

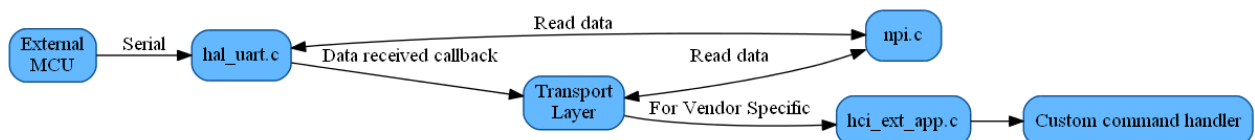
BLE HostTest Add Cmds

Introduction

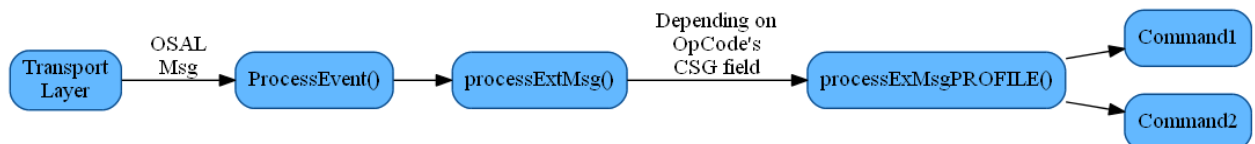
It can sometimes be useful to add one's own commands to the Network Processor project to perhaps utilize the CC2540/41's peripherals or otherwise perform remote procedure calls from an external MCU.

The below example shows how to do this, but there is no guarantee that the OpCode space used in the example will be available in later versions of the BLE stack.

External Command Data Flow



In the HostTestApp sample application, as with all projects, external commands are parsed by the TL Transport Layer lib, and the command is sent to the relevant stack module.



In the case of HCI Vendor Extended Commands, as they are not a part of the Bluetooth specified commands, these are routed to hci_ext_app.c's ProcessEvent() function as OSAL messages. See the Vendor Specific HCI Guide for more explanation on the significance of the bits in the HCI opcode.

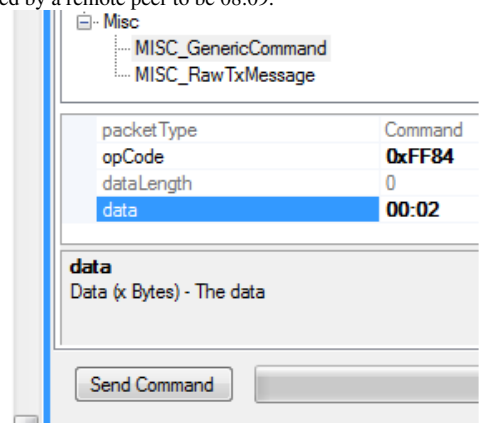
Testing the new commands

Using BTool it's easy to send custom commands by going to the Advanced Pane, then Misc and Generic Command. The image below shows how to read out the contents of Characteristic 1 of our arbitraryService. The value has been changed by a remote peer to be 08:09.

```

[175] : <Tx> - 04:59:45.594
-Type           : 0x01 (Command)
-OpCode         : 0xFF84 (Unknown Op Code) GetParam
-Data Length    : 0x02 (2) byte(s)          Characteristic 0,
Raw            : 00 02                    2 bytes
Dump(Tx):      01 84 FF 02 00 02

[176] : <Rx> - 04:59:45.644
-Type           : 0x04 (Event)
-EventCode      : 0xFF (HCI_LE_ExtEvent)
-Data Length    : 0x08 (8) bytes(s)
Event          : 0x067F (GAP_HCI_ExtentionCommandStatus)
Status         : 0x00 (Success)
OpCode         : 0xFF84 (Unknown Op Code)
DataLength     : 0x02 (2)
Raw            : 00 84 FF 02 08 09      2 bytes returned,
Dump(Rx):      04 FF 08 7F 06 00 84 FF 02 08 09      08:09
  
```



When testing this example with remote hosts, remember to configure the NWP as a peripheral

- DeviceInit as Peripheral
- Use command 0xFF81 above
- Update Advertising data (not scan response) to have contents 02:01:06 and length 3
- MakeDiscoverable
- Do whatever you want

Download

Download the below file and unzip it into <stack install>/Projects/ble.

HostTest_UserCmd.zip

This archive also includes the arbitraryService used in the example.

Code implementation

This example will show how to add some commands in the PROFILE subgroup of the HCI OpCode space. It will operate on a service - `arbitraryService` - that we will compile into the project.

Intercept PROFILE commands

By default there is no handler for PROFILE commands (Opcodes 0xFF80 to 0xFFFF), and HCI commands with these opcodes are simply discarded. We simply add an extra case in the `processExtMsg()` function in `hci_ext_app.c` that routes the command to our handler (that we will make).

```
case HCI_EXT_PROFILE_SUBGRP:
    stat = processExtMsgPROFILE( (msg.opCode & 0x007F), &msg, &rspDataLen );
    break;
```

Handle the incoming commands

It is not strictly necessary, but for clarity's sake it is useful to have some defines for the commands we wish to create. We add these defines to `hci_ext_app.h`

```
//      Commands      define      HCI_EXT_PROFILE_ADD_ARB_SVC      0x01      define
HCI_EXT_PROFILE_REG_WRT_CB 0x02 define HCI_EXT_PROFILE_SETPARAM 0x03 // 0xFF83
define HCI_EXT_PROFILE_GETPARAM 0x04 // 0xFF84
```

// An event that we will make later

```
1. define HCI_EXT_PROFILE_EVENT ( HCI_EXT_BASE_EVENT | (HCI_EXT_PROFILE_SUBGRP << 7) ) //
    0x0780
```

Once we have these defines, it's easy to do some actions based on the incoming data. The function below shows how to use the parameters sent after the opcode in the serial command. We have defined four commands to be able to manipulate a service that we have made.

- Add service (0xFF81)
- Register callback function (0xFF82), will cause remote writes to us to trigger a callback from the service to a function we make later that emits a serial event.
- Set parameter (0xFF83), allows us to change the data stored for the characteristics in the service
- Get parameter (0xFF84)

```
// Declaration static uint8 processExtMsgPROFILE( uint8 cmdID, hciExtCmd_t
*pCmd, uint8 *pRspDataLen );
```

```
static uint8 processExtMsgPROFILE( uint8 cmdID, hciExtCmd_t *pCmd, uint8 *pRspDataLen ) {
```

```
    bStatus_t stat = SUCCESS;
```

```
    *pRspDataLen = 0;
```

```
    switch( cmdID )
```

```
    {
```

```
    case HCI_EXT_PROFILE_ADD_ARB_SVC:
```

```
        stat = ArbitraryService_AddService( );
```

```
        break;
```

```
    case HCI_EXT_PROFILE_REG_WRT_CB:
```

```
    stat = ArbitraryService_RegisterAppCBs( &hci_ext_ArbitraryServiceCBs );
    break;

case HCI_EXT_PROFILE_SETPARAM:
{
    uint8 param = pCmd->pData[0];
    uint8 len = pCmd->len - 1;
    uint8 *value = &pCmd->pData[1];

    if ( len > 0 )
        stat = ArbitraryService_SetParameter( param, len, (void *)value );
    else
        stat = INVALIDPARAMETER;
}
break;

case HCI_EXT_PROFILE_GETPARAM:
{
    uint8 param = pCmd->pData[0]; // Which parameter
    uint8 len = pCmd->pData[1]; // Need to know how much to return
    stat = ArbitraryService_GetParameter( param, (void *) (rspBuf+6) );
    if (stat == SUCCESS)
        *pRspDataLen = len;
    else
        stat = INVALIDPARAMETER;
}
break;

default:
    stat = FAILURE;
    break;
}

return ( stat );
```

} Note that a CommandStatus will always be returned for these commands. The command status's Status field is determined by the value returned in *ret* above. You can also append more data to the CommandStatus event by doing as the GETPARAM example; namely changing the value of *rspBuf* (global) from the 6th offset and onwards, then setting the *pRspDataLen* accordingly. A maximum of 50 bytes can be sent this way.

Emitting an asynchronous event

Calling the HCI_EXT_PROFILE_REG_WRT_CB above will cause writes to our service to give a callback. The callback function is shown below, and it shows how to send out an event that is not CommandStatus.

```
// Local function declaration for hci_ext_app.c static void
arbitraryServiceChangeCB( uint8 paramID, uint16 len, uint16 connHandle );

// Structure used in the call to RegisterAppCBs. static arbitraryServiceCBs_t hci_ext_ArbitraryServiceCBs = {
    arbitraryServiceChangeCB
};

// Service write callback static void arbitraryServiceChangeCB( uint8 paramID, uint16 len, uint16 connHandle ) {
    // Send an event.
    uint8 msgLen = 0;
    // Build the message header first
    msgLen = buildHCIExtHeader( out_msg, (HCI_EXT_PROFILE_EVENT | 0x01), // 0x0781 event code, randomly chosen.
                               SUCCESS, connHandle ); // Always success, always conn handle 0.

    ArbitraryService_GetParameter( paramID, (void *) (out_msg + msgLen) );
    msgLen += len;

    HCI_SendControllerToHostEvent( HCI_VE_EVENT_CODE, msgLen, out_msg );
}
```

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