AN2405
Application note

Migrating from RS232-only applications to RS232/USB applications using Turbo Plus uPSD

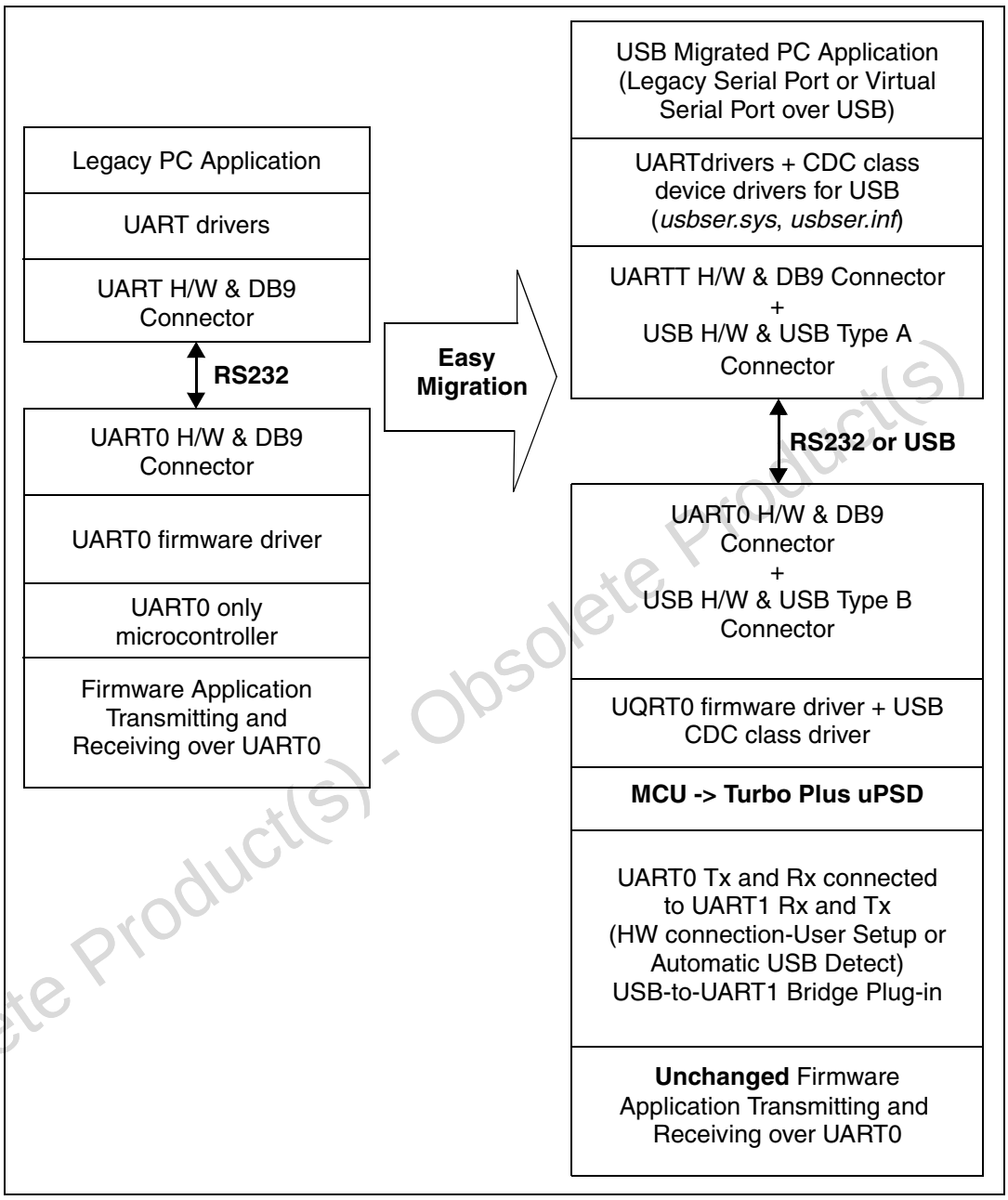
Introduction

Most laptops and recent desktops do not have serial ports however many legacy applications still use RS232. The scope of this application note is to migrate such RS232 applications to RS232/USB applications using Turbo Plus uPSD. Since Turbo Plus uPSD has two UART ports, one of them is used for the USB-to-Serial Bridge connection. The scope is to implement an easy migration with minimal impact on legacy applications.

Contents

1 Migration description

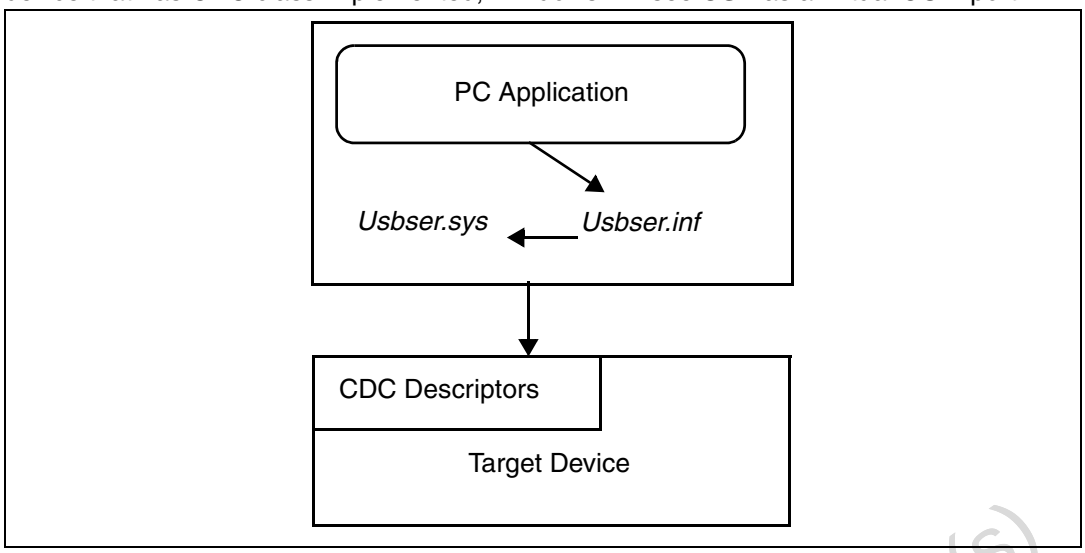
1.1 Architecture



1.2 Loading CDC class drivers for USB

Install the setup application provided with this example and the necessary CDC class drivers will be loaded on your PC. The driver installed will work with Windows 2000 & XP

only. The *.inf* file has to be modified to work with Windows 98/Me. When connected to a device that has CDC class implemented, Windows will see USB as a virtual COM port.



1.3 *.INF* file

When a USB device is connected, windows checks the *.inf* file to load the appropriate driver for the device.

Microsoft does not provide an *.inf* file with the *usbser.sys* driver file. The *.inf* file *usbser.inf* provided via the setup application allows the user to load the *usbser.sys* driver file under Windows 2000 and Windows XP. The *.inf* file has to be modified to work with Windows 98/Me.

Application manufacturers can modify this file and the device descriptors in *usb_desc.h* for their own VID & PID.

To install the drivers from a directory instead of running the provided setup application, copy the *usbser.inf* file and *usbser.sys* file to a folder. When the dialog box displaying “Found New Hardware Wizard” opens up, choose **Install from a specific location** and point to the folder where the *usbser.inf* file is copied.

Note: Do not copy the .inf file into the windows\inf folder manually.

1.3.1 Usbser.inf (Windows 2000,XP only) file:

```
[Version]
DriverVer=08/03/2004,5.1.2600.2180
Signature=$CHICAGO$
Class=Ports
ClassGUID={4d36e978-e325-11ce-bfc1-08002be10318}
Provider=%String0%

; Port Class Install
[ClassInstall]
AddReg=USBClassInstall

[USBClassInstall]
HKR,,,,%Enumerator%
HKR,,Icon,,"-23"
```

```
HKR,,Installer32,,"MsPorts.Dll, PortsClassInstaller"

[Manufacturer]
%String0%=STMicroelectronics

[ControlFlags]
ExcludeFromSelect=USB\VID_0483&PID_3420
ExcludeFromSelect=USB\VID_0483&PID_3400

[STMicroelectronics]
%String1%=STUSB, USB\VID_0483&PID_3401

; Win 2000
[STUSB]
;CopyFiles=WDM.Drvrs
AddReg=STUSB.AddReg, DevMap.AddReg

;[WDM.Drvrs]
; usbser.sys,,,0x00000020

[STUSB.AddReg]
HKR,,DevLoader,0,*ntkern
HKR,,NTMPDriver,,"usbser.sys"
HKR,,EnumPropPages32,,"MsPorts.dll, SerialPortPropPageProvider"

[DevMap.AddReg]
; HKLM, hardware\devicemap\serialcomm,COM5,,COM5

[STUSB.Services]
AddService=usbser, 0x00000002, FuncDrv_Service_Inst

[FuncDrv_Service_Inst]
DisplayName=%USBFilterString%
ServiceType= 1
StartType = 3
ErrorControl = 0
ServiceBinary = %12%\usbser.sys

[Strings]
String0="STMicroelectronics"
String1="STMicroelectronics USB Serial Emulator"
Enumerator = "USB Serial Emulator"
%USBFilterString% = "USB Serial Service"
```

1.4 CDC Firmware Driver

The device enumerates as a CDC driver and talks to the PC over USB on Virtual COM port. To be considered as a COM port, the USB device declares two interfaces:

- Abstract Control Model Communication class interface using interrupt endpoint 2(IN).
- Data Class Interface using Bulk endpoint 1(IN & OUT)

Descriptors (Device, Configuration and Interface):

```
const device_descriptor code deviceDesc =
 {
sizeof(device_descriptor),            // Size of this Descriptor in Bytes
DT_DEVICE,                            // Descriptor Type (=1)
{USB_SPEC_REV_LSB, USB_SPEC_REV_MSB}, // USB Spec Release Number in BCD
CDC_CLASS,                            // Device Class Code (CDC class code)
  0,                                  // Device Subclass Code (CDC Subclass Code)
  0,                                  // Device Protocol Code (CDC Device Protocol)
```

```
  EP0_PKT_SIZE,                          // Maximum Packet Size for EP0
 {
    VENDOR_ID_LSB, VENDOR_ID_MSB   },  // Vendor ID
 {PRODUCT_ID_LSB, PRODUCT_ID_MSB},    // Product ID
  {
   0x01, 0x02},
 0,                                     // Index of String Desc for Manufacturer
 0,                                     // Index of String Desc for Product
 0,                                     // Index of String Desc for SerNo
 1                                      // Number of possible Configurations
};

const uchar code configDesc[] =
 {
  9,                                    // Configuration descriptor length
  2,                                    // Descriptor type (configuration)
  0x43,                                 // Total length of this descriptor 2EP+Control
  0x00,
  NO_OF_INTERFACES,                     // Number of interfaces
  0x01,                                 // Configuration value (OnSetConfiguration)
  0x00,                                 // Index of string descriptor (none)
  BM_ATTRIBUTES,
  0x32,                                 // 100 mA max power consumption

//Communication class Interface Descriptor Requirement
  0x09,                                 // Descriptor length
  0x04,                                 // Descriptor type (interface)
  0x00,                                 // Number of interface
  0x00,                                 // Alternate setting
  0x01,                                 // Number of endpoints (except EP0)
  CDC_CLASS,                            // Class code - CDC class code
  ACM_VIRTUALCOM,             // Subclass - Abstract Control Model(for virtual COM)
  INTERFACE_PROTOCOL,                   // Protocol - 0(interface protocol)
  0x00,                                 // iInterface String

                                        //Header functional descriptor
  0x05,                                 //bFunctionLength
  0x24,                                 //bDescriptor type - CS_INTERFACE
  0x00,                                 //bDescriptor Subtype - Header Func Desc
  0x10,                                 //bcd CDC spec release number
  0x01,                                 //Call Management functional descriptor
  0x05,                                 //bFunctionLength
  CS_INTERFACE,                         //bDescriptor type - CS_INTERFACE
  CALL_MANAGEMENT_FN,                //bDescriptor subtype - Call Management Func Desc
  0x00,                                 //bmCapabilities D0+D1
  0x01,                                 //bDataInterface: 1
                                        //ACM Functional descriptor
  0x04,                                 //bFunction Length
  CS_INTERFACE,                         //bDescriptor type - CS_INTERFACE
  ACM_VIRTUALCOM,                       //bDescriptor subtype: ACM func desc
  0x02,                                 //bmCapabilities

                                        //Union Functional descriptor
  0x05,                                 //bFunctionalLength
  CS_INTERFACE,                         //bDescriptor type - CS_INTERFACE
  UNION_MANAGEMENT_FN,                  //bDescriptor subtype: Union func desc
  0x00,                                //bMasterInterface: Communication class interface
  0x01,                                 //bSlaveInterface0: Data Class Interface

  //Endpoint 2 descriptor
  /* EP2 */
  0x07,                                  // Descriptor length (7 bytes)
  0x05,                                  // Descriptor type (endpoint)
```

```
  0x82,                                 // Address (IN3)
  EP_ATTR_INTERRUPT,                    // Attributes-Interrupt transfer
  0x08, 0,                              // Maximum packet size
  0xFF,                                 // Polling interval-Maximum

  //Data class interface descriptor requirement
  0x09,                                 //bLength,
  0x04,                                 //bDescriptorType
  0x01,                                 //bInterface Number
  0x00,                                 //bAlternate setting
  0x02,                                 //bNumEndpoints
  DATA_CLASS_INTERFACE,                 //bInterfaceClass-Data class interface
  0x00,                                 //bInterfaceSubclass
  0x00,                                 //bInterfaceProtocol
  0x00,                                 //iInterface

//Endpoint 1 Descriptor
/* EP1-OUT */
  0x07,                                 // Descriptor length (7 bytes)
  0x05,                                 // Descriptor type (endpoint)
  0x01,                                 // Address (OUT1)
  EP_ATTR_BULK,                         // Attributes -bulk transfer
  EP1_PKT_SIZE, 0,                      // Maximum packet size
  0,                                    // Polling interval not used

 /* EP1-IN*/
  0x07,                                 // Descriptor length (7 bytes)
  0x05,                                 // Descriptor type (endpoint)
  0x81,                                 // Address (OUT1)
  EP_ATTR_BULK,                         // Attributes -bulk transfer
  EP1_PKT_SIZE, 0,                      // Maximum packet size
  0                                     // Polling interval not used
 };
```

1.5 CDC Class Requests

The firmware is required to handle the following CDC class requests:

Request	Code	Description	Req'd/Opt
SEND_ENCAPSULATED_COMMAND	00h	Issues a command in the format of the supported control protocol	Required
GET_ENCAPSULATED_RESPONSE	01h	Requests a response in the format of the supported control protocol	Required
SET_COMM_FEATURE	02h	Controls the settings for a particular communication feature	Optional
GET_COMM_FEATURE	03h	Returns the current settings for the communication feature	Optional
CLEAR_COMM_FEATURE	04h	Clears the settings for a particular communication feature	Optional
SET_LINE_CODING	20h	Configures DTE rate, stop-bits, parity, and number-of-character bits	Optional [1)]
GET_LINE_CODING	21h	Requests current DTE rate, stop-bits, parity, and number-of-character bits	Optional [1)]

Request	Code	Description	Req'd/Opt
SET_CONTROL_LINE_STATE	22h	RS-232 signal used to tell the DCE device the DTE device is now present	Optional
SEND_BREAK	23h	Sends special carrier modulation used to specify RS-232 style break	Optional

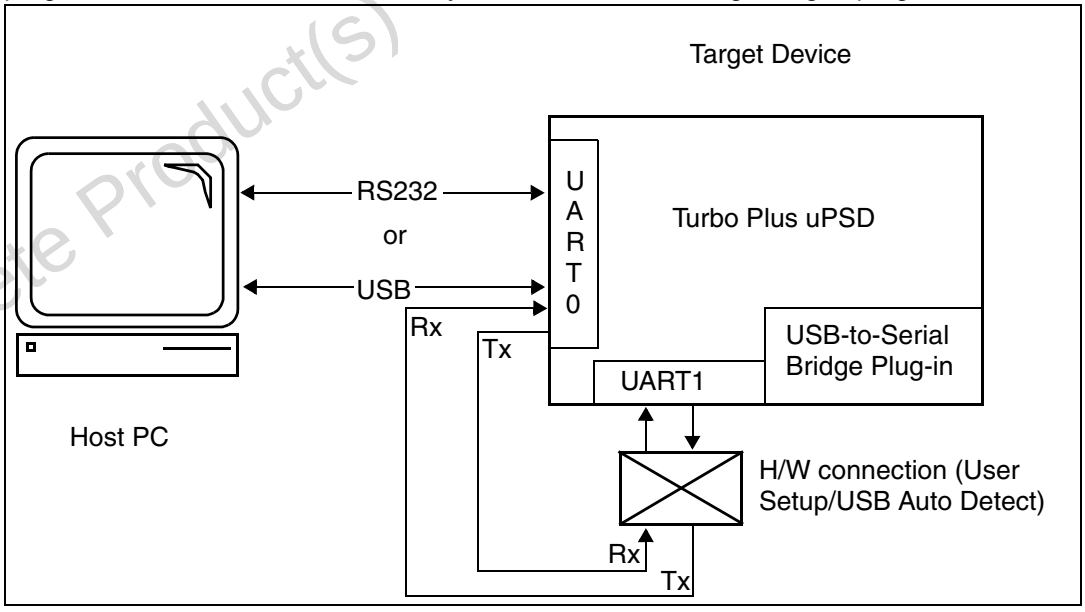
Note: 1 These requests can be used to configure the UARTs in USB-to Serial bridge implementations.

1.6 USB_UART1 Bridge (HW Connection-User setup or Automatic USB Detect)

The target MCU for the migrated application is the Turbo Plus uPSD. The Turbo Plus uPSD has two UARTs - UART0 and UART1 and a USB communication interface. The UARTs can be configured using Timer2 to operate at one of the following Kbps baud rates:

f_{OSC} MHz	Desired Baud Rate	Timer 2 SFRs		Resulting Baud Rate	Baud Rate Deviation
		RCAP2H (hex)	RCAP2L(hex)		
40.0	115200	FF	F5	113636	-1.36%
40.0	57600	FF	EA	56818	-1.36%
40.0	28800	FF	D5	29070	0.94%
40.0	19200	FF	BF	19231	0.16%
40.0	9600	FF	7E	9615	0.16%

The Tx and Rx lines of UART0 must be connected to the Tx and Rx lines of UART1 when using Virtual COM port. This will enable the data transferred over UART0 by the application program to be transferred over USB by the USB-to Serial Bridge Plug-in program.



This connection can be done by the user or can be done through automatic USB detection.

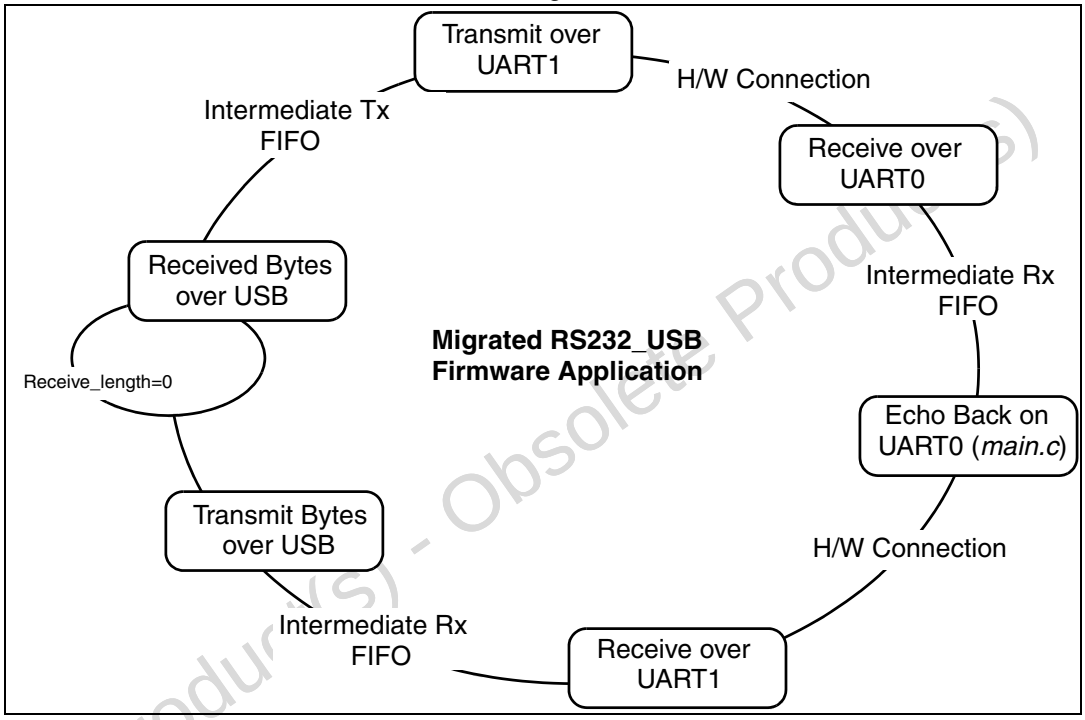
1.7 USB-to-Serial Bridge plug-in

The USB-to-Serial Bridge Plug-in is provided as a library file (upsd3400_USB-to_Serial.lib . Features of this library are:

- Small code footprint of approximately 3.5K
- Xdata memory space of 800 bytes including intermediate FIFO buffers used for transfer
- Data space of 50 bytes

1.8 Example of easy migration to RS232_USB application:

The scope is to provide an easy migration. The example application echoes back character typed and sent to Turbo Plus uPSD. All received and transmitted characters are stored in an intermediate FIFO buffer to avoid data being lost when UART is not able to handle them.



2 Conclusion

The example application is aimed at easy migration from RS232 only applications to RS232/USB applications. There is a overhead of one UART port and the firmware is not efficient in RS232 transfers. Once the reader has familiarized himself with the concepts of USB and CDC Class implementation it is recommended that he moves to implement a USB-to Serial bridge.

3 References

1. Universal Serial Bus definitions for Communication devices, Version 1.1
2. uPSD34xx-Turbo Plus Series Fast Turbo 8032 MCU with USB and Programmable Logic
3. DK3400_USB_To_Serial_Bridge_Using_UART1 firmware.

4 Revision history

Table 1. Document revision history

Date	Revision	Changes
02-Jul-2007	1	Initial release.