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IoT Device Prototyping with STMicroelectronics Nucleo Development Boards

Day 3:
Prototyping with STM32 IoT Middleware

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Fred Eady

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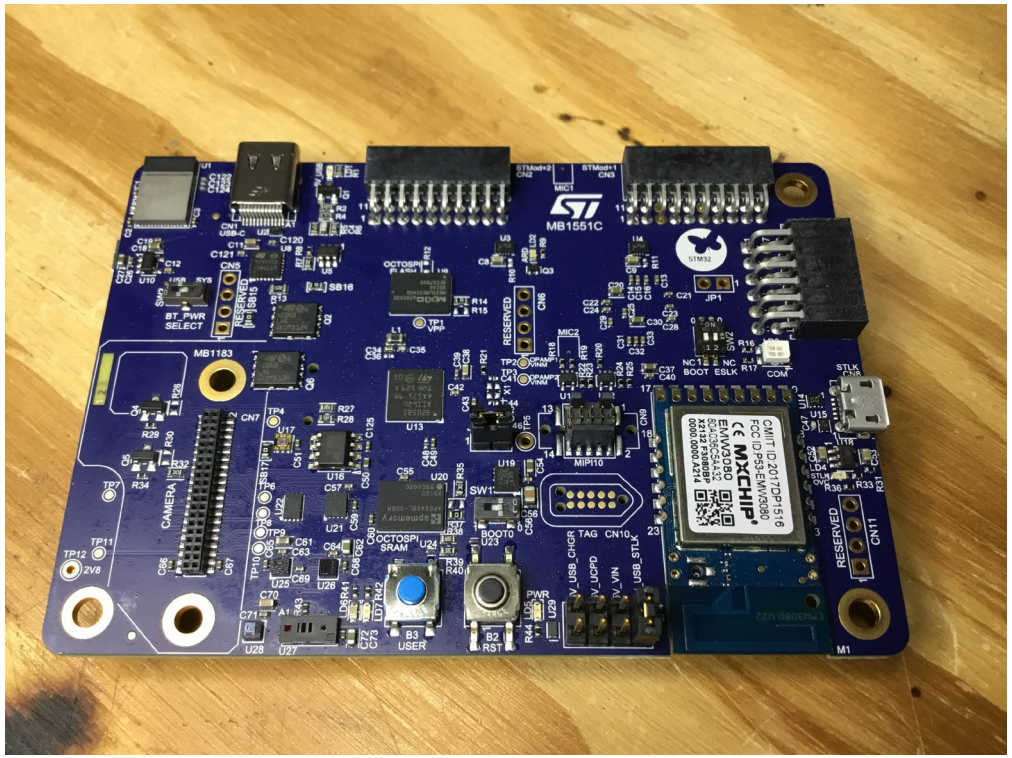
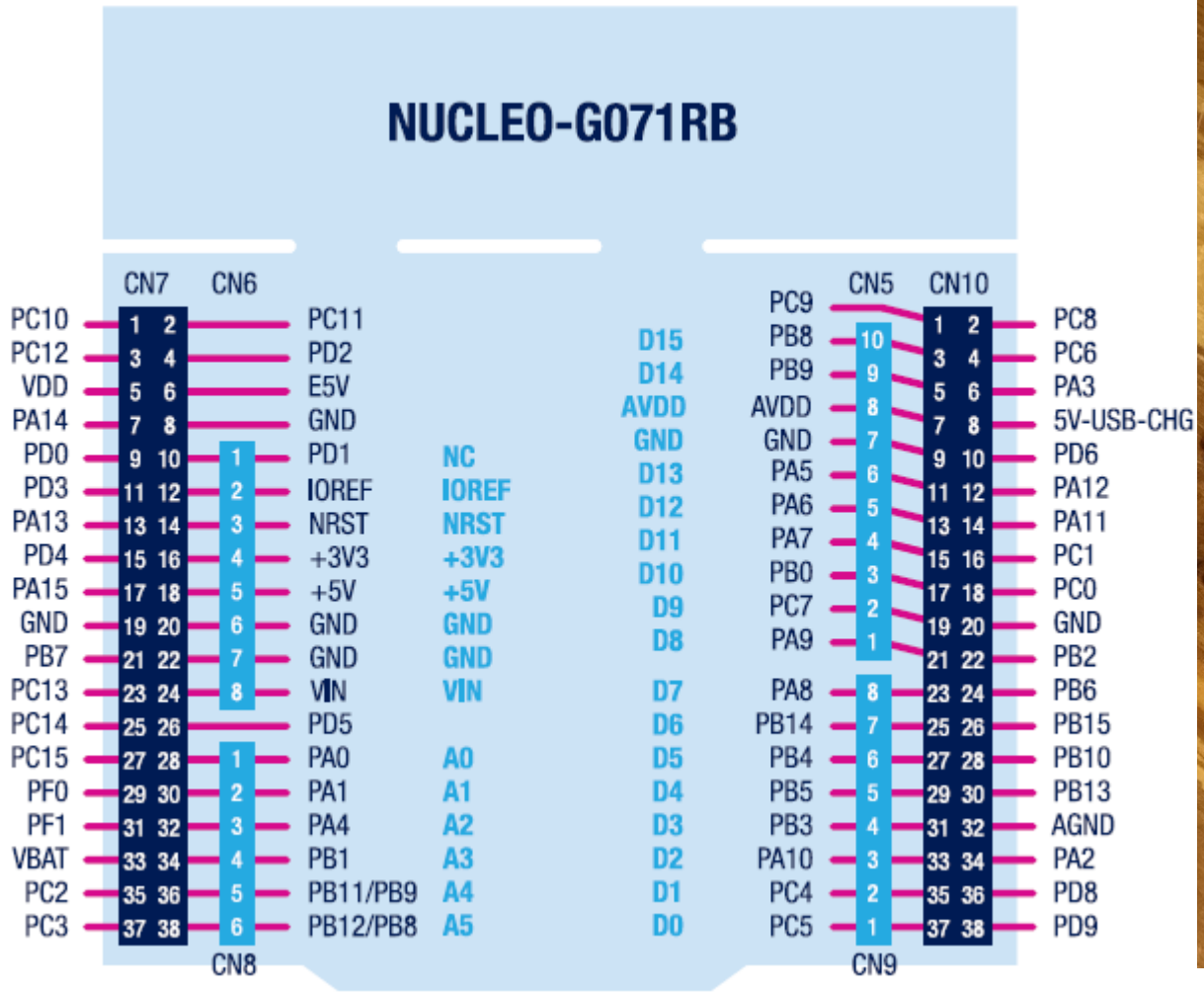
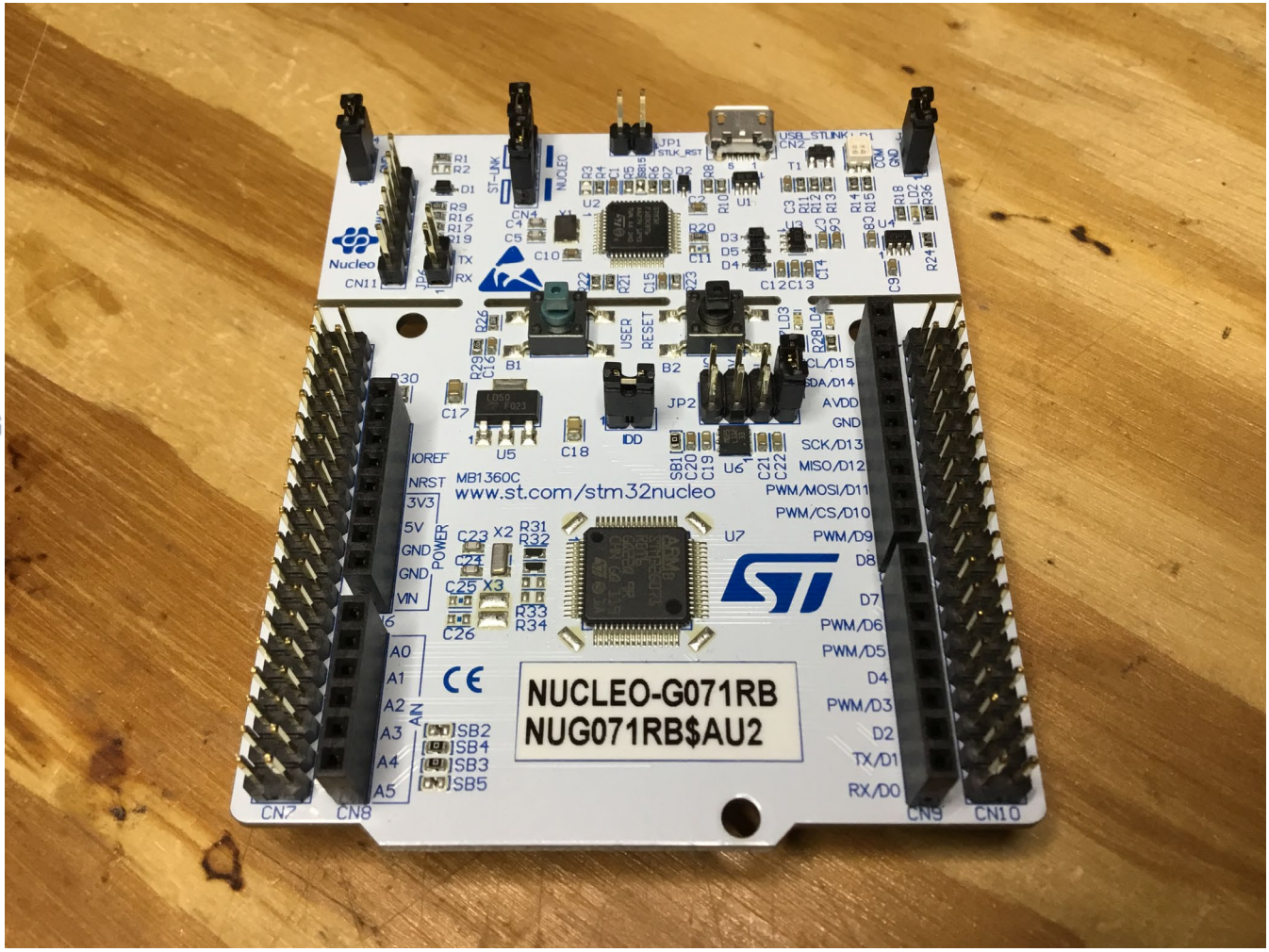
AGENDA

- NUCLEO-G071RB click EXPANSION (a.k.a. the "SLED")
- NUCLEO-U575ZI-Q click ARDUINO EXPANSION
- FatFs Driver
- STM32U585 Nx_TCP_Echo_Client

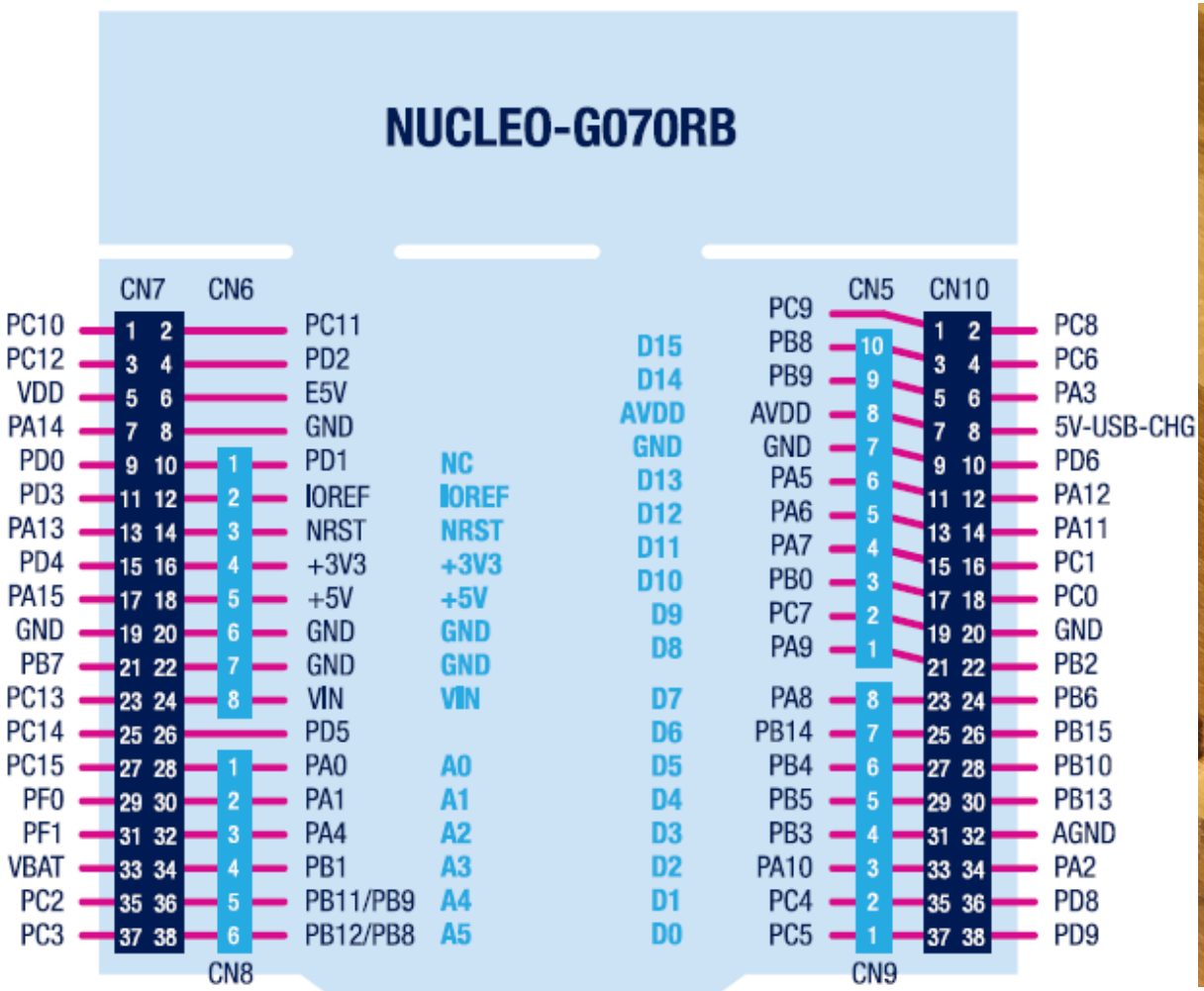


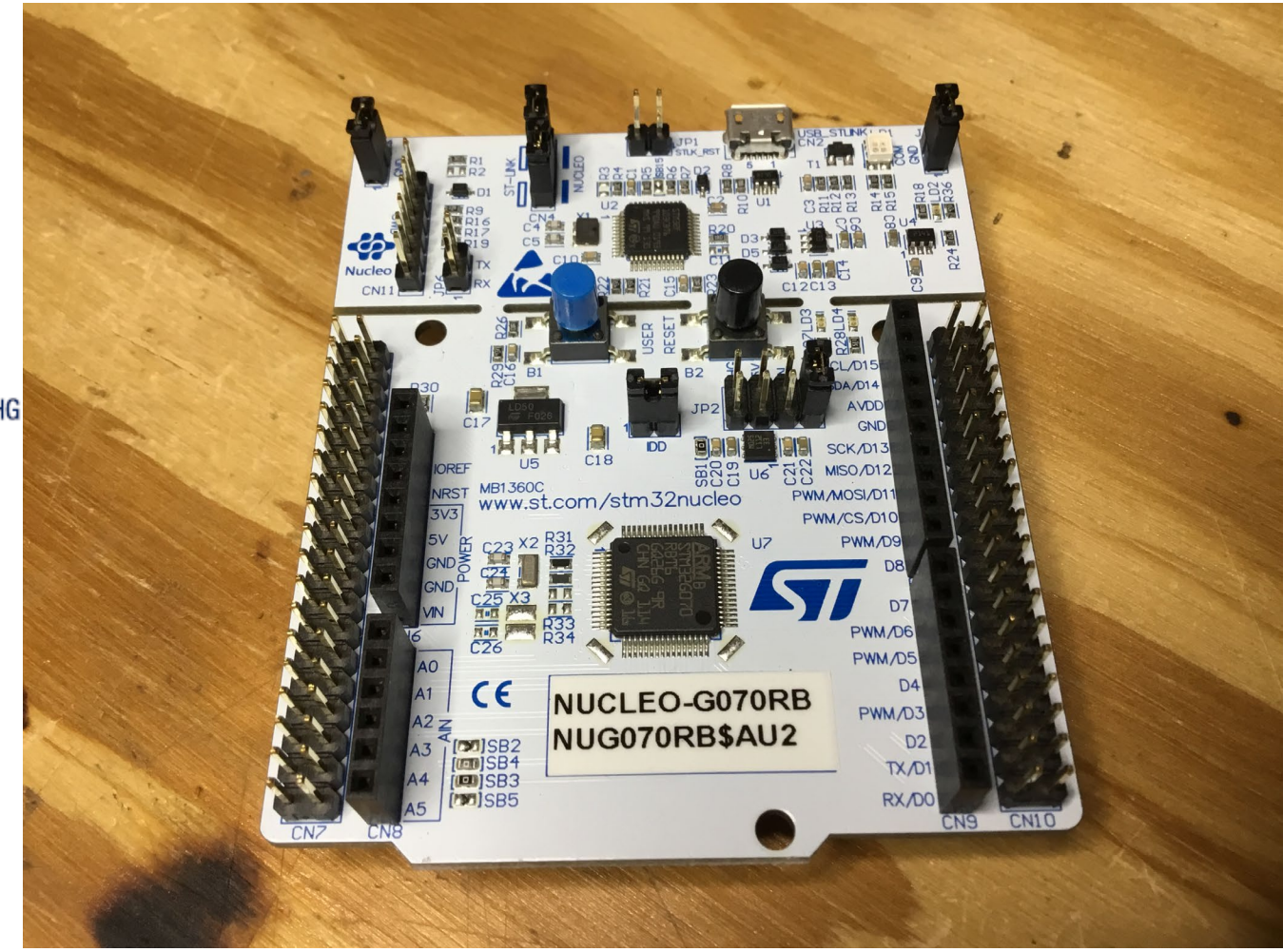
NUCLEO-G071RB click EXPANSION



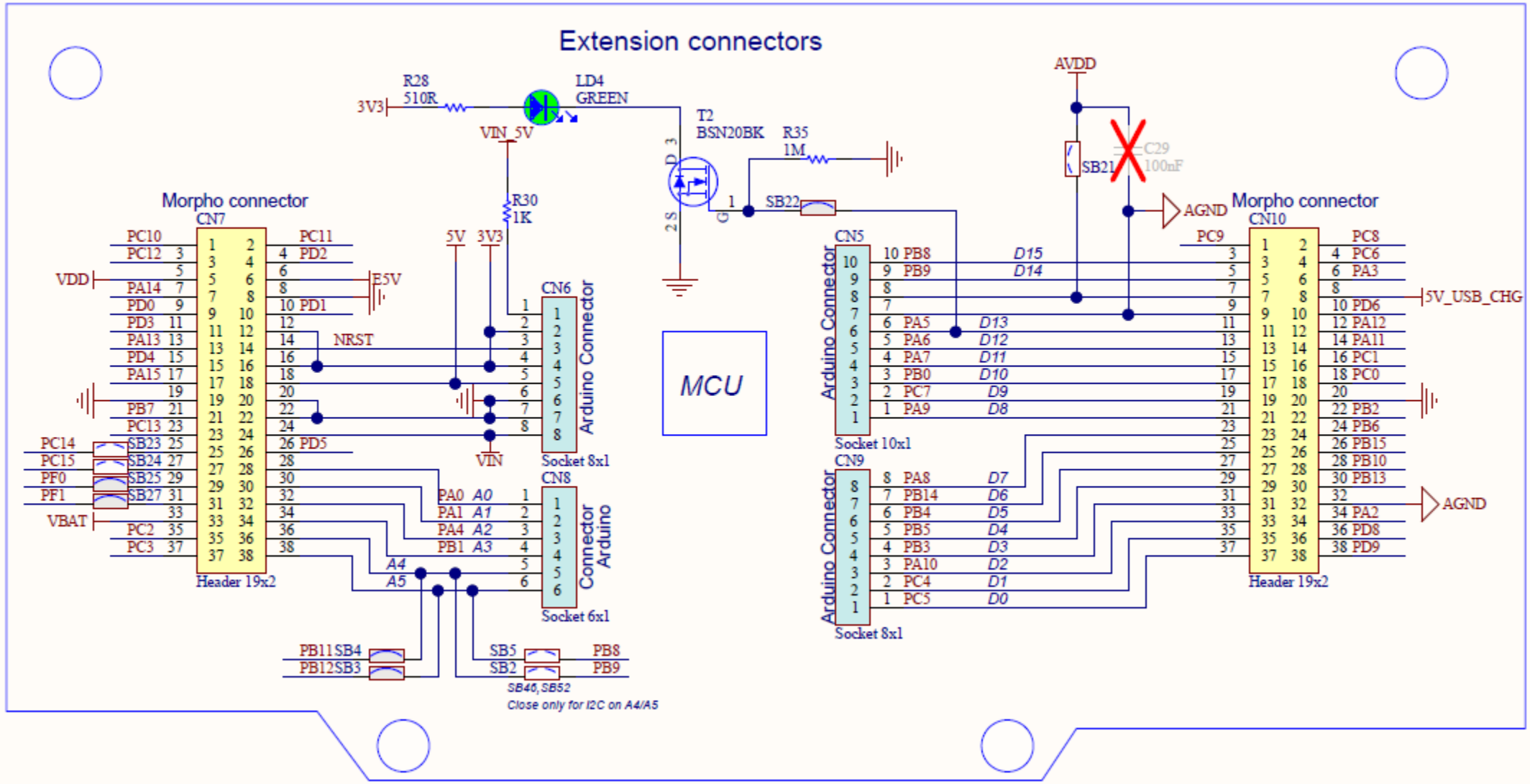


NUCLEO-G071RB click EXPANSION

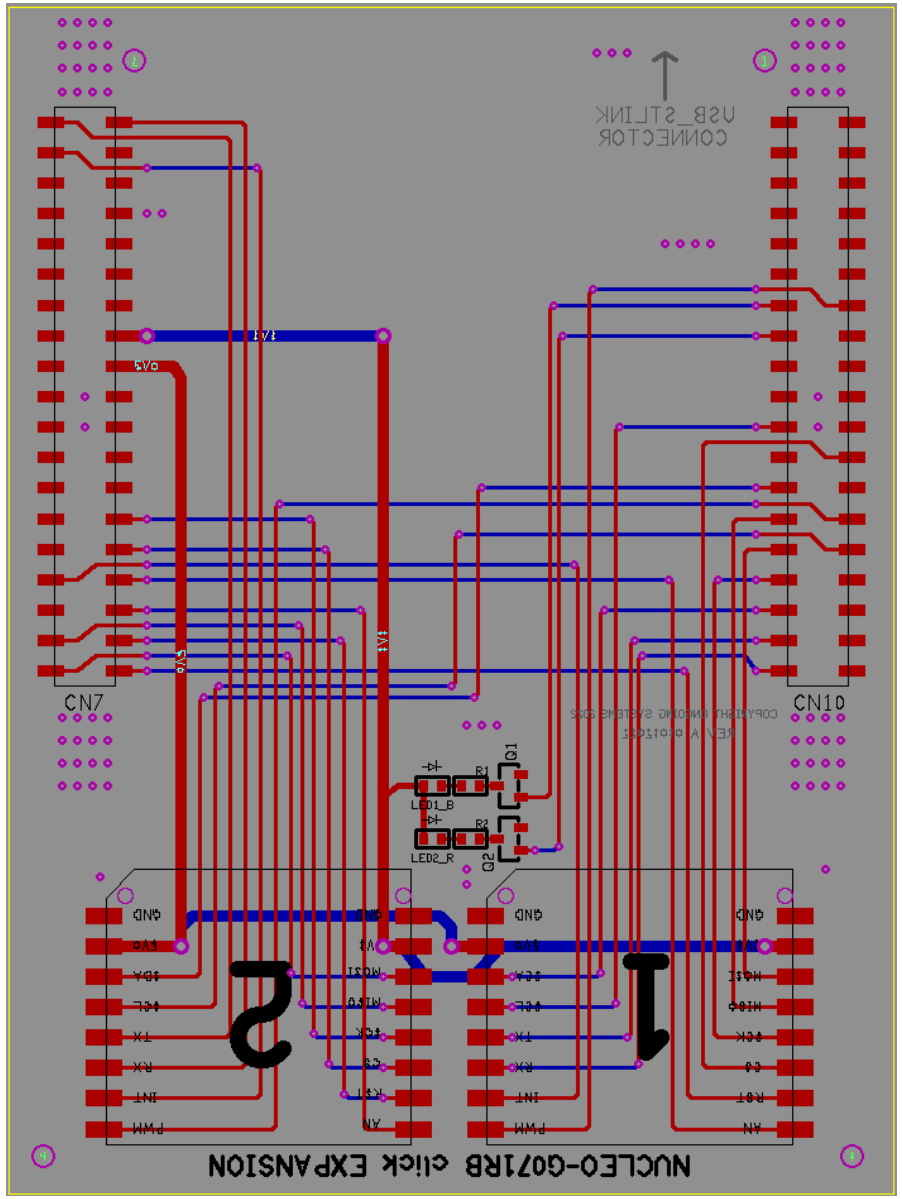


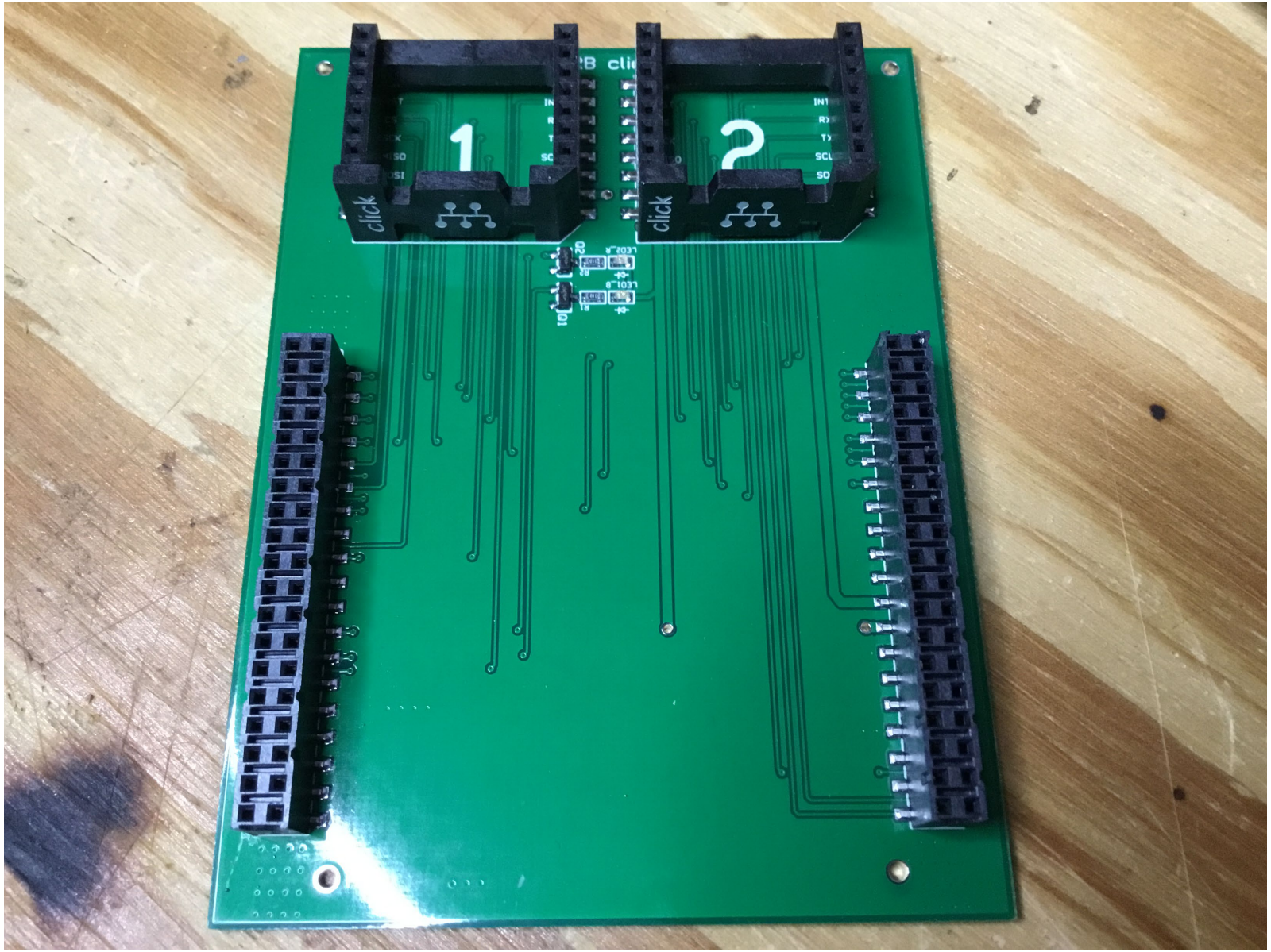


NUCLEO-G071RB click EXPANSION: G070RB Schematic

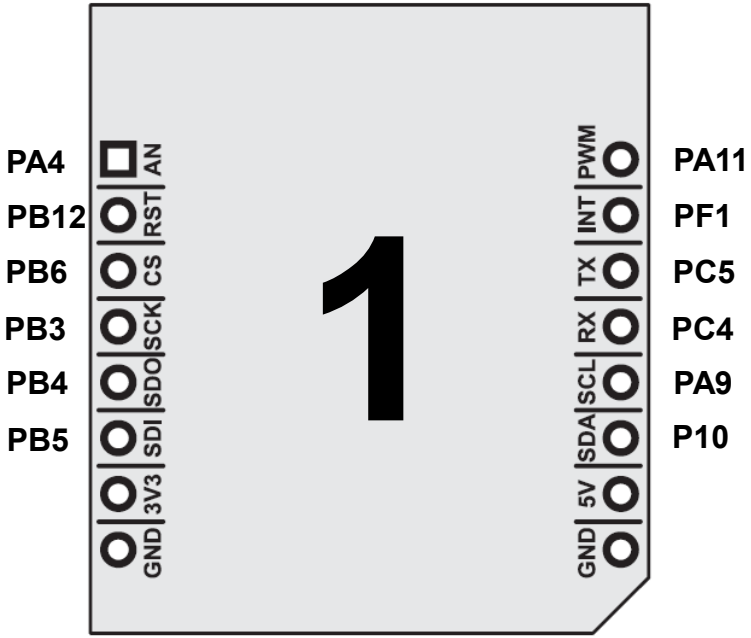


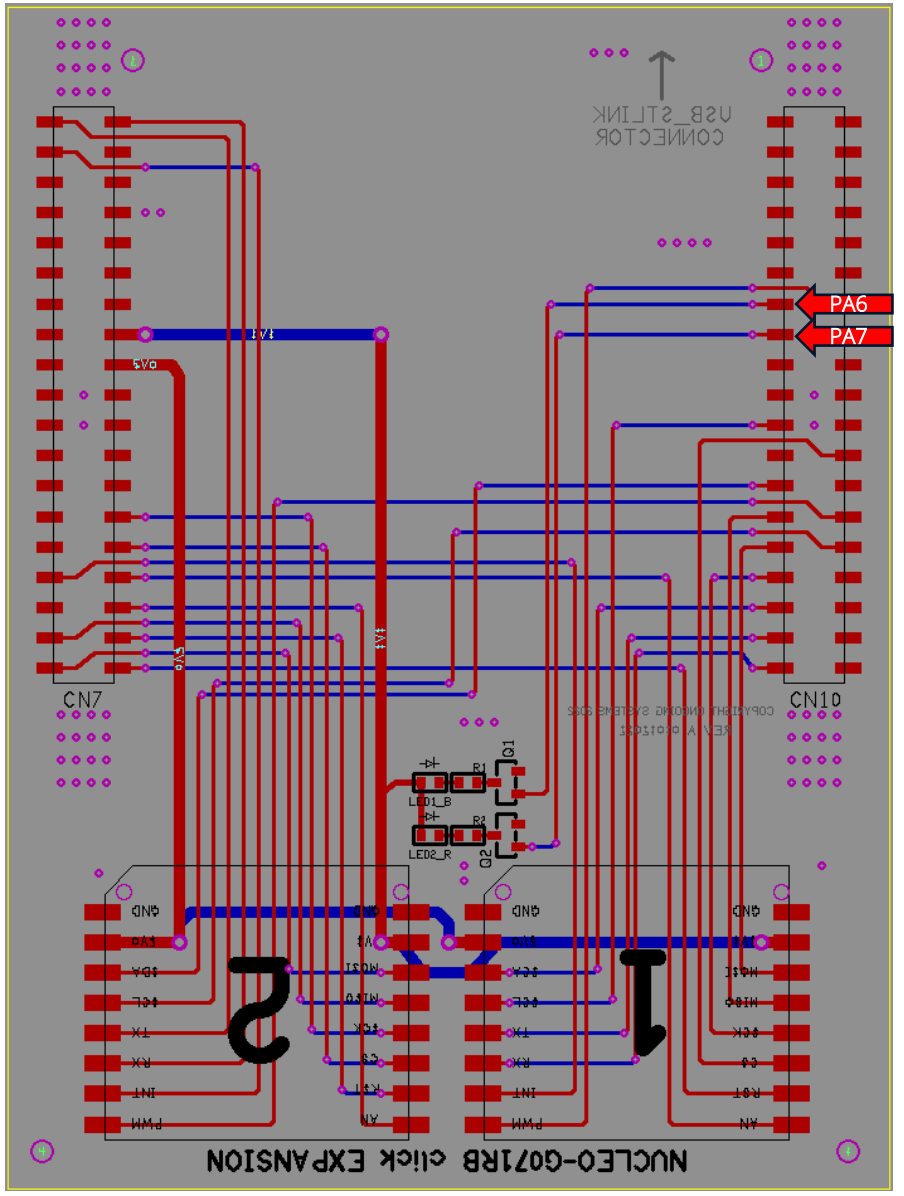
NUCLEO-G071RB click EXPANSION (SLED)





NUCLEO-G071RB click EXPANSION (SLED)





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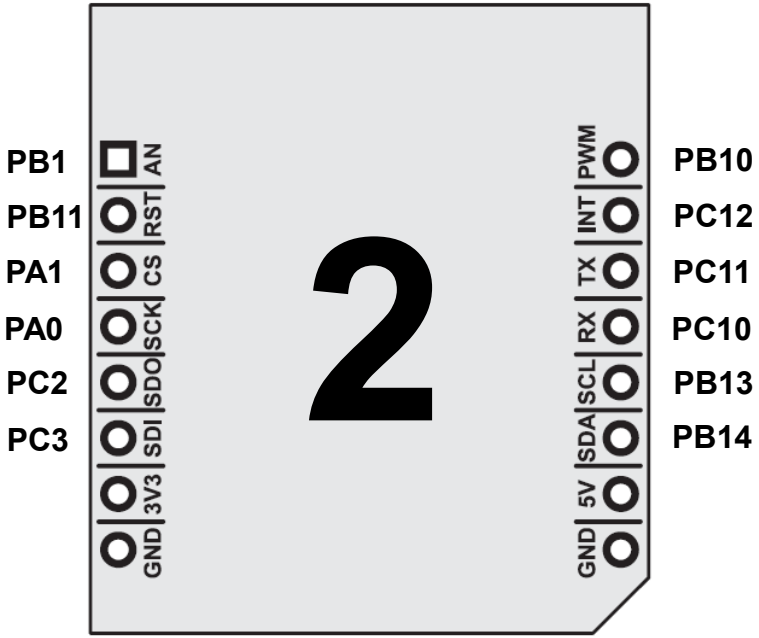
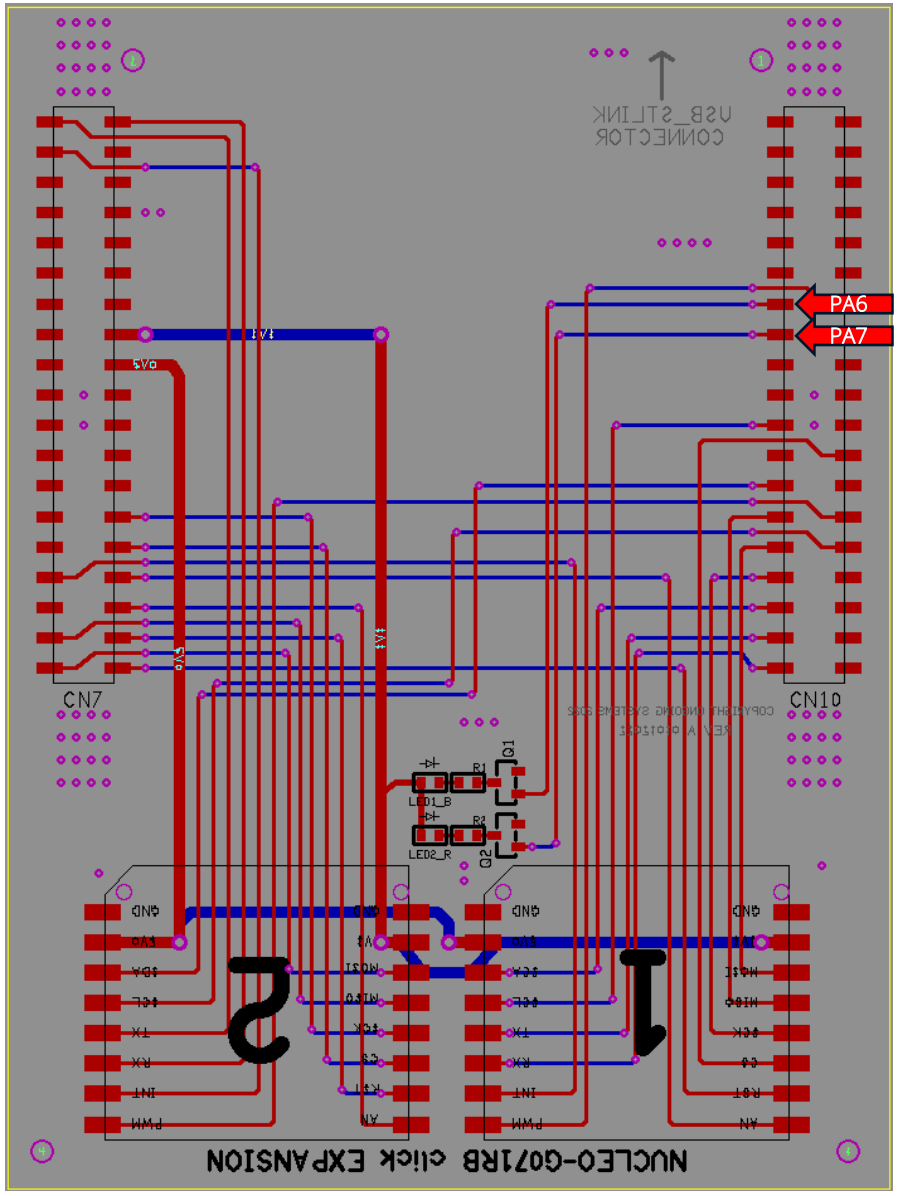
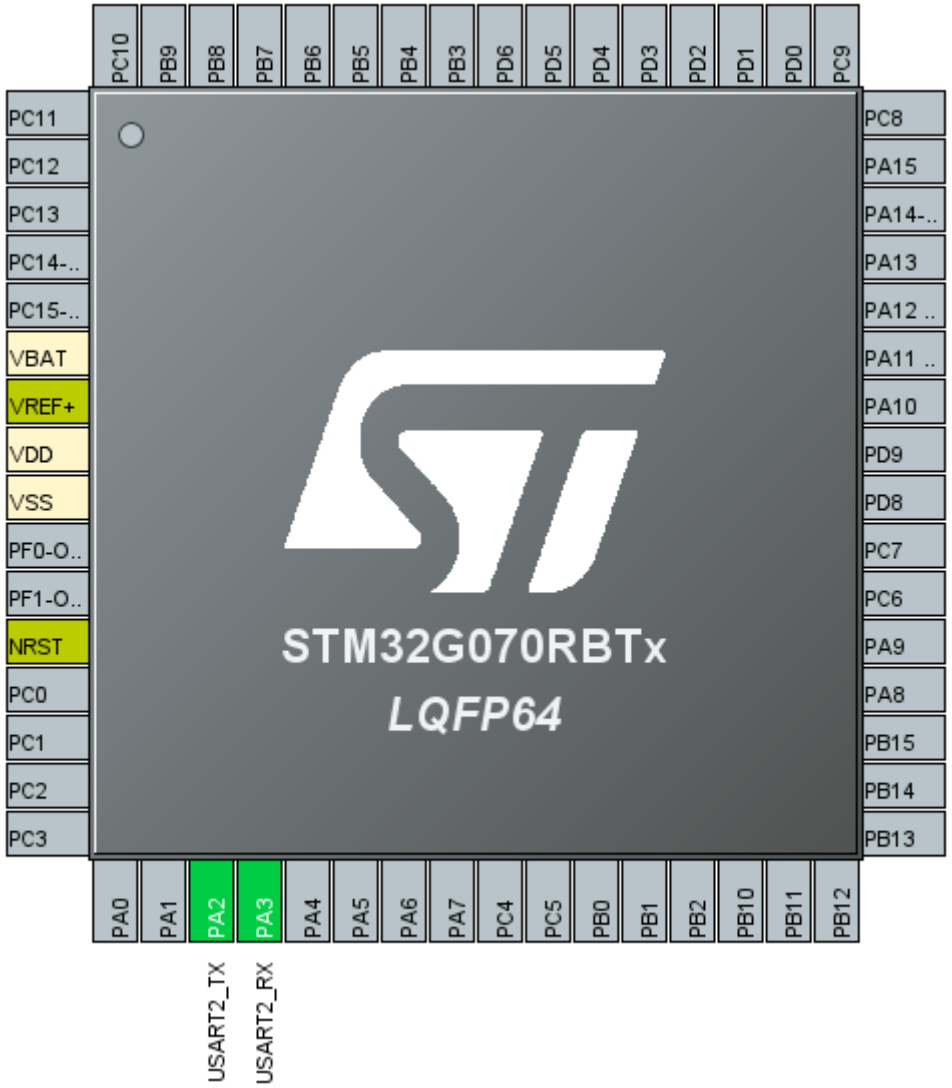
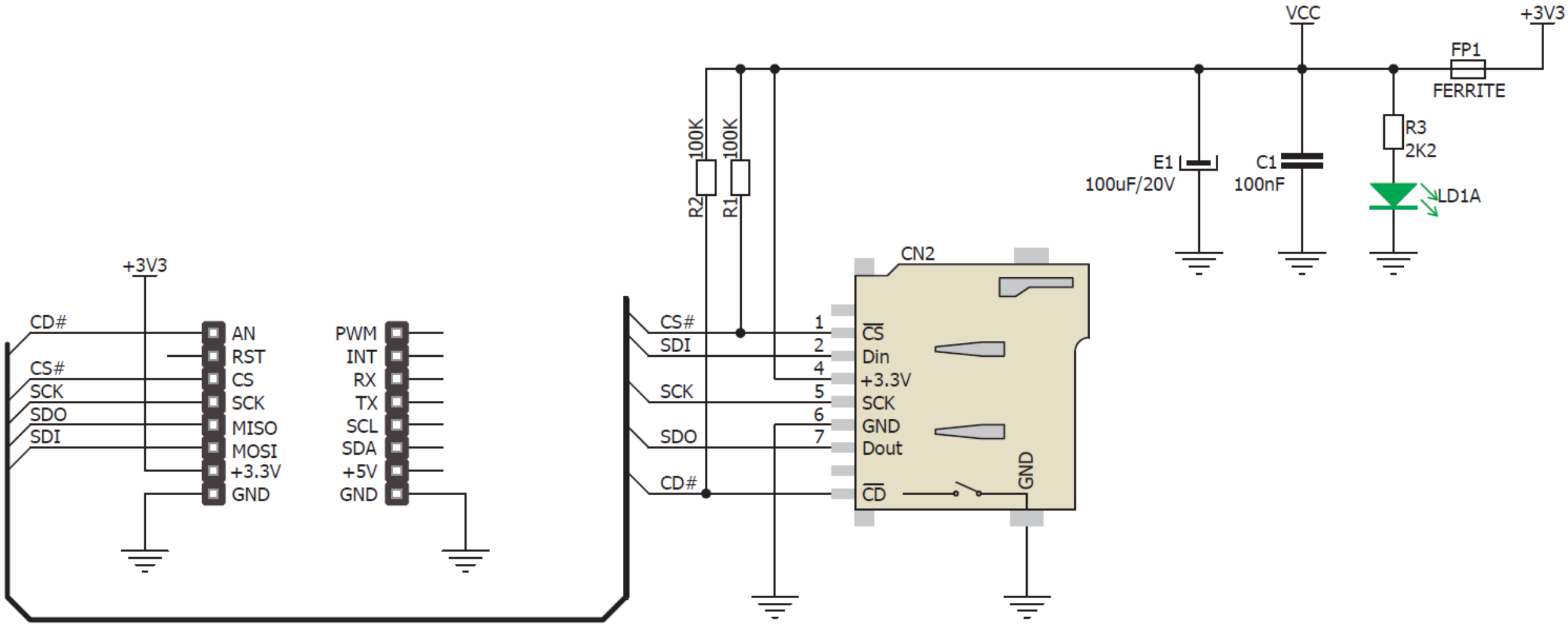




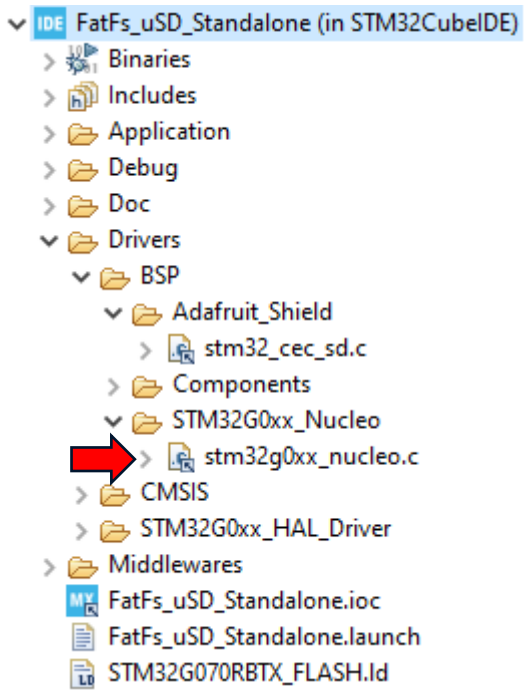
FatFs Driver: Hardware Configuration



FatFs Driver: Hardware Configuration

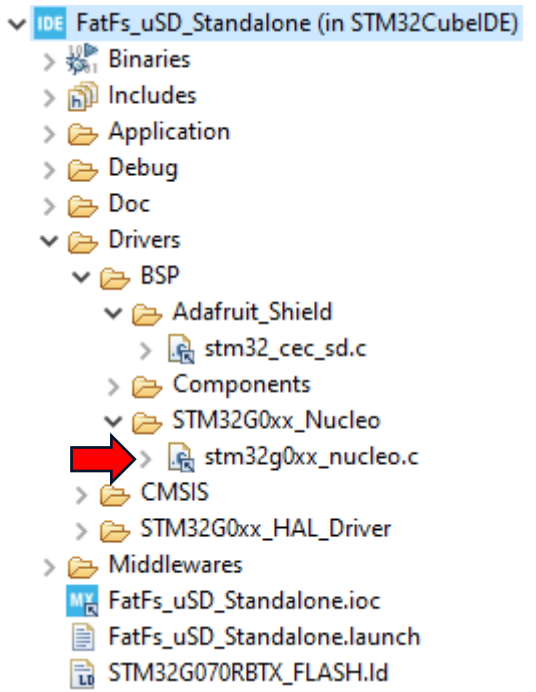


FatFs Driver: stm32g0xx_nucleo.h



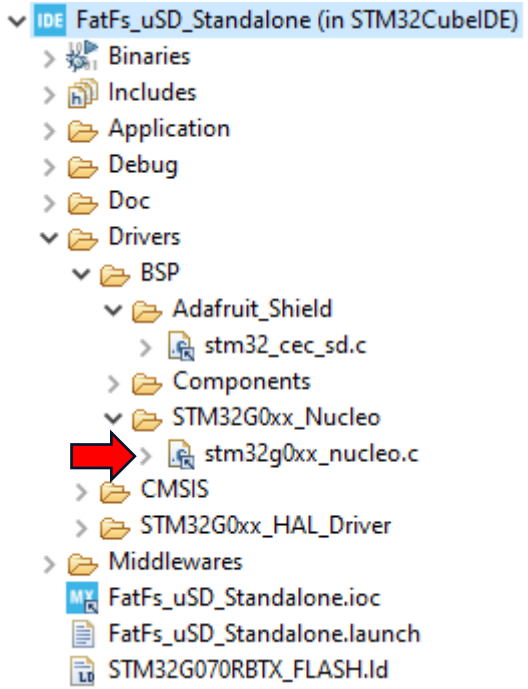

```
/*##################### SPI1 ###################################*/
#define NUCLEO_SPIx                                 SPI1
#define NUCLEO_SPIx_CLK_ENABLE()                    __HAL_RCC_SPI1_CLK_ENABLE()

#define NUCLEO_SPIx_SCK_AF                          GPIO_AF0_SPI1
#define NUCLEO_SPIx_SCK_GPIO_PORT                   GPIOB
#define NUCLEO_SPIx_SCK_PIN                         GPIO_PIN_3
#define NUCLEO_SPIx_SCK_GPIO_CLK_ENABLE()           __HAL_RCC_GPIOB_CLK_ENABLE()
#define NUCLEO_SPIx_SCK_GPIO_CLK_DISABLE()          __HAL_RCC_GPIOB_CLK_DISABLE()

#define NUCLEO_SPIx_MISO_MOSI_AF                    GPIO_AF0_SPI1
#define NUCLEO_SPIx_MISO_MOSI_GPIO_PORT             GPIOB
#define NUCLEO_SPIx_MISO_MOSI_GPIO_CLK_ENABLE()     __HAL_RCC_GPIOB_CLK_ENABLE()
#define NUCLEO_SPIx_MISO_MOSI_GPIO_CLK_DISABLE()    __HAL_RCC_GPIOB_CLK_DISABLE()
#define NUCLEO_SPIx_MISO_PIN                        GPIO_PIN_4
#define NUCLEO_SPIx_MOSI_PIN                        GPIO_PIN_5
/* Maximum Timeout values for flags waiting loops. These timeouts are not based
   on accurate values, they just guarantee that the application will not remain
   stuck if the SPI communication is corrupted.
   You may modify these timeout values depending on CPU frequency and application
   conditions (interrupts routines ...). */
#define NUCLEO_SPIx_TIMEOUT_MAX                     1000


/**
  * @brief  SD Control Lines management
  */
#define SD_CS_LOW()       HAL_GPIO_WritePin(SD_CS_GPIO_PORT, SD_CS_PIN, GPIO_PIN_RESET)
#define SD_CS_HIGH()      HAL_GPIO_WritePin(SD_CS_GPIO_PORT, SD_CS_PIN, GPIO_PIN_SET)
/**
  * @brief  SD Control Interface pins (shield D4)
  */
#define SD_CS_PIN                                   GPIO_PIN_6
#define SD_CS_GPIO_PORT                             GPIOB
#define SD_CS_GPIO_CLK_ENABLE()                     __HAL_RCC_GPIOB_CLK_ENABLE()
#define SD_CS_GPIO_CLK_DISABLE()                    __HAL_RCC_GPIOB_CLK_DISABLE()
```

FatFs Driver: stm32g0xx_nucleo.c

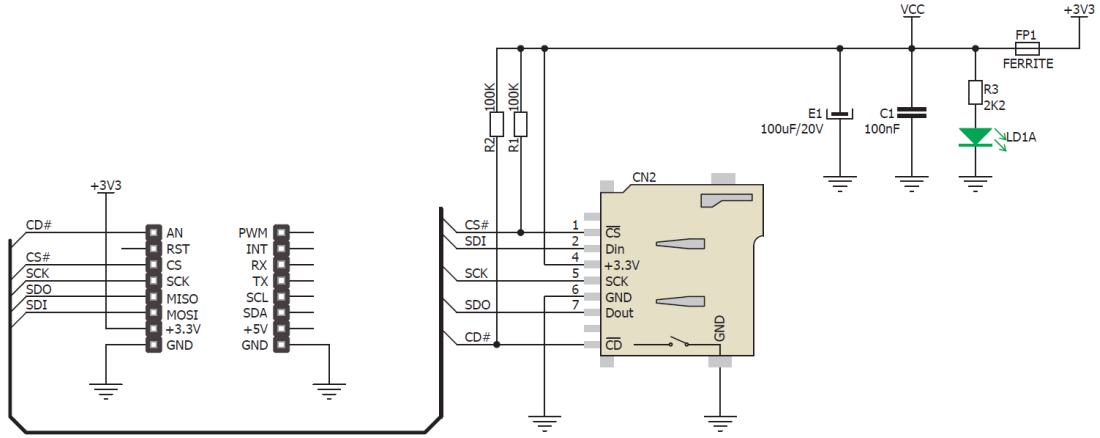



```c
static void SPIx_Init(void)
{
  if(HAL_SPI_GetState(&hnucleo_Spi) == HAL_SPI_STATE_RESET)
  {
    /* SPI Config */
    hnucleo_Spi.Instance = NUCLEO_SPIx;
      /* SPI baudrate is set to 12 MHz maximum (PCLK1/SPI_BaudRatePrescaler = 48/4 = 12 MHz)
       to verify these constraints:
          - ST7735 LCD SPI interface max baudrate is 15MHz for write and 6.66MHz for read
            Since the provided driver doesn't use read capability from LCD, only constraint
            on write baudrate is considered.
          - SD card SPI interface max baudrate is 25MHz for write/read
          - PCLK1 max frequency is 48 MHz
       */
    hnucleo_Spi.Init.BaudRatePrescaler = SPI_BAUDRATEPRESCALER_4;
    hnucleo_Spi.Init.Direction = SPI_DIRECTION_2LINES;
    hnucleo_Spi.Init.CLKPhase = SPI_PHASE_2EDGE;
    hnucleo_Spi.Init.CLKPolarity = SPI_POLARITY_HIGH;
    hnucleo_Spi.Init.CRCCalculation = SPI_CRCCALCULATION_DISABLE;
    hnucleo_Spi.Init.CRCLength = SPI_CRC_LENGTH_DATASIZE;
    hnucleo_Spi.Init.CRCPolynomial = 7;
    hnucleo_Spi.Init.DataSize = SPI_DATASIZE_8BIT;
    hnucleo_Spi.Init.FirstBit = SPI_FIRSTBIT_MSB;
    hnucleo_Spi.Init.NSS = SPI_NSS_SOFT;
    hnucleo_Spi.Init.TIMode = SPI_TIMODE_DISABLE;
    hnucleo_Spi.Init.NSSPMode = SPI_NSS_PULSE_DISABLE;
    hnucleo_Spi.Init.Mode = SPI_MODE_MASTER;

    SPIx_MspInit();
    HAL_SPI_Init(&hnucleo_Spi);
  }
}
```

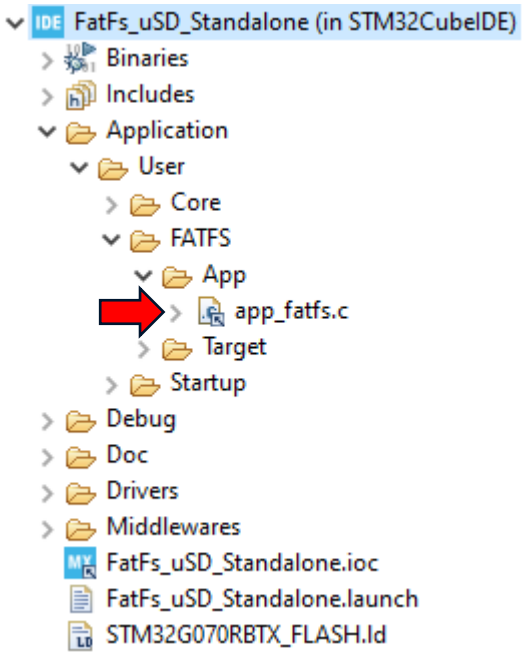
FatFs Driver: stm32g0xx_nucleo.c



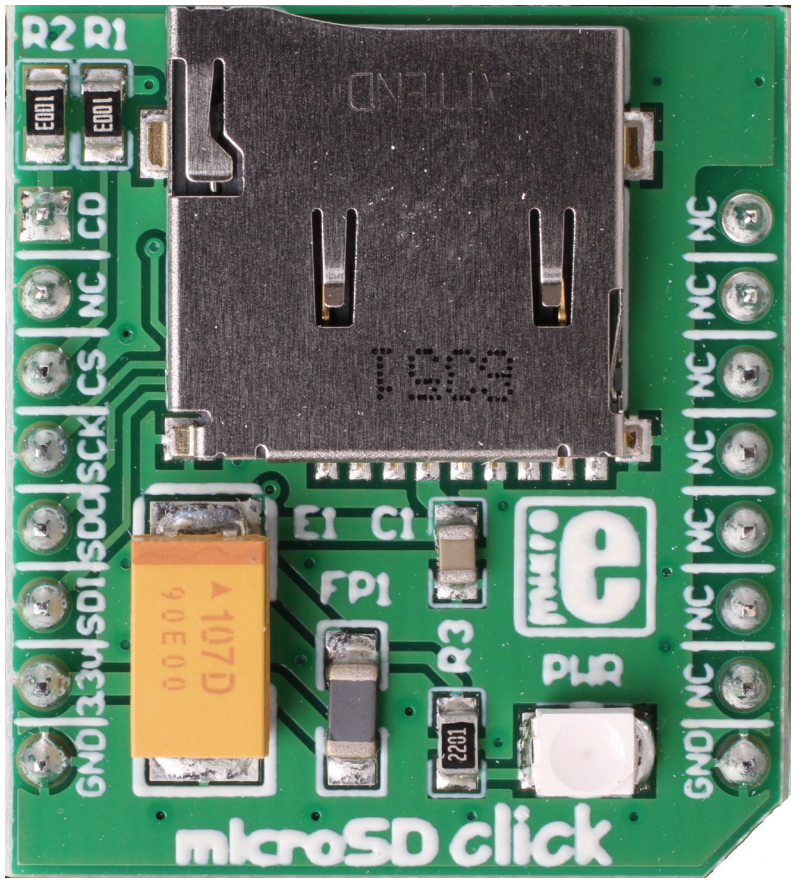

```
static void SPIx_MspInit(void)
{
  GPIO_InitTypeDef  gpioinitstruct = {0};

  /*** Configure the GPIOs ***/
  /* Enable GPIO clock */
  NUCLEO_SPIx_SCK_GPIO_CLK_ENABLE();
  NUCLEO_SPIx_MISO_MOSI_GPIO_CLK_ENABLE();

  /* Configure SPI SCK */
  gpioinitstruct.Pin = NUCLEO_SPIx_SCK_PIN;
  gpioinitstruct.Mode = GPIO_MODE_AF_PP;
  gpioinitstruct.Pull  = GPIO_PULLUP;
  gpioinitstruct.Speed = GPIO_SPEED_FREQ_VERY_HIGH;
  gpioinitstruct.Alternate = NUCLEO_SPIx_SCK_AF;
  HAL_GPIO_Init(NUCLEO_SPIx_SCK_GPIO_PORT, &gpioinitstruct);

  /* Configure SPI MISO and MOSI */
  gpioinitstruct.Pin = NUCLEO_SPIx_MOSI_PIN;
  gpioinitstruct.Alternate = NUCLEO_SPIx_MISO_MOSI_AF;
  gpioinitstruct.Pull  = GPIO_PULLDOWN;
  HAL_GPIO_Init(NUCLEO_SPIx_MISO_MOSI_GPIO_PORT, &gpioinitstruct);

  gpioinitstruct.Pin = NUCLEO_SPIx_MISO_PIN;
  HAL_GPIO_Init(NUCLEO_SPIx_MISO_MOSI_GPIO_PORT, &gpioinitstruct);

  /*** Configure the SPI peripheral ***/
  /* Enable SPI clock */
  NUCLEO_SPIx_CLK_ENABLE();
}
```



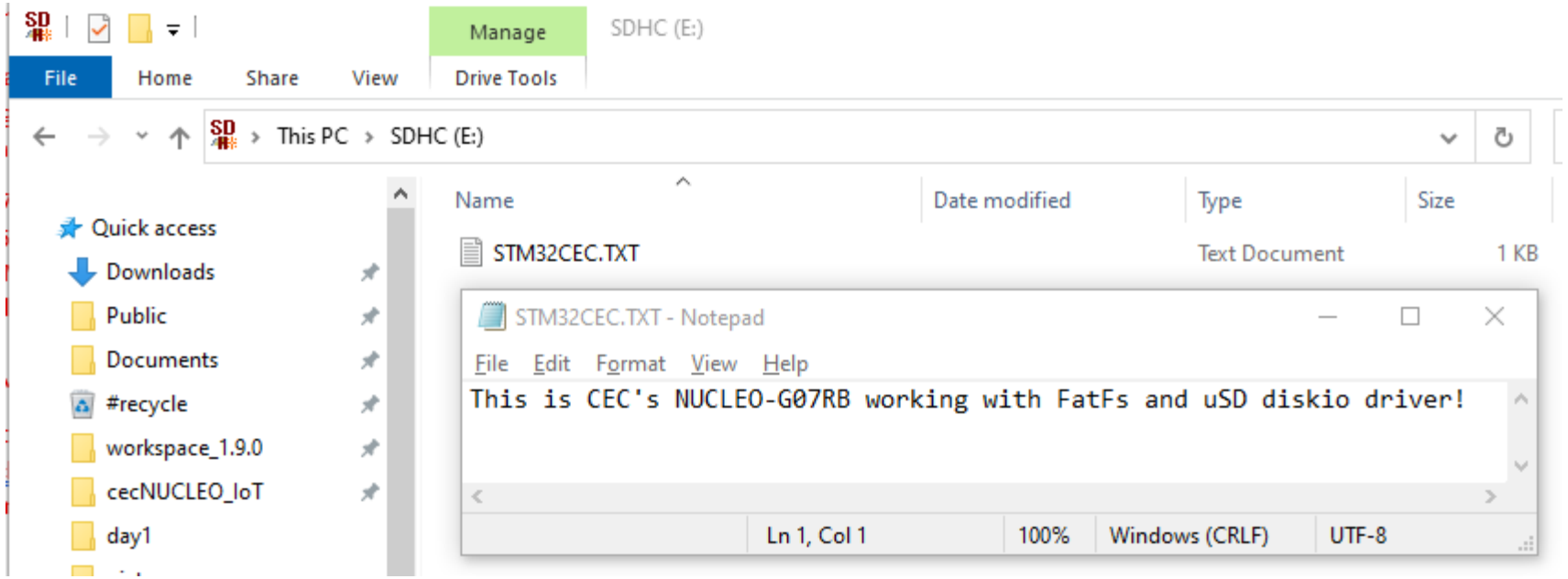
FatFs Driver: app_fatfs.c



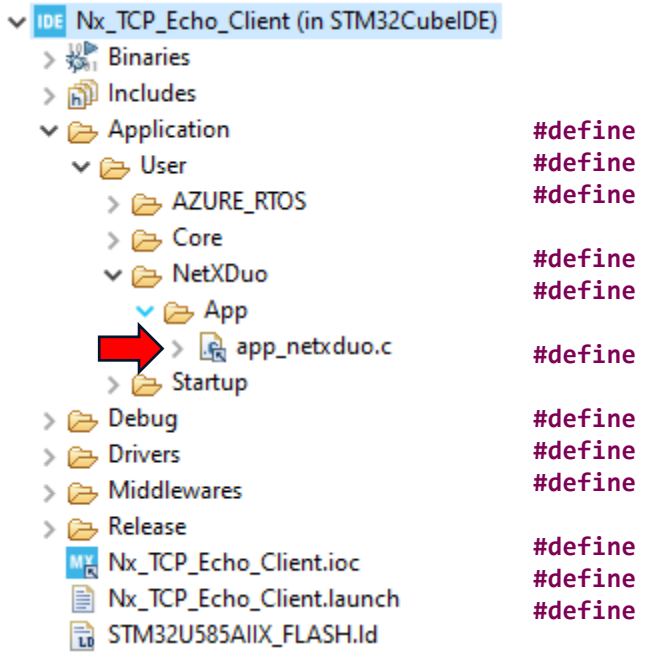

```c
static int32_t FS_FileOperations(void)
{
  FRESULT res; /* FatFs function common result code */
  uint32_t byteswritten, bytesread; /* File write/read counts */
  uint8_t wtext[] = "This is CEC's NUCLEO-G07RB working with FatFs and uSD diskio driver!";
/* File write buffer */
  uint8_t rtext[100]; /* File read buffer */

  /* Register the file system object to the FatFs module */
  if(f_mount(&SDFatFs, (TCHAR const*)SDPath, 0) == FR_OK)
  {
    /* Create and Open a new text file object with write access */
    if(f_open(&SDFile, "STM32CEC.TXT", FA_CREATE_ALWAYS | FA_WRITE) == FR_OK)
    {
      /* Write data to the text file */
      res = f_write(&SDFile, wtext, sizeof(wtext), (void *)&byteswritten);

      if((byteswritten > 0) && (res == FR_OK))
      {
        /* Close the open text file */
        f_close(&SDFile);

        /* Open the text file object with read access */
        if(f_open(&SDFile, "STM32CEC.TXT", FA_READ) == FR_OK)
        {
          /* Read data from the text file */
          res = f_read(&SDFile, rtext, sizeof(rtext), (void *)&bytesread);

          if((bytesread > 0) && (res == FR_OK))
          {
            /* Close the open text file */
            f_close(&SDFile);

            /* Compare read data with the expected data */
            if((bytesread == byteswritten))
            {
              if(Buffercmp((uint32_t *)rtext, (uint32_t *)wtext, sizeof(rtext)))
              {  /* Success no error occurrence */
                return 0;
              }
```



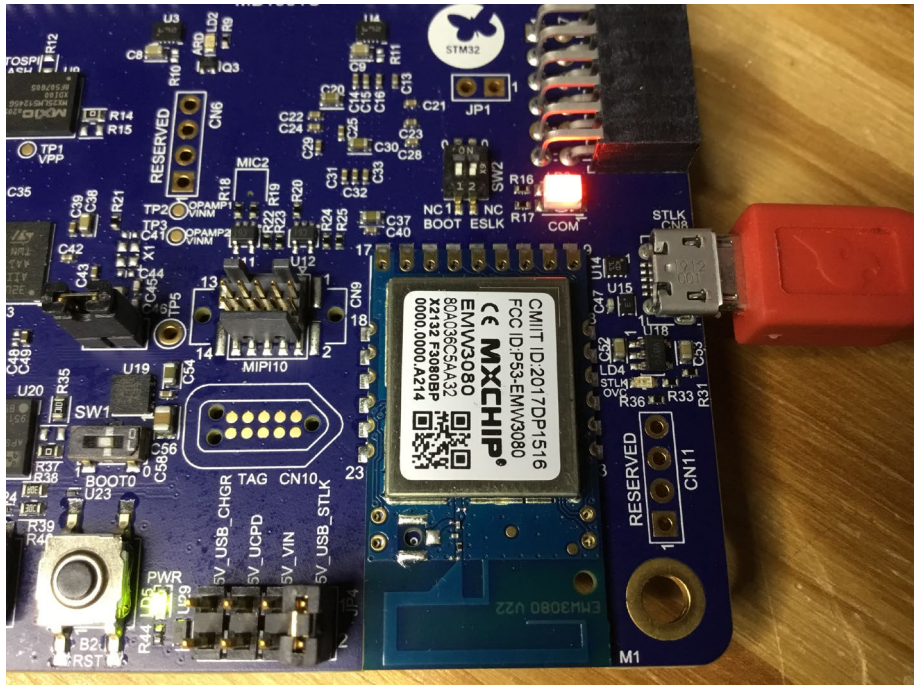
FatFs Driver: Fire It UP!!



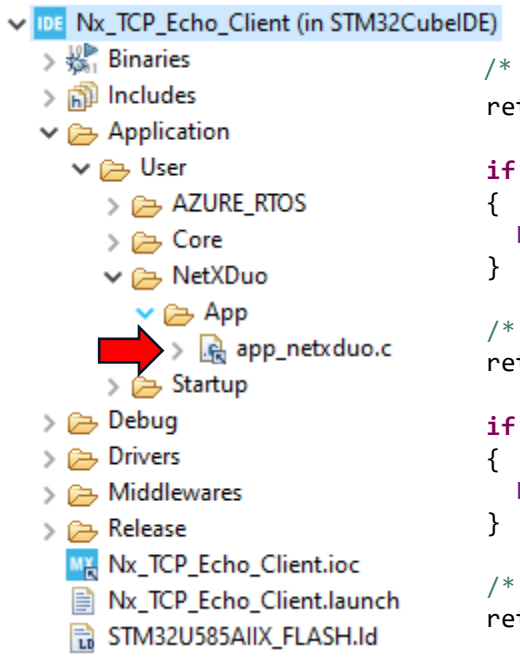
STM32U585 Nx_TCP_Echo_Client: app_netxduo.h




```
#define PAYLOAD_SIZE            1544
#define NX_PACKET_POOL_SIZE     (( PAYLOAD_SIZE + sizeof(NX_PACKET)) * 10)
#define WINDOW_SIZE             512

#define DEFAULT_MEMORY_SIZE     1024
#define DEFAULT_PRIORITY        10

#define NULL_ADDRESS            0

#define DEFAULT_PORT            6000
#define TCP_SERVER_PORT         6001
#define TCP_SERVER_ADDRESS      IP_ADDRESS(192, 168, 1, 73)

#define MAX_PACKET_COUNT        5
#define DEFAULT_MESSAGE         "TCP Client on STM32U5-IOT\r\n"
#define DEFAULT_TIMEOUT         10 * NX_IP_PERIODIC_RATE
```

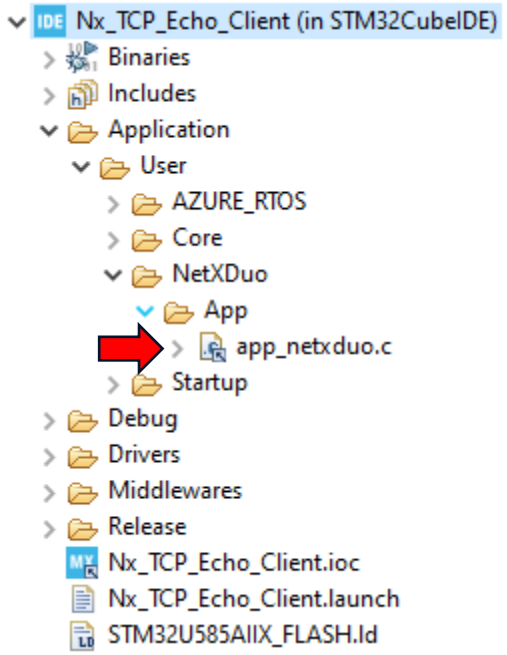


STM32U585 Nx_TCP_Echo_Client: app_netxduo.c

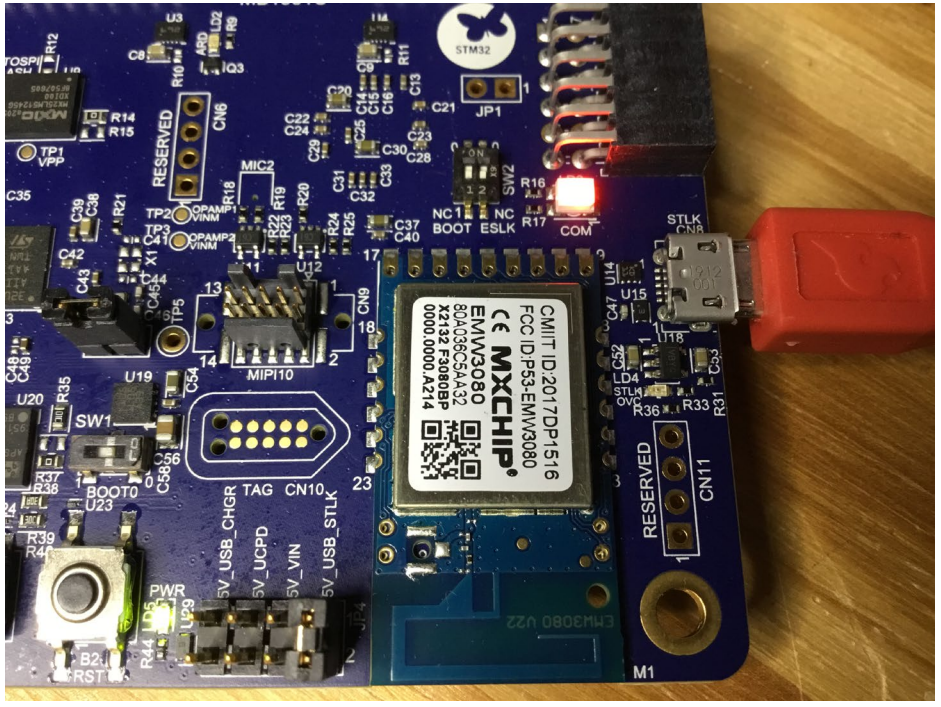



```
/* create the TCP socket */
ret = nx_tcp_socket_create(&IpInstance, &TCPSocket, "TCP Server Socket", NX_IP_NORMAL, NX_FRAGMENT_OKAY,
                           NX_IP_TIME_TO_LIVE, WINDOW_SIZE, NX_NULL, NX_NULL);
if (ret != NX_SUCCESS)
{
  Error_Handler();
}

/* bind the client socket for the DEFAULT_PORT */
ret =  nx_tcp_client_socket_bind(&TCPSocket, DEFAULT_PORT, NX_WAIT_FOREVER);

if (ret != NX_SUCCESS)
{
  Error_Handler();
}

/* connect to the remote server on the specified port */
ret = nx_tcp_client_socket_connect(&TCPSocket, TCP_SERVER_ADDRESS, TCP_SERVER_PORT, NX_WAIT_FOREVER);
```

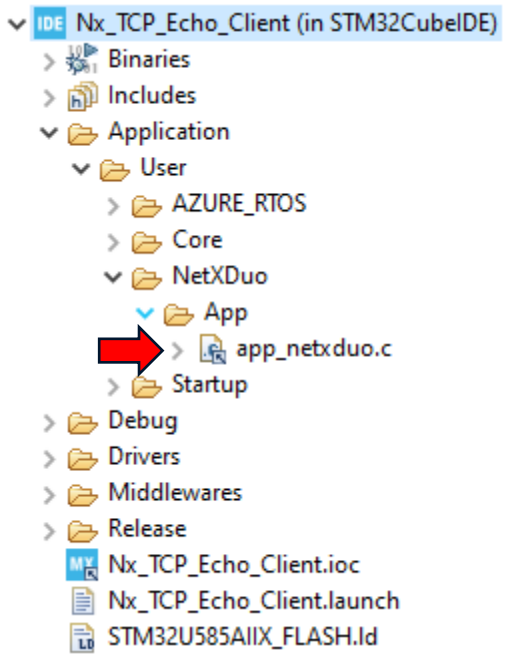
STM32U585 Nx_TCP_Echo_Client: app_netxduo.c



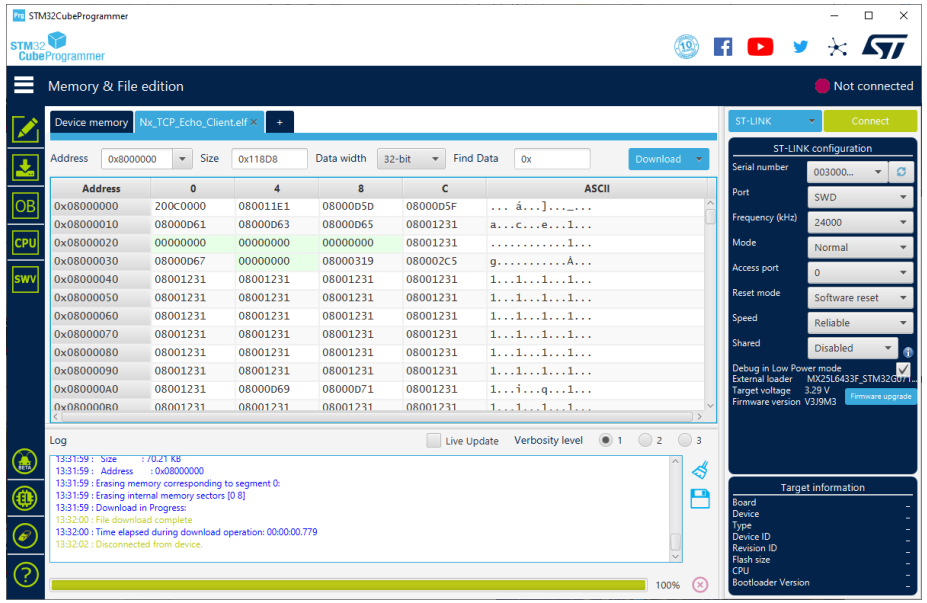

```
while(count++ < MAX_PACKET_COUNT)
{
  TX_MEMSET(data_buffer, '\0', sizeof(data_buffer));

  /* allocate the packet to send over the TCP socket */
  ret = nx_packet_allocate(&AppPool, &data_packet, NX_TCP_PACKET, TX_WAIT_FOREVER);

  if (ret != NX_SUCCESS)
  {
    break;
  }

  /* append the message to send into the packet */
  ret = nx_packet_data_append(data_packet, (VOID *)DEFAULT_MESSAGE, sizeof(DEFAULT_MESSAGE), &AppPool, TX_WAIT_FOREVER);
```



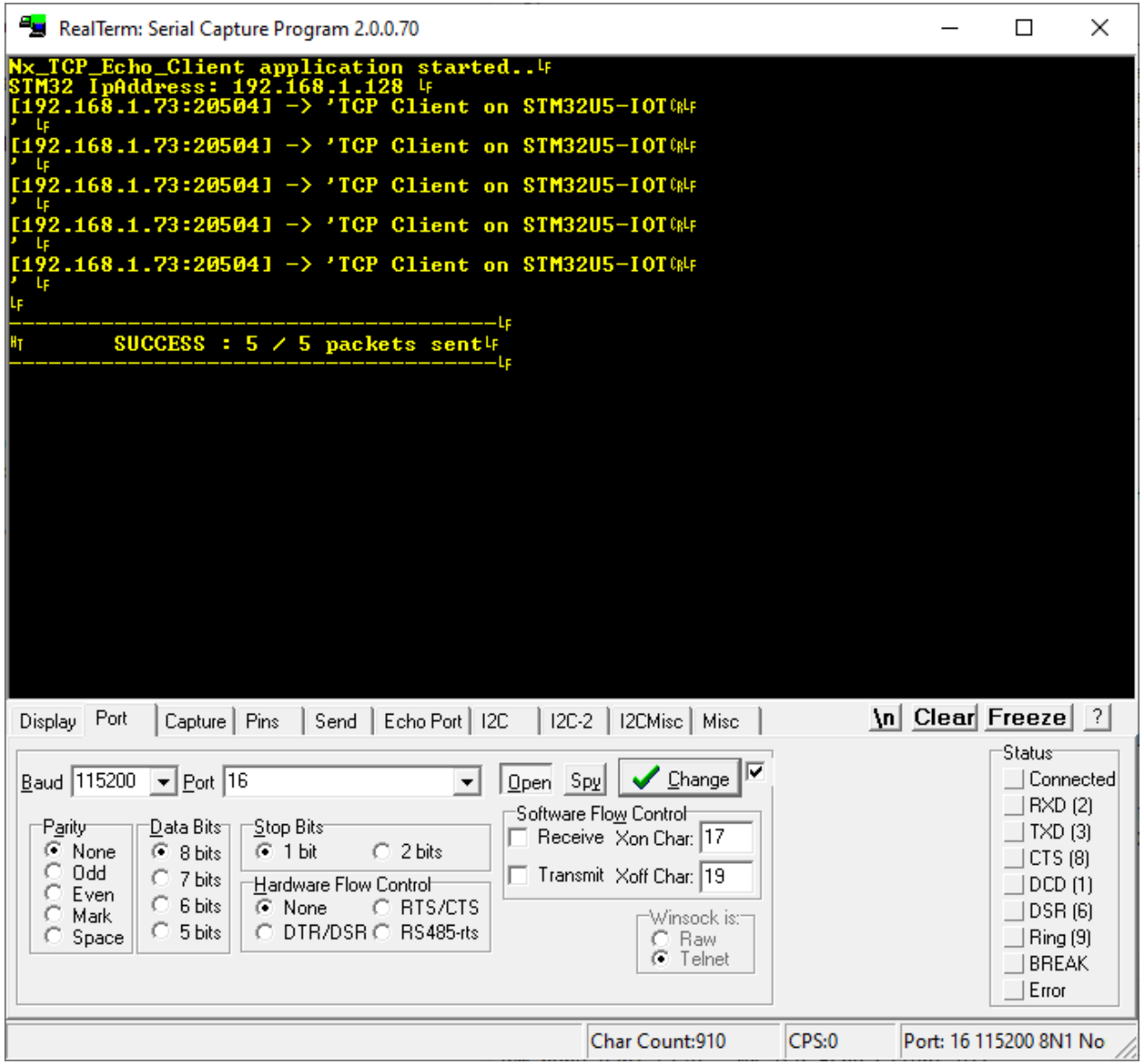
STM32U585 Nx_TCP_Echo_Client: app_netxduo.c

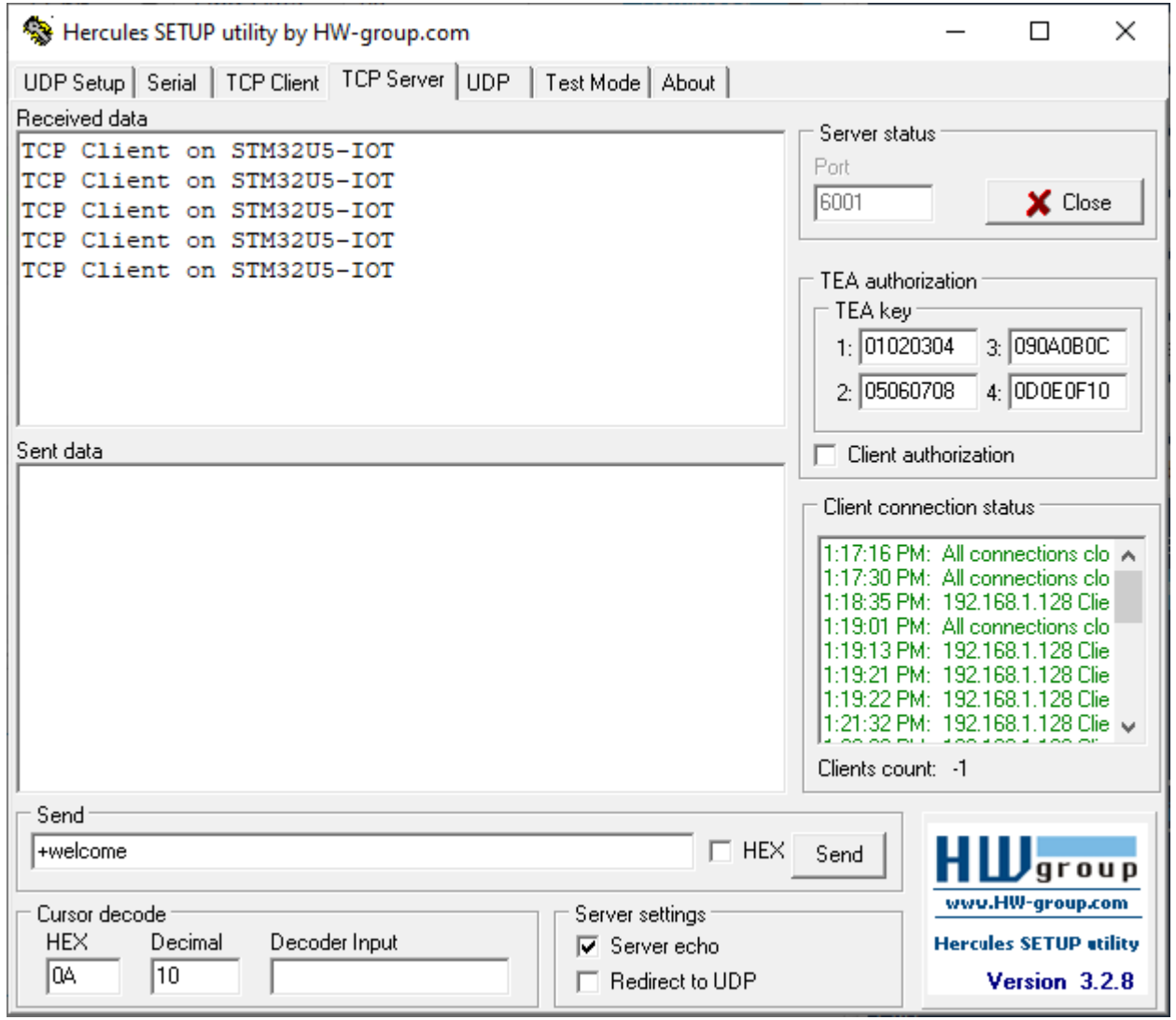



```c
/* send the packet over the TCP socket */
  ret = nx_tcp_socket_send(&TCPSocket, data_packet, DEFAULT_TIMEOUT);

  if (ret != NX_SUCCESS)
  {
    break;
  }

  /* wait for the server response */
  ret = nx_tcp_socket_receive(&TCPSocket, &server_packet, DEFAULT_TIMEOUT);

  if (ret == NX_SUCCESS)
  {
    /* get the server IP address and  port */
    nx_udp_source_extract(server_packet, &source_ip_address, &source_port);

    /* retrieve the data sent by the server */
    nx_packet_data_retrieve(server_packet, data_buffer, &bytes_read);

    /* print the received data */
    PRINT_DATA(source_ip_address, source_port, data_buffer);

    /* release the server packet */
    nx_packet_release(server_packet);

    /* toggle the green led on success */
    BSP_LED_Toggle(LED_GREEN);
  }
```



STM32U585 Nx_TCP_Echo_Client: Fire It UP!!





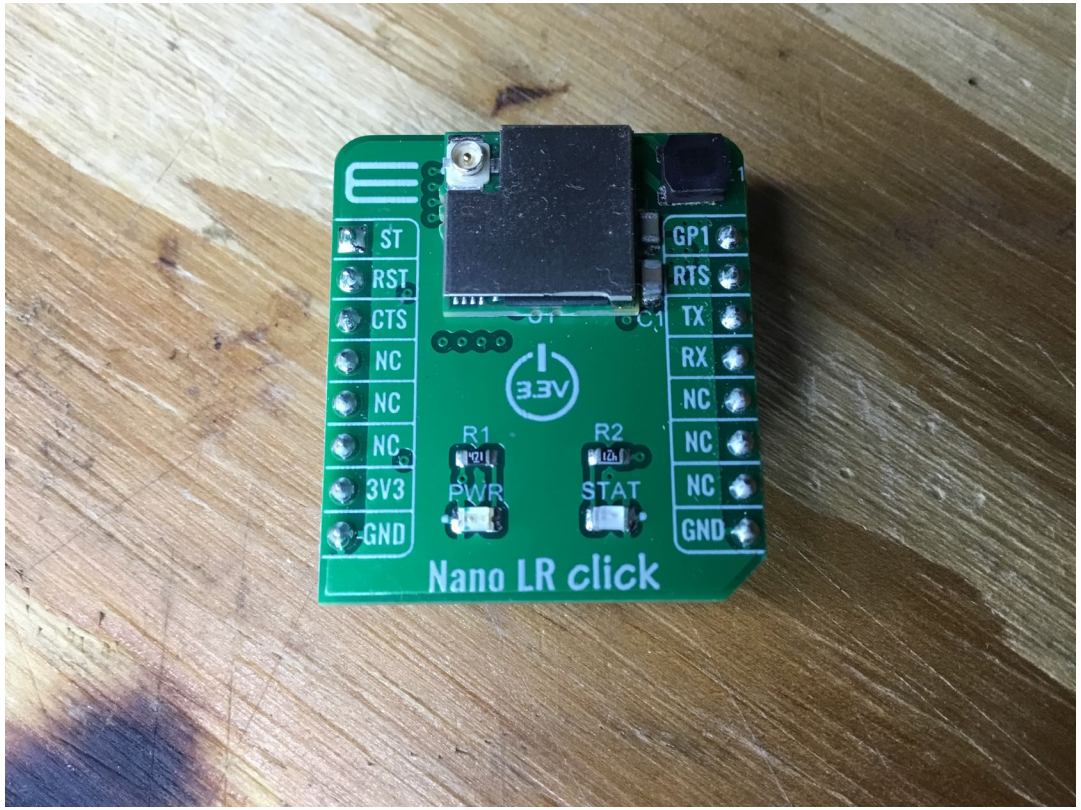
Thank you for attending!!!

Please consider the resources below:

- Today's Project Download Package
- AZURE RTOS
- FatFs

To get today's Project Download Package please send an email request to:
therealfredeady@gmail.com

MORE TO COME..



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