4_0		
	CCU	scu/0/clkctrl/0/ccu
	CPU	scu/0/clkctrl/0/cpu
	EBU	scu/0/clkctrl/0/ebu
	HIBERNATE	scu/0/pwrctrl/0/hibernate
	PERIBRIDGE	scu/0/clkctrl/0/perbridge
	PLL	scu/0/clkctrl/0/pll
	RTC	scu/0/rtcclksel
	SDMMC	scu/0/clkctrl/0/sdmmc
	SYSTEM	scu/0/clkctrl/0/sys
	USB	scu/0/clkctrl/0/usb
	WDT	scu/0/clkctrl/0/wdt
CMSIS_RTOS_RTX_0		
	pendsv_exception	cpu/0/exception/pendsv
	svcall_exception	cpu/0/exception/svcall
	systick	cpu/0/systick
	systick_exception	cpu/0/exception/systick
CPU_CTRL_XMC4_0		
	busfault_exception	cpu/0/exception/busfault
	hardfault_exception	cpu/0/exception/hardfault
	memmanagefault_exception	cpu/0/exception/memm...
	nmi_exception	cpu/0/exception/nmi
	swd	cpu/0/debug
	swd clk	debug_port/0/pad/0
	swd io	debug_port/0/pad/1
	usagefault_exception	cpu/0/exception/usagefa...
ETH_LWIP_0		
	CRS_DV	p/15/pad/9
	ETH	eth/0/eth
	MDC	p/2/pad/7
	MDIO	p/2/pad/0
	NVIC node	cpu/0/nvic/interrupt/108
	RMII_CLK	p/15/pad/8
	RXD0	p/2/pad/2
	RXD1	p/2/pad/3
	RXER	p/2/pad/4
	TXD0	p/2/pad/8
	TXD1	p/2/pad/9
	TXEN	p/2/pad/5



APP Instance Name	Resource	Mapped Resource
LED_0		
	pin	p/1/pad/14
LED_1		
	pin	p/0/pad/14
LED_2		
	pin	p/3/pad/14
LED_3		
	pin	p/0/pad/15
LED_4		
	pin	p/1/pad/2
LED_5		
	pin	p/3/pad/13
LED_6		
	pin	p/5/pad/3
LED_7		
	pin	p/3/pad/11
SYSTIMER_0		
	syst	cpu/0/systick

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Configuration – Option 1: Server/Client connected directly Hardware - Setup



This option is the one with the lowest requirements on equipment/hardware. The DAVE™ project provided with this example is configured for this option by default.
The web server is installed via XAMPP and running on laptop. The IoT client (XMC Relax Kit) is connected directly to the laptop.

In addition the XMC 4700/4800 Relax Kit is connected to laptop via USB to download software and provide power supply to the kit.

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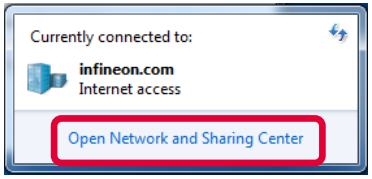
Configuration – Option 1:
Server/Client connected directly
Fix IP address (web server) of your laptop [1/2]

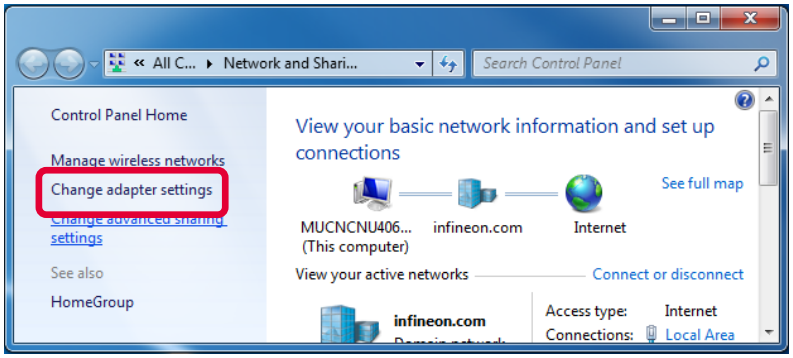
1



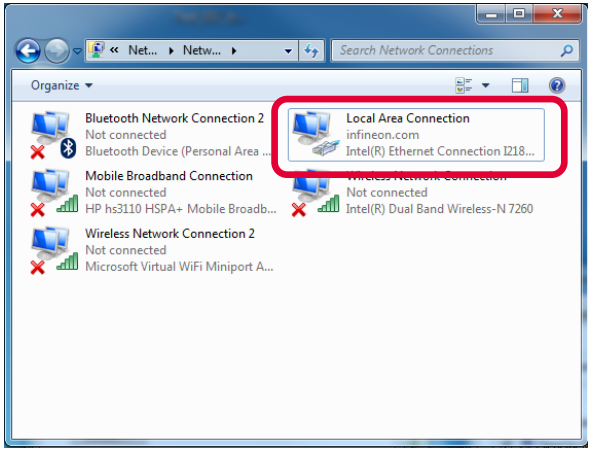
2



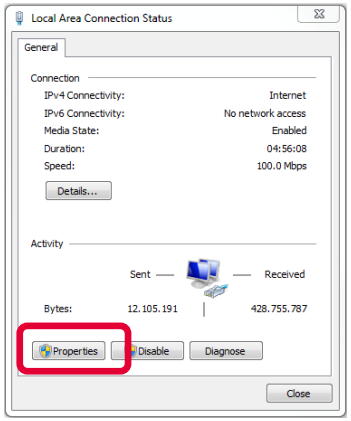
3



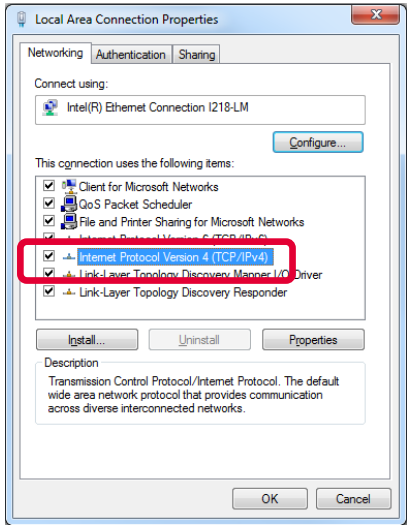
4



5



6



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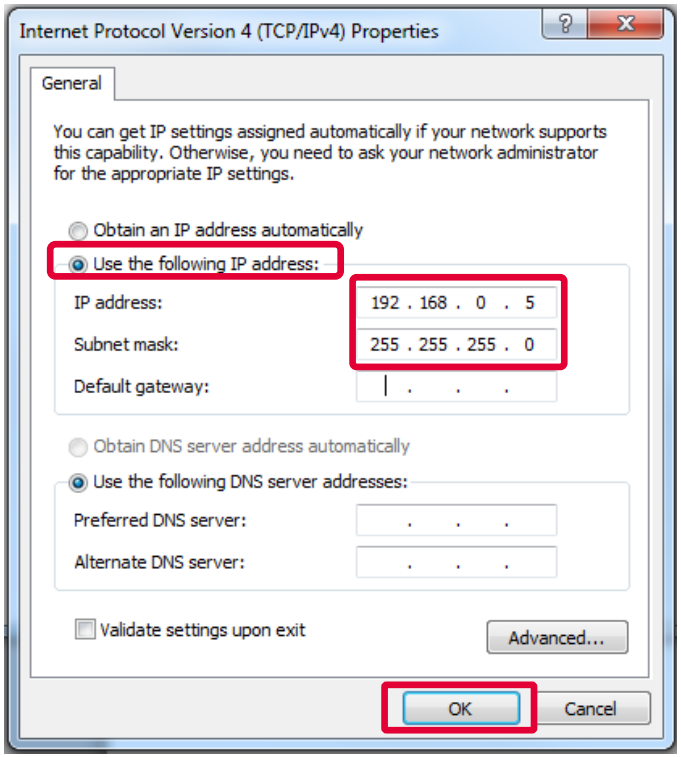
Configuration – Option 1: Server/Client connected directly Fix IP address of your laptop (server) [2/2]



7 Select option „Use the following IP address“

8 Set IP address to 192.168.0.5 and the subnet mask to 255.255.255.0

9 Confirm with OK

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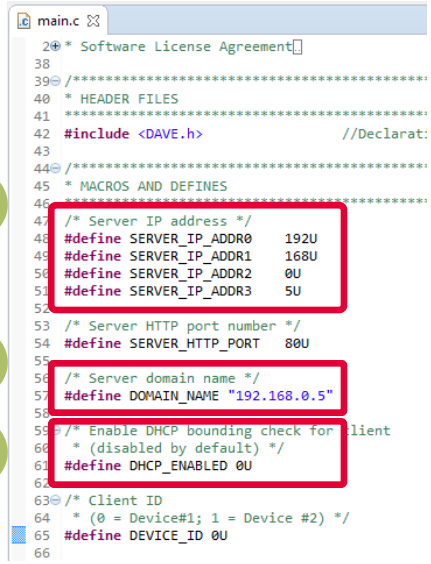
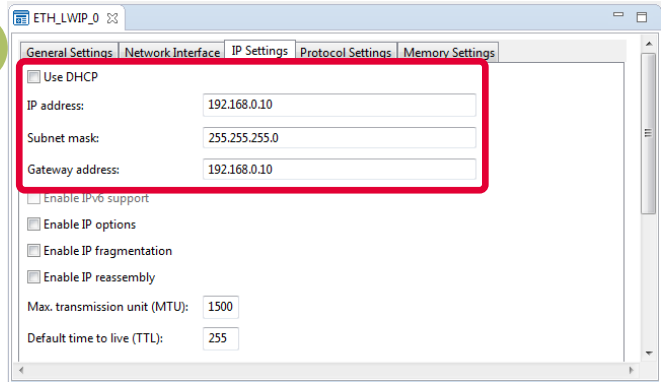
Configuration – Option 1:
Server/Client connected directly
Fix IP address (server and client) inside XMC Relax Kit





1 Fix IP address of destination server (your laptop) to 192.168.0.5 inside main.c

2 Disable DHCP of IoT client inside main.c

3 Disable DHCP of IoT client inside ETH_LWIP_APP.
Fix IP address of client to 192.168.0.10 and the subnet mask to 255.255.255.0 inside ETH_LWIP APP

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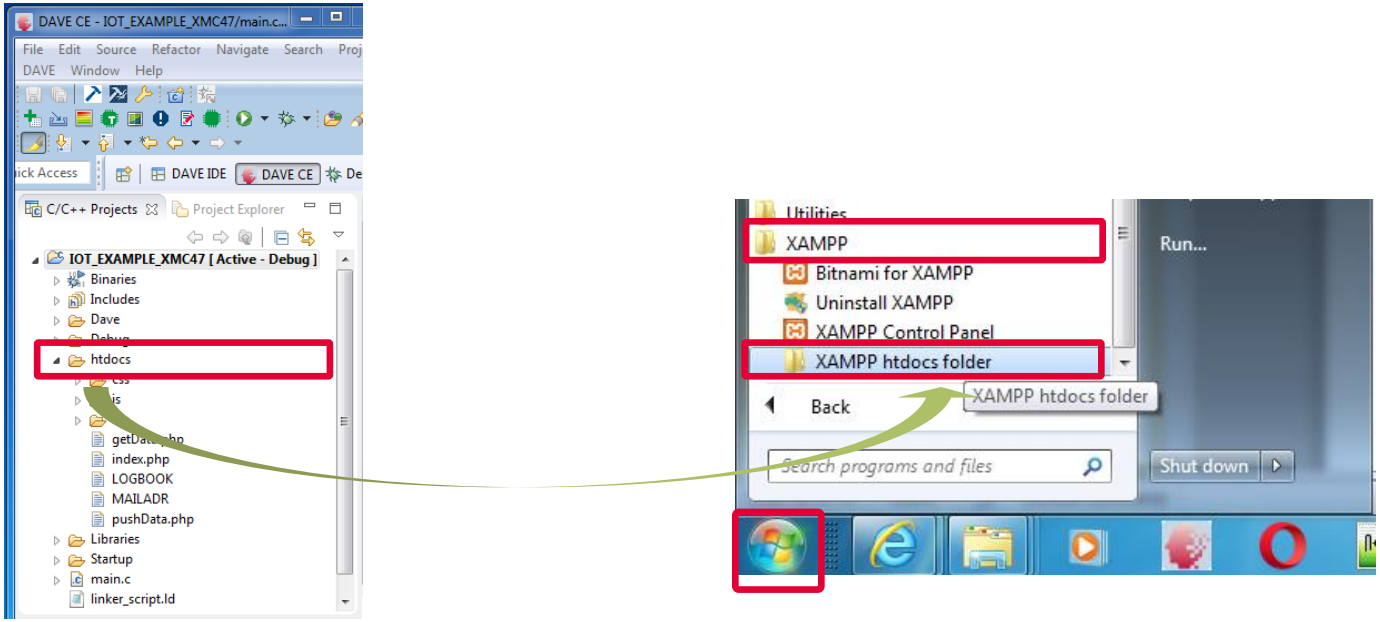
Configuration – Option 1:
Server/Client connected directly
Install server software on XAMPP



Copy server software from example folder to htdocs folder of your local XAMPP server. Replace the default email address inside the file MAILADR with the email address on which you want to receive notification events.

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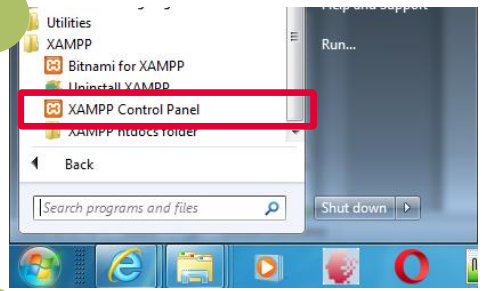
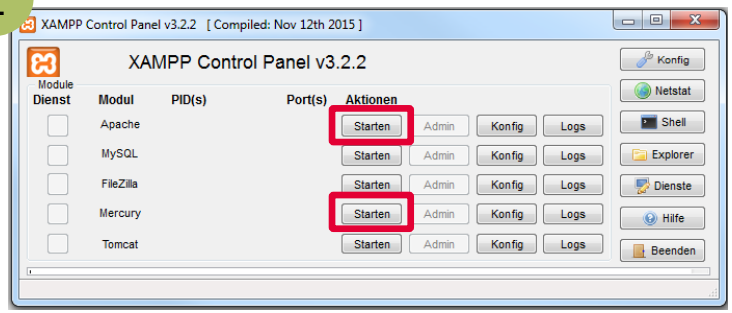
Configuration – Option 1:
Server/Client connected directly
Start XAMPP apache and mail server

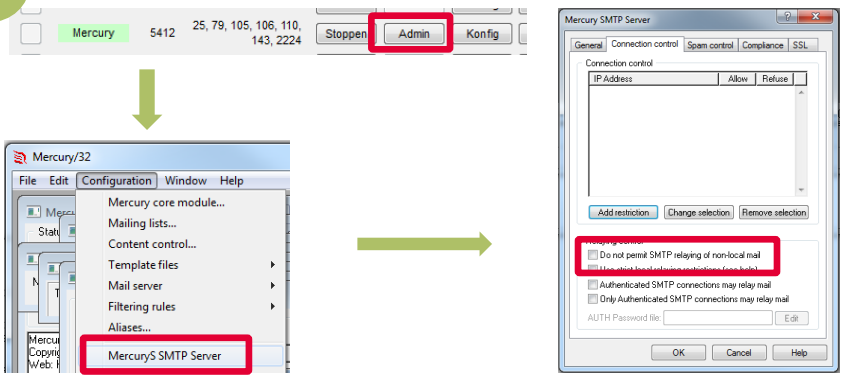
1



2



3



1 Start XAMPP Control Panel

2 Start apache and mail server

3 Disable „Not relay non-local mail“ –feature inside mail server.

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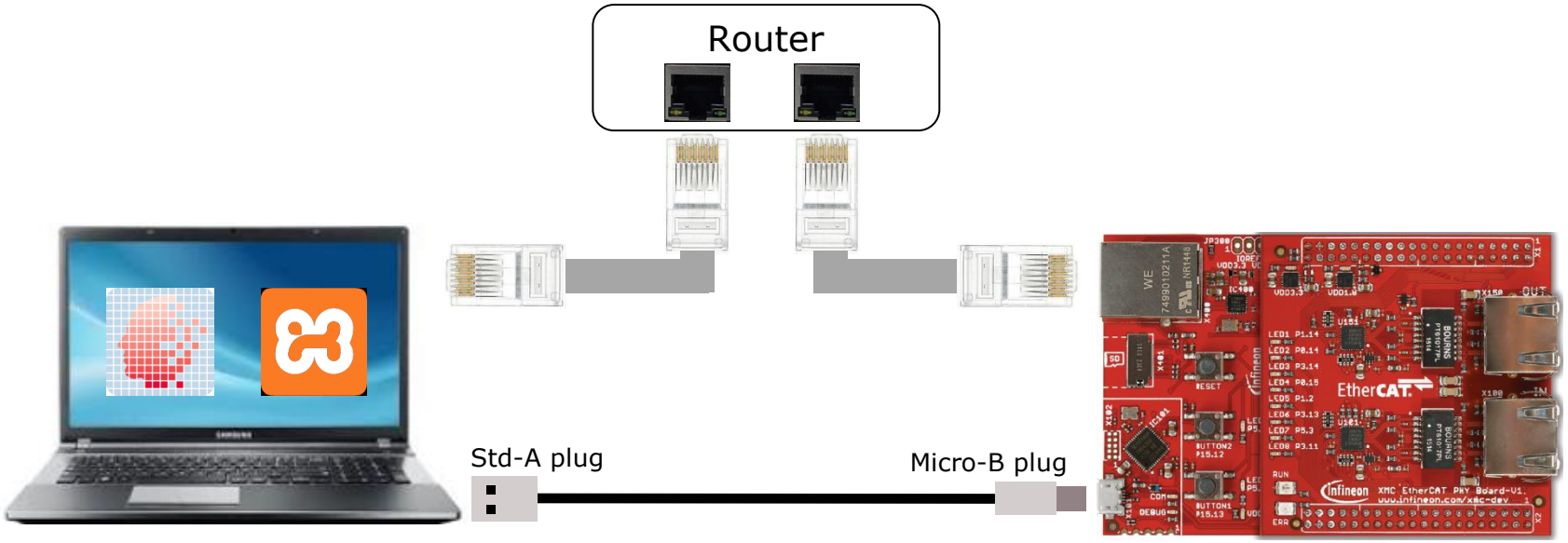
Configuration – Option 2:
Server/Client connected via router
Hardware - Setup



Inside the DAVE™ project provided with this example DHCP has to be enabled.
The web server is installed via XAMPP and running on laptop. The IoT client (XMC Relax Kit) and the Web-Server are connected via a router.

In addition the XMC 4700/4800 Relax Kit is connected to laptop via USB to download software and provide power supply to the kit.

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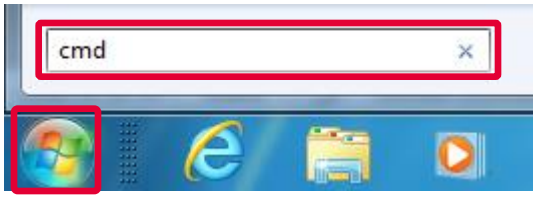
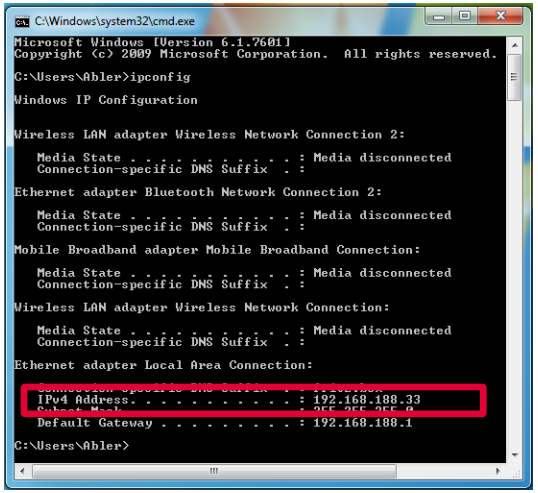
Configuration – Option 2:
Server/Client connected via router
Fix server IP address in IoT client [1/2]





1. Open command window

2. Find the IP address assigned via DHCP to your laptop (e.g. here: 192.168.188.33)

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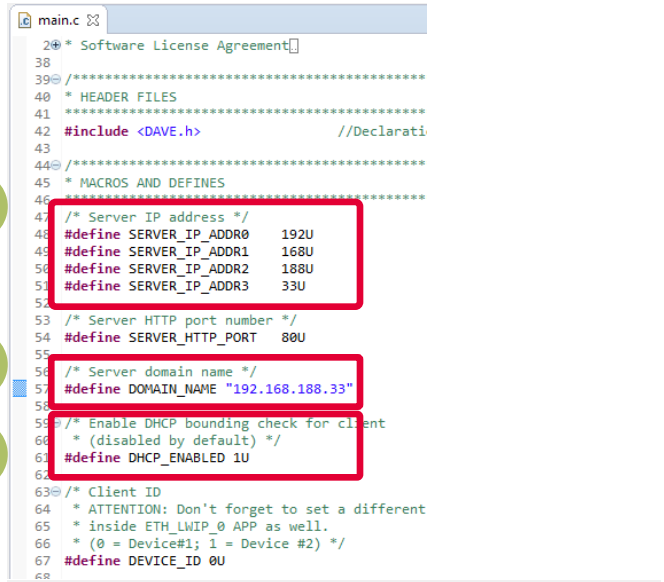
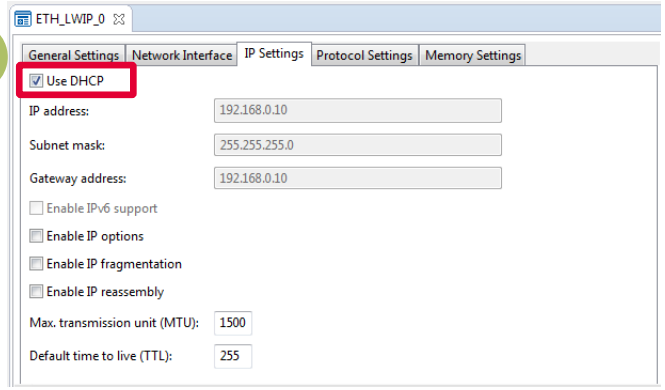
Configuration – Option 2:
Server/Client connected via router
Fix IP address (server) inside XMC Relax Kit





3 Set the IP address of destination server to your laptops IP address (e.g. here: 192.168.188.33) inside main.c

4 Enable DHCP of IoT client inside main.c

5 Enable DHCP of IoT client inside ETH_LWIP_APP.

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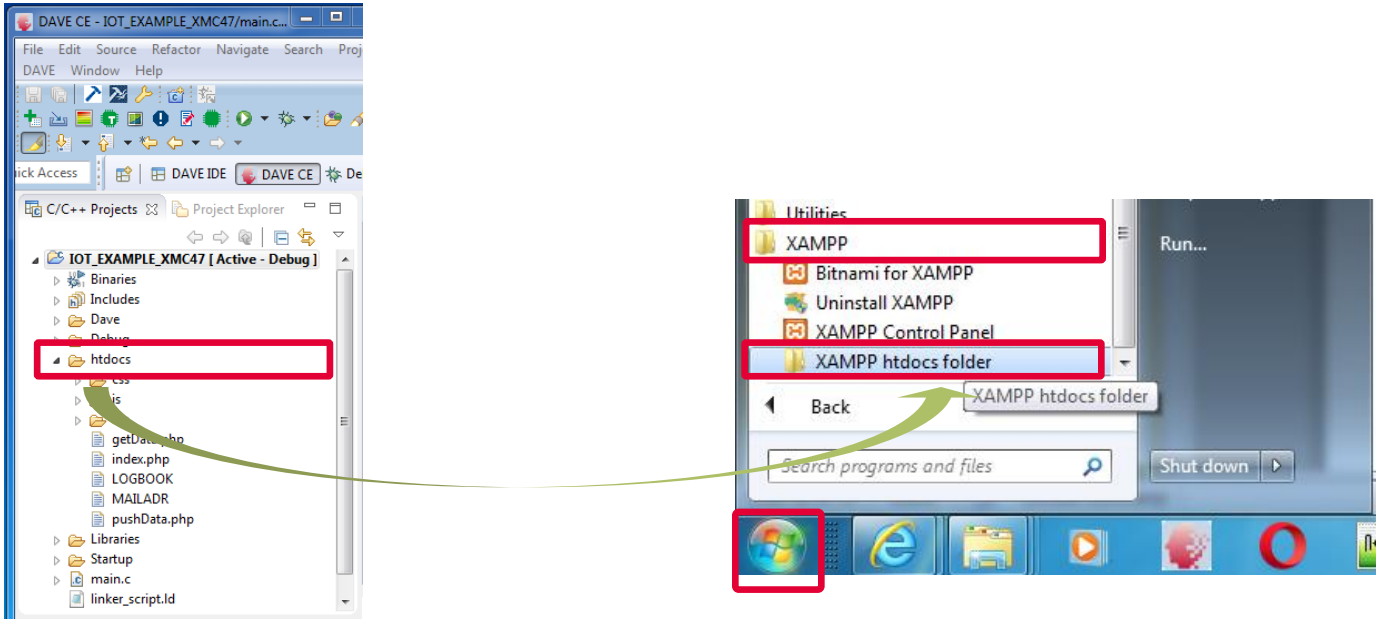
Configuration – Option 2:
Server/Client connected via router
Install server software on XAMPP



Copy server software from example folder to htdocs folder of your local XAMPP server. Replace the default address inside the file MAILADR with the email address on which you want to receive notification events.

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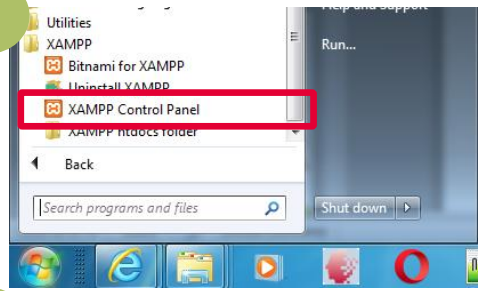
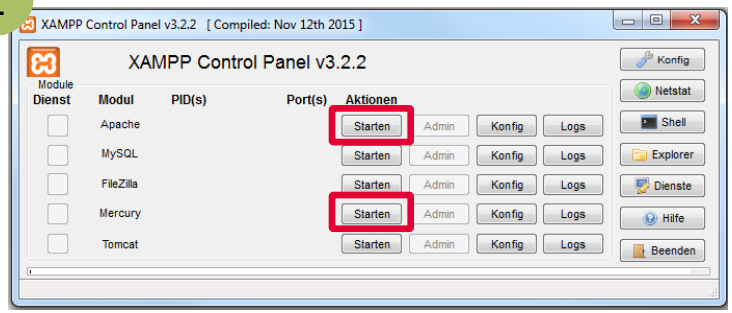
Configuration – Option 2:
Server/Client connected via router
Start XAMPP apache and mail server

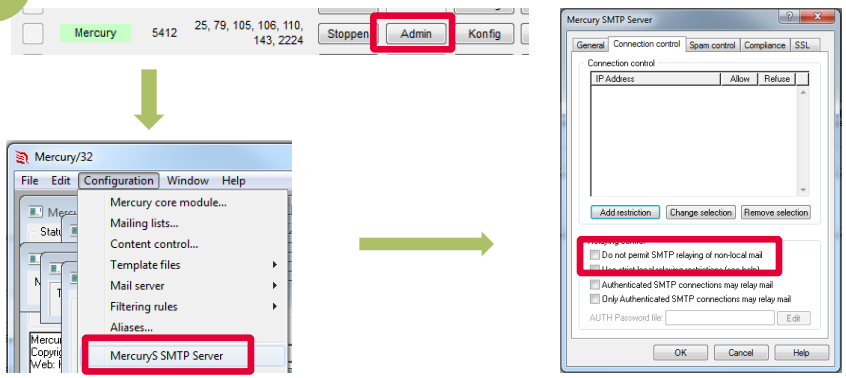
1



2



3



1. Start XAMPP Control Panel

2. Start apache and mail server

3. Disable „Not relay non-local mail“ –feature inside mail server.

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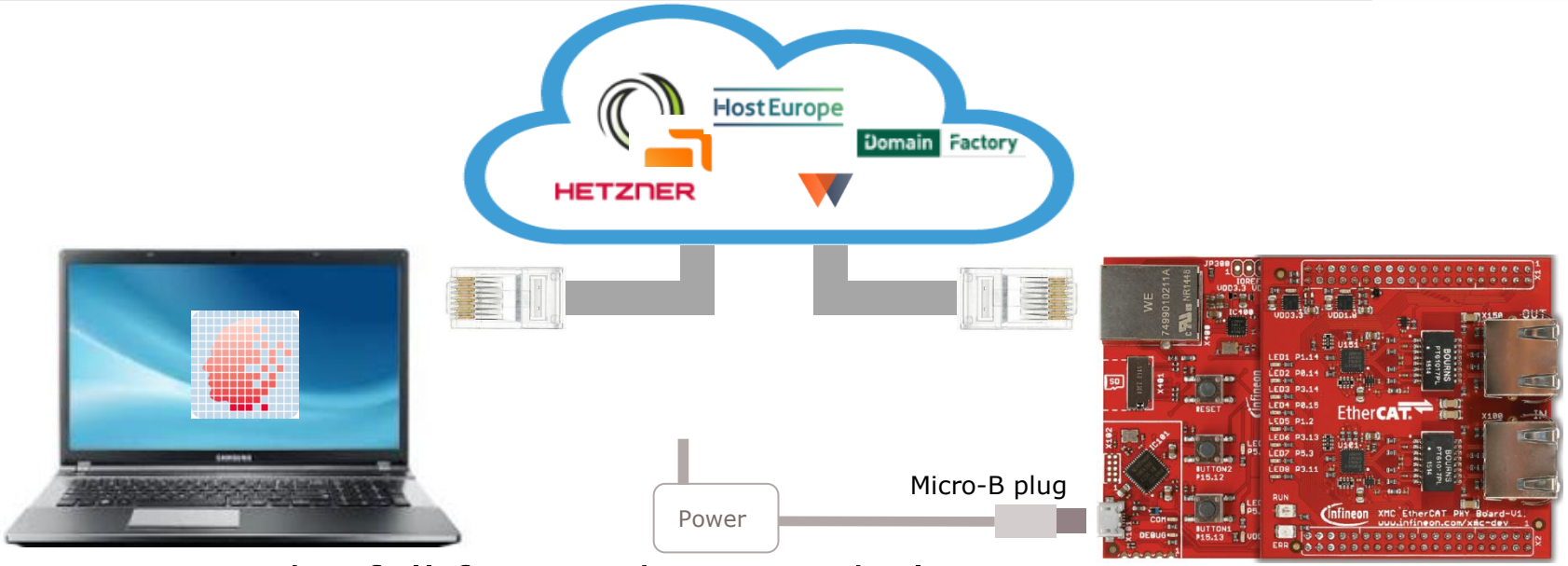
Configuration – Option 3:
Server / Client connected via cloud
Hardware - Setup



This setup is the full featured Server / Client option.
The web server is hosted somewhere in the cloud. The IoT client (XMC Relax Kit) can connect to the server worldwide via a standard internet connection.
The laptop is only need to build the example project and to download the software to XMC 4700/4800 Relax Kit. In operation XMC 4700/4800 relax kit is independently powered and connected to the cloud.
Use your laptop or any other device with a browser to monitor the client status via the web interface.

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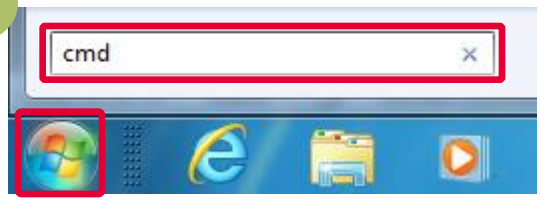
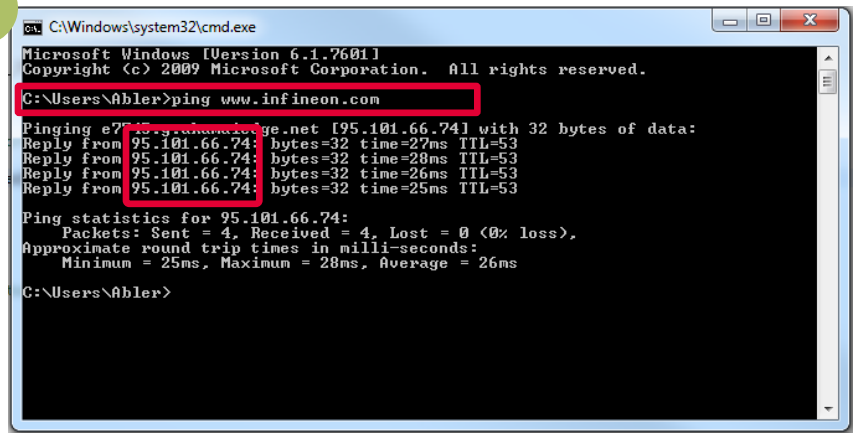
Configuration – Option 3:
Server / Client connected via cloud
Fix server IP address in IoT client [1/2]

1



2



1 Open command window

2 Find the IP address assigned of your server using ping (e.g. here:95.101.66.74)

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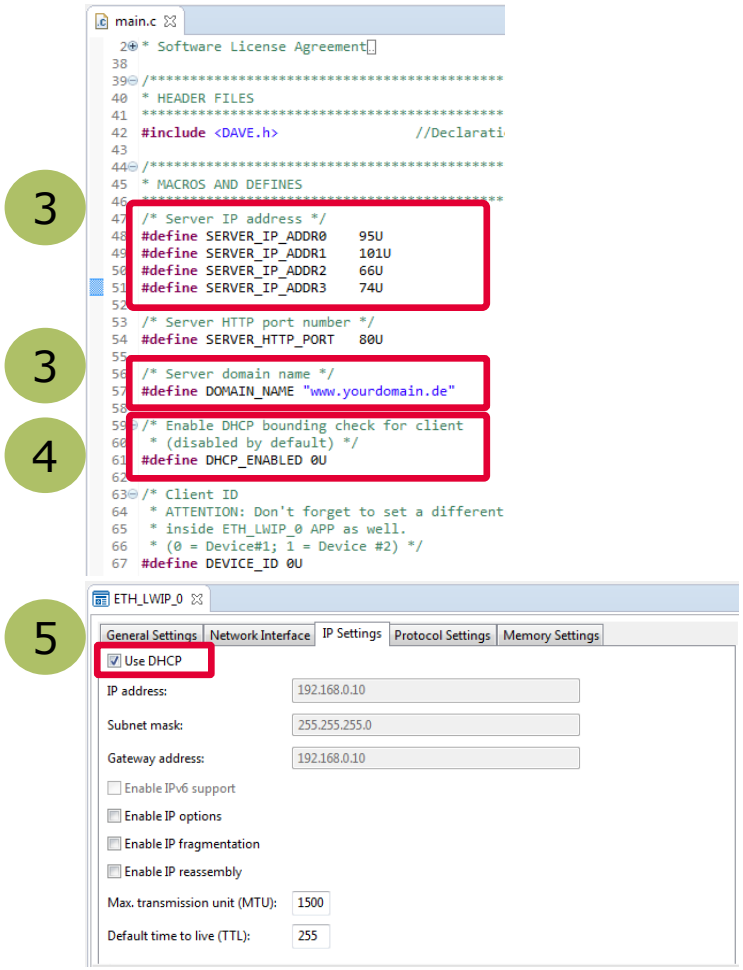
Configuration – Option 3:
Server / Client connected via cloud
Fix IP address (server) inside XMC Relax Kit



3 Set the IP address and domain name of destination server (e.g. here: 95.101.66.74) inside main.c

4 Enable DHCP of IoT client inside main.c

5 Enable DHCP of IoT client inside ETH_LWIP_APP.

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Configuration – Option 3:
Server / Client connected via cloud
Install server software on XAMPP



Copy server software from example folder to htdocs folder of your web hoster. Replace the default address inside the file MAILADR with the email address on which you want to receive the notification events.

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1 Overview and requirements

2 Setup

3 Implementation of the application

4 Configuration options

5 How to test

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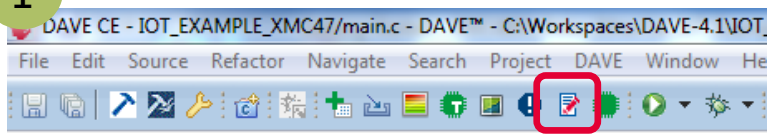
How to test – Download the executable and start IoT client application



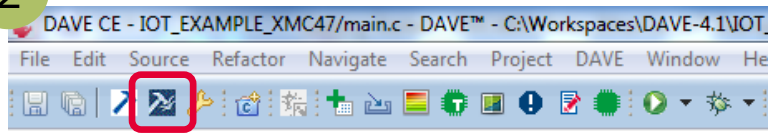
ACTIONS

1. Generate the source code for the APPs used. Build and download the executable to the XMC4800 / XMC4700 Relax Kit and start the debugger

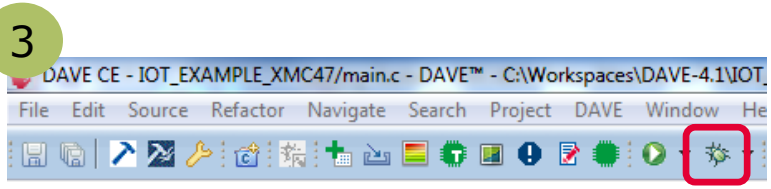
1



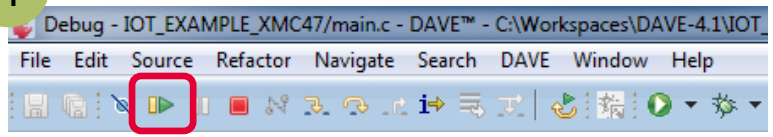
2



3

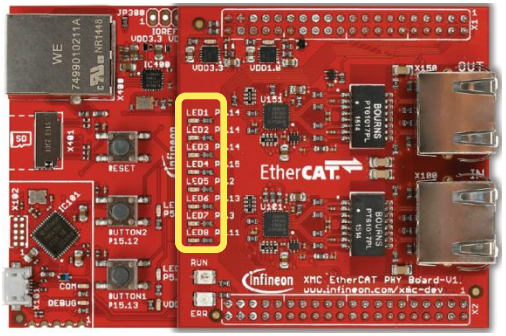


4





OBSERVATIONS



All eight LEDs of the shield are turned on.

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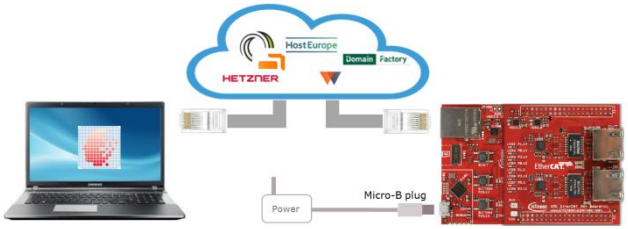
How to test – Application executable is running

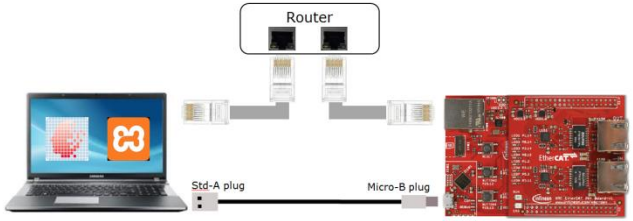


ACTIONS

Make sure your hardware is setup according the configuration you have selected (see also section „Configuration options“)

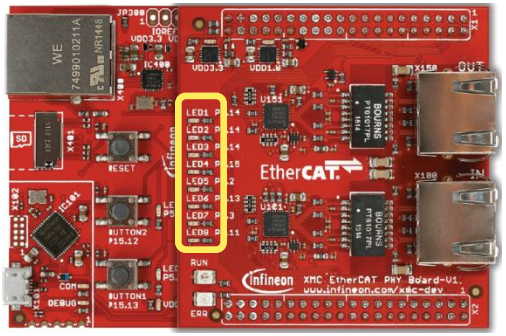








OBSERVATIONS



Once the IoT client has connected to the server the „8bit-state“ (counting up) will be indicated on the eight IoT client‘s status LEDs.

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How to test – Application executable is running

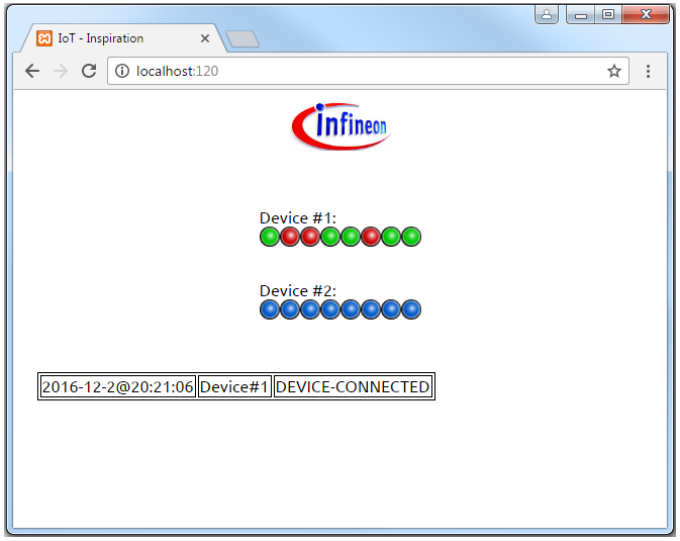


ACTIONS

Open a web browser. In case of configuration option1/2 enter the url „localhost“, otherwise enter the url of your domain.



OBSERVATIONS



You can monitor live the „8bit-state“ of your XMC Relax Kit on the web-page of the browser.
In the event history you can see the connection event of Device#1.

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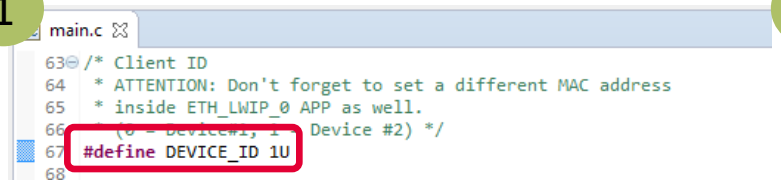
How to test – Application executable is running



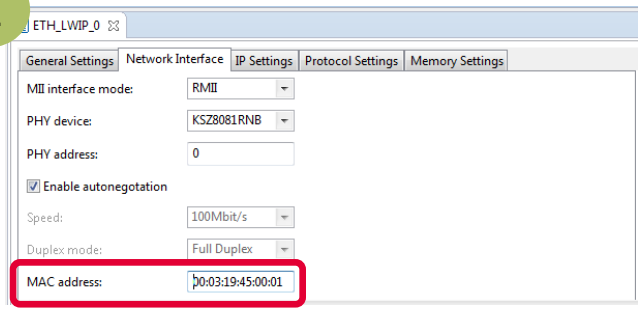
ACTIONS

If you have 2nd XMC 4700/4800 Relax Kit available, use this 2nd Kit. Optionally you can also use the 1st board you have. Modify inside the example project the device ID and the MAC address to customize it as Device#2. Generate the source code for the APPs. Build and download the executable to the XMC4800 / XMC4700 Relax Kit and start the debugger. Connect the board according your configuration option.

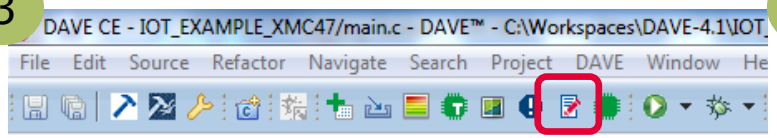
1



2



3



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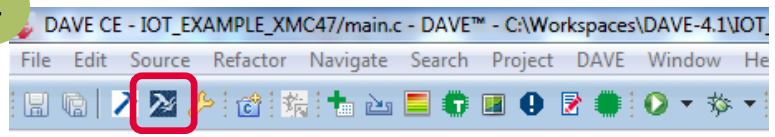
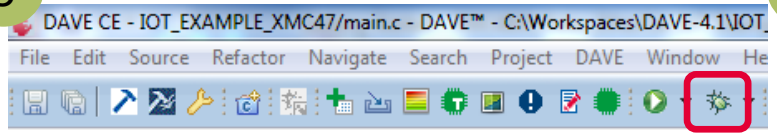
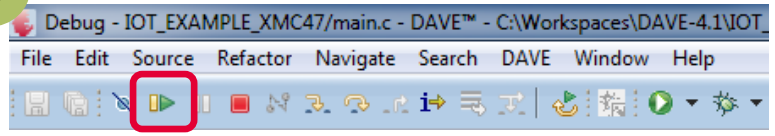


5



6



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How to test – Application executable is running

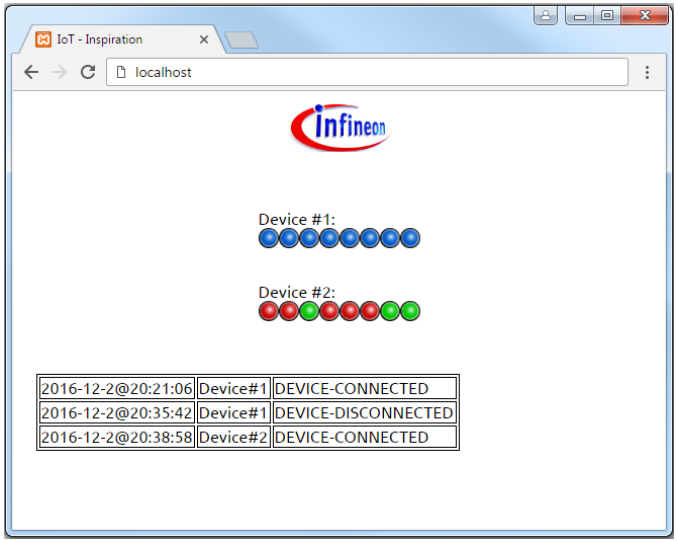


ACTIONS

Again, open the web browser. In case of configuration option1/2 enter the url „localhost", otherwise enter the url of your domain.



OBSERVATIONS



You can now monitor live the „8bit-state" of your XMC Relax Kit(s) worldwide on the web page of the browser.
The event history shows the connect/disconnect event of Device#1 and the connect event of Device#2.

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How to test – Application executable is running

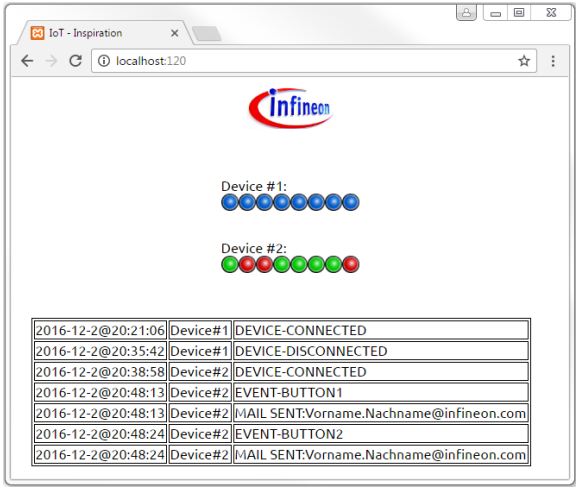


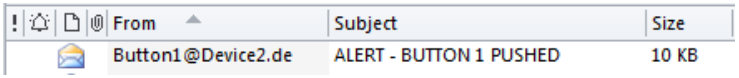
ACTIONS

Push BUTTON1 of the XMC4700/4800 Relax Kit. Push BUTTON2 of the XMC4700/4800 Relax Kit



OBSERVATIONS





In the event history on the web interface you can find the button push events and notifications about the sent emails.
Check your inbox to find the emails which were sent to you because of the button pushed on your XMC4700/4800 Relax Kit - acting as a IoT device.

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