

How to do File Based Decoding for USB

Application Note

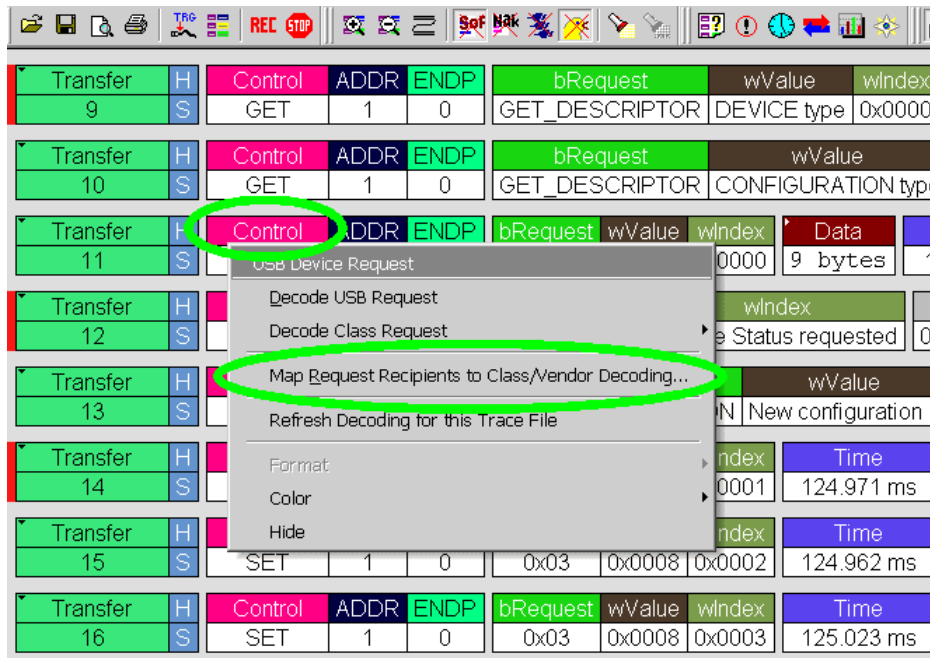
Introduction

This document shows step-by-step how to decode USB transfers associated with higher-level protocols than USB. As a pre-requisite it is assumed that the reader is familiar with the CATC Trace viewer software and is able to set the display to the transfer level.

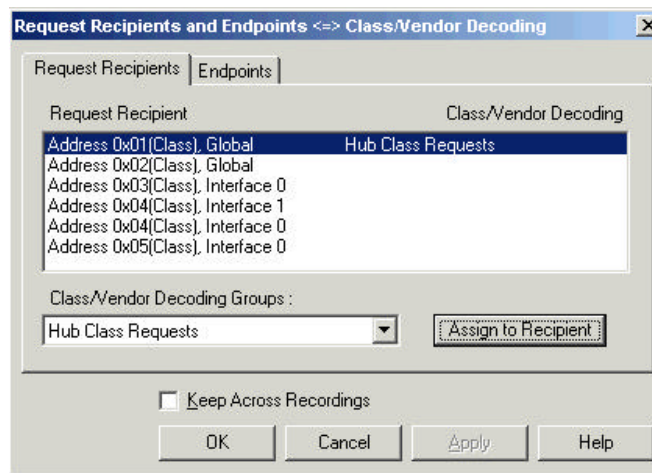
Introduction.....	1
Hub Decoding.....	2
Mass Storage Decode	5
PTP Decoding.....	8
HID Device Decoding	10

Hub Decoding

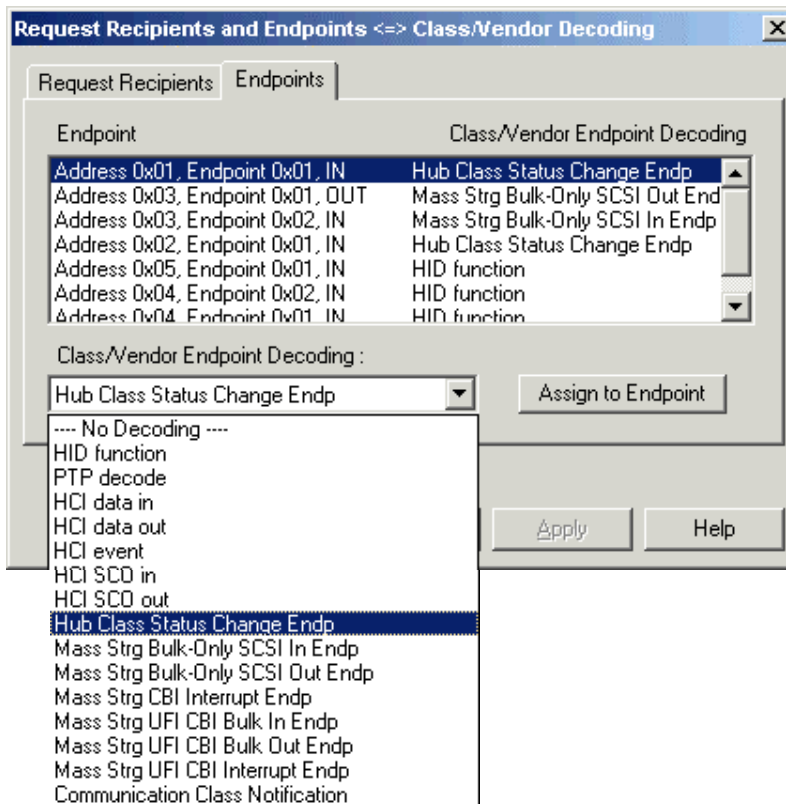
The 'trick' is to tell the software which device address was assigned to the Hub, this is likely to be Address 1, assuming that it is the first device connected to the host and nothing else has been connected to the same port since start-up before the hub. Selecting the decode-to-transfer level, then just after the hub has been enumerated you will see some control packets to that device address with bRequest fields.



If you left-click the control packet and select the option *Map Request Recipients to Class/Vendor Decoding* you can assign the device to a class and the endpoint to a control function:



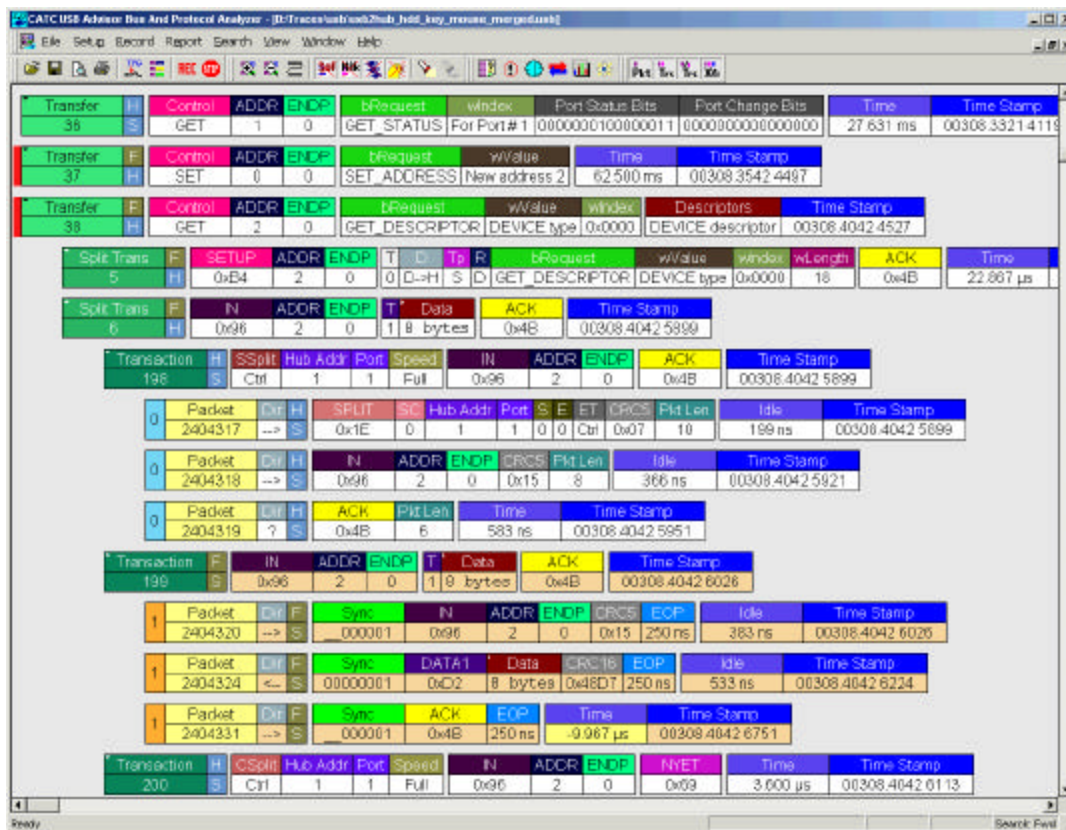
Now click *Endpoints* and assign the hub endpoint to the hub control:



I have assigned the other endpoints in the trace to other standard USB functions so they will be decoded too.

Note: You need to select the address/endpoint and the decode type and press assign—BEFORE selecting OK or Apply.

When successfully decoded then hub events will be decoded further like this:

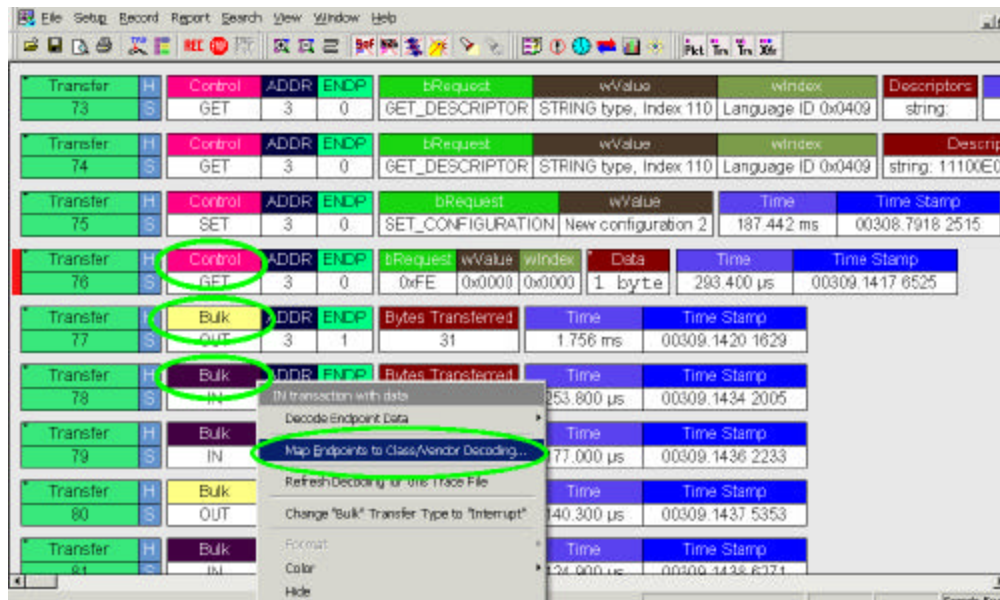


This is a USB1.1 hub connected to a USB2.0 hub connected to a USB2.0 host. Packet 36 the host asks the USB2.0 hub (address 1) for the port#1 status (this is from the map endpoint decoding) as the USB1.1 device is Full speed Transfer 37 is shown as a FullSpeed Transaction over a Highspeed link.

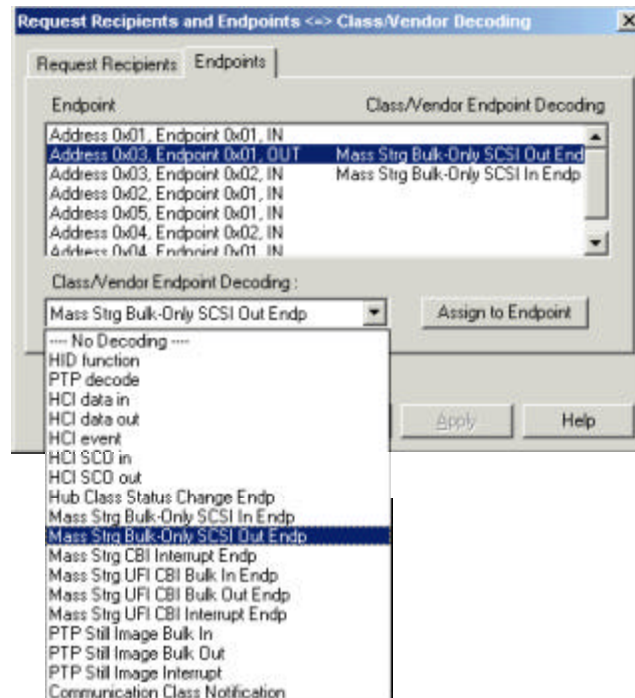
Transfer 38 is expanded to show that the USB2.0 hub is doing a store and forward using the USB2.0 split transaction system. Transaction 198 is the Host PC asking the USB2.0 hub to perform a FullSpeed IN on port#1, this was recorded on the Highspeed channel. The classic speed channel was connected to port#1 of the usb2.0 hub so the merged trace shows Transaction 199 as Full speed and we see the packets were recorded on channel 1 not channel 0. After this the host polls the usb2.0 hub to see if the FS transaction has been completed and when it has been completed, it pulls up the data across the HS link.

Mass Storage Decode

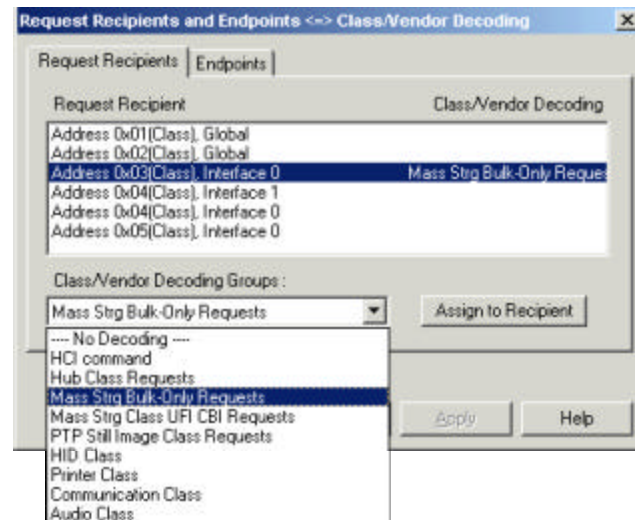
Just after the enumeration of a Mass storage device, left click the control or Bulk packet cell header associated with the mass storage device. If you click in the right place the menu will offer you the 'Map Endpoints to Class/Vendor Decoding'. Select this to assign the endpoint decoding.



Next on the dialog select Mass storage decode from the drop down list and assign it to the endpoint. On the *Endpoint* tab you will need to assign the appropriate mass-storage IN or OUT decode to the In or Out endpoint. In general, this will be the SCSI Bulk format unless it is a USB floppy in which case the UFI is more appropriate.



Similarly on the *Request Recipients* tab the device address can be assigned to the Mass Storage Bulk Class.



Note: You need to select the address/endpoint and the decode type and press assign—BEFORE selecting OK or Apply.

If the assignment is correct the transfer level display will change from:

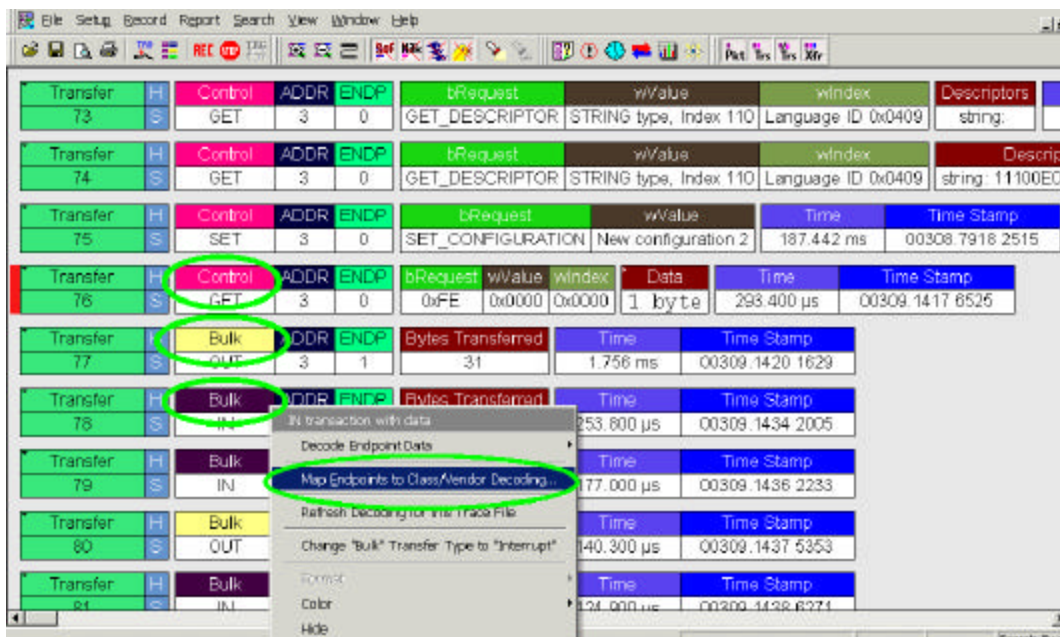
Transfer	H	Control	ADDR	ENDP	bRequest	wValue	wIndex	Data	Time	Time Stamp
76	S	GET	3	0	0xFE	0x0000	0x0000	1 byte	293.400 µs	00309.1417.6525
Transfer	H	Bulk	ADDR	ENDP	Bytes Transferred	Time	Time Stamp			
77	S	OUT	3	1	31	1.756 ms	00309.1420.1629			
Transfer	H	Bulk	ADDR	ENDP	Bytes Transferred	Time	Time Stamp			
78	S	IN	3	2	36	253.800 µs	00309.1434.2005			
Transfer	H	Bulk	ADDR	ENDP	Bytes Transferred	Time	Time Stamp			
79	S	IN	3	2	13	177.000 µs	00309.1436.2233			
Transfer	H	Bulk	ADDR	ENDP	Bytes Transferred	Time	Time Stamp			
80	S	OUT	3	1	31	140.300 µs	00309.1437.5353			

to:

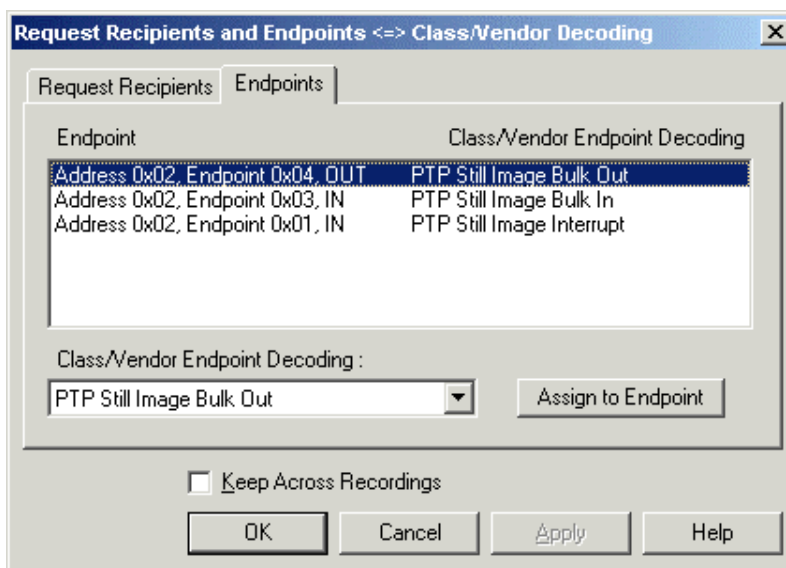
Transfer	H	Control	ADDR	ENDP	Mass Storage	Time	Time Stamp											
76	S	GET	3	0	Storage	293.400 µs	00309.1417.6525											
Transfer	H	Bulk	ADDR	ENDP	Mass Storage	CBSU In Len	SCSI CDB	INQUIRY	Time	Time Stamp								
77	S	OUT	3	1	Storage	0x00000024	00	0x00	1.756 ms	00309.1420.1629								
Transfer	H	Bulk	ADDR	ENDP	Mass Storage	INQUIRY Response	PO	Dev Typ	Part	Version	Flags(0)	Addr Len	SCSI	Flags(6)	Flags(7)	Vendor ID	Product ID	Product Rev
78	S	IN	3	2	Storage	0	0x00	0	0x00	0x01	0x1F	0x00	0x00	0x00	0x00	FUJITSU	MHNC200AT	7255
Transfer	H	Bulk	ADDR	ENDP	Mass Storage	SBSU Tag	Residual	Status	Time	Time Stamp								
79	S	IN	3	2	Storage	813A0A68	0x0	Passed	177.000 µs	00309.1436.2233								
Transfer	H	Bulk	ADDR	ENDP	Mass Storage	CBSU Tag	ReqLen	Dir	Lun	CB Len	SCSI CDB	OpCode	Data	CONTROL	Time	Time Stamp		
80	S	OUT	3	1	Storage	81406348	0xFC	In	0x0	0x0A	00	0x23	8 bytes	0x00	140.300 µs	00309.1437.5353		

PTP Decoding

Just after the enumeration of a Picture Transfer Protocol (PTP) device, left click the control or Bulk packet cell header associated with the Picture Transfer Protocol (PTP) device. If you click in the right place the menu will offer you the 'Map Endpoints to Class/Vendor Decoding' option. Select this to assign the endpoint decoding.



Next on the dialog select Picture Transfer Protocol (PTP) decode from the drop down list and assign it to the endpoint.



Note: You need to select the address/endpoint and the decode type and press assign—BEFORE selecting OK or Apply.

If the assignment is correct the transfer level display will change from:

Transfer	Host	A	F	Control	ADDR	ENDP	bRequest	wValue	Time	Time Stamp
23	PC	XP	S	SET	2	0	SET_CONFIGURATION	New configuration 1	1.284 sec	00043.5864 0163
24	PC	XP	S	Interrupt	OUT	2	4	Bytes Transferred	56.655 ms	00045.0134 1425
25	PC	XP	S	Bulk	IN	2	3	Bytes Transferred	3.333 ms	00045.0587 3217
26	PC	XP	S	Bulk	IN	2	3	Bytes Transferred	1.174 ms	00045.0614 0716
27	PC	XP	S	Bulk	IN	2	3	Bytes Transferred	557.727 ms	00045.0623 3628
28	PC	XP	S	Interrupt	OUT	2	4	Bytes Transferred	9.407 ms	00045.5085 2234
29	PC	XP	S	Bulk	IN	2	3	Bytes Transferred	678.800 μs	00045.5160 4157

to:

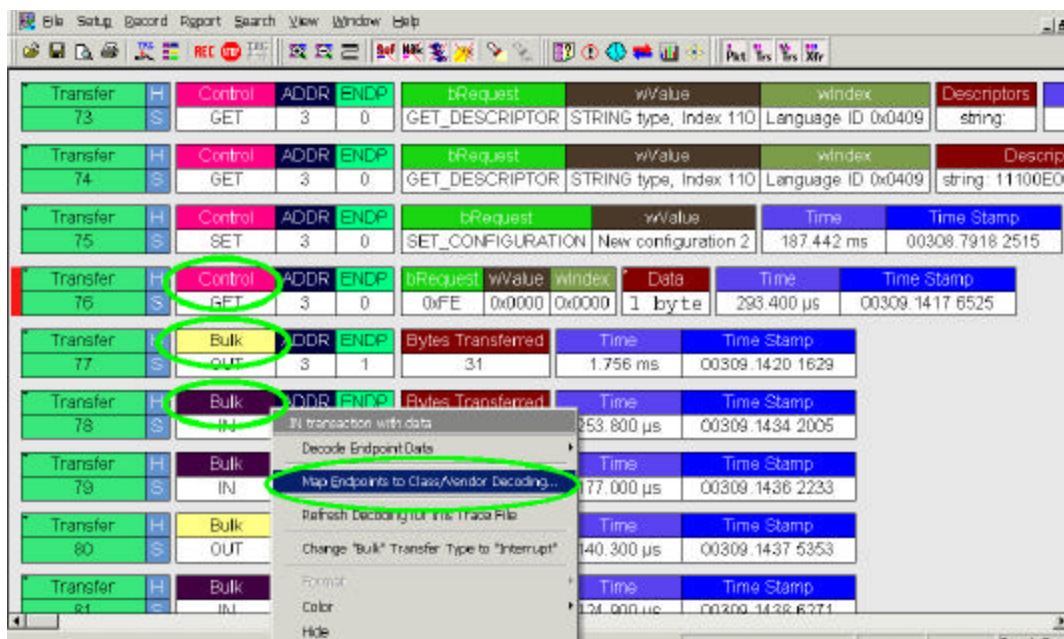
Transfer	Host	A	F	Control	ADDR	ENDP	bRequest	wValue	Time	Time Stamp
23	PC	XP	S	SET	2	0	SET_CONFIGURATION	New configuration 1	1.284 sec	00043.5864 0163
24	PC	XP	S	Interrupt	OUT	2	4	Bytes Transferred	56.655 ms	00045.0134 1425
25	PC	XP	S	Bulk	IN	2	3	Bytes Transferred	3.333 ms	00045.0587 3217
26	PC	XP	S	Bulk	IN	2	3	Bytes Transferred	1.174 ms	00045.0614 0716
27	PC	XP	S	Bulk	IN	2	3	Bytes Transferred	557.727 ms	00045.0623 3628
28	PC	XP	S	Interrupt	OUT	2	4	Bytes Transferred	9.407 ms	00045.5085 2234
29	PC	XP	S	Bulk	IN	2	3	Bytes Transferred	678.800 μs	00045.5160 4157

Operations	Events	CPS	CaptureFormats	Image	Man,Manufacturer	Model	DevVer	SerialNumber	Imp	AccessMode
Supported	Supported	0	0	Image	Nikon Corporation	E895	E895v1.2	000095222128		

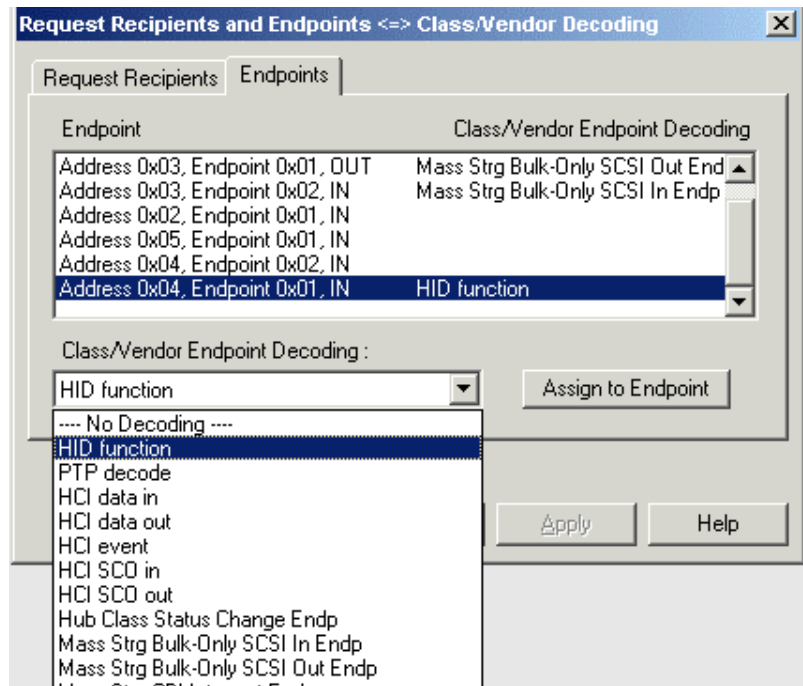
Vendor Extension information which includes:
 VendorExtensionID: 0x000A (hexdecimal)
 VendorExtensionVersion: 0x0064 (hexdecimal)
 VendorExtensionDesc: Nikon PTP Extension

HID Device Decoding

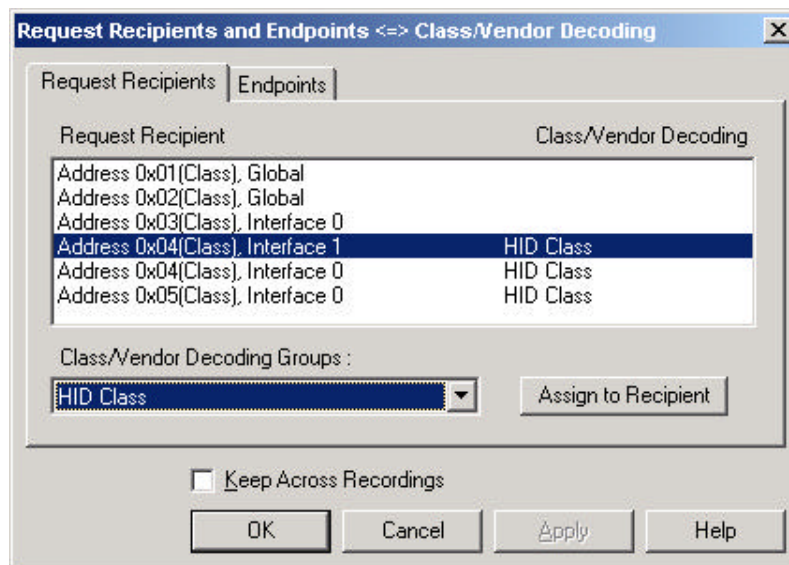
Just after the enumeration of a Human Interface Device (HID) device, left click the control or anywhere else in the trace click the packet cell header associated with the Human Interface Device(HID) device transfer. This latter will usually be an Interrupt In transfer. A menu will offer you the 'Map Endpoints to Class/Vendor Decoding' option. Select this to assign the endpoint decoding.



Next on the dialog select Human Interface Device(HID) decode from the drop down list and assign it to the endpoint.



Similarly on the Request Recipients tab the device address can be assigned to the Human Interface Device(HID) Class.



Note: You need to select the address/endpoint and the decode type and press assign– BEFORE selecting OK or Apply.

If the assignment is correct the transfer level display will change from:

Transfer	L	Control	ADDR	ENDP	bRequest	wValue	wIndex	Descriptors		
7039	H	GET	4	0	GET_DESCRIPTOR	Descriptor type 0x22, Index 0	0x0000	HID Report descriptor		
Transfer	L	Control	ADDR	ENDP	bRequest	wValue	wIndex	Data	Time	Time Stamp
7040	H	SET	4	0	0x09	0x0200	0x0000	1 byte	6.609 sec	00326.2541 7067
Transfer	L	Control	ADDR	ENDP	bRequest	wValue	wIndex	Data	Time	Time Stamp
7052	H	SET	4	0	0x09	0x0200	0x0000	1 byte	132.867 sec	00332.7415 6515
Transfer	L	Interrupt	ADDR	ENDP	Bytes Transferred	Time	Time Stamp			
7192	H	IN	4	1	8	95.980 ms	00465.6349 1591			
Transfer	L	Interrupt	ADDR	ENDP	Bytes Transferred	Time	Time Stamp			
7193	H	IN	4	1	8	239.949 ms	00465.7117 0379			
Transfer	L	Interrupt	ADDR	ENDP	Bytes Transferred	Time	Time Stamp			
7194	H	IN	4	1	8	135.971 ms	00466.1036 4847			
Transfer	L	Interrupt	ADDR	ENDP	Bytes Transferred	Time	Time Stamp			
7195	H	IN	4	1	8	727.847 ms	00466.2124 3129			
Transfer	L	Interrupt	ADDR	ENDP	Bytes Transferred	Time	Time Stamp			
7196	H	IN	4	1	8	415.912 ms	00466.7947 1429			
Transfer	L	Interrupt	ADDR	ENDP	Bytes Transferred	Time	Time Stamp			
7197	H	IN	4	1	8	119.975 ms	00467.3274 3673			

to:

Transfer	L	Control	ADDR	ENDP	bRequest	wValue	wIndex	Descriptors		
7039	H	GET	4	0	GET_DESCRIPTOR	Descriptor type 0x22, Index 0	0x0000	HID Report descriptor		
Transfer	L	Control	ADDR	ENDP	bRequest	wValue	wIndex	Report:	Time	
7040	H	SET	4	0	SET_REPORT	Output Report, Report ID 0	Interface 0	00	6.609 sec	
Transfer	L	Control	ADDR	ENDP	bRequest	wValue	wIndex	Report:	Time	
7052	H	SET	4	0	SET_REPORT	Output Report, Report ID 0	Interface 0	00	132.867 sec	
Transfer	L	Interrupt	ADDR	ENDP	HIDDev	Modifier Keys	KeyData	Time	Time Stamp	
7192	H	IN	4	1	Keyboard		c	95.980 ms	00465.6349 1591	
Transfer	L	Interrupt	ADDR	ENDP	HIDDev	Modifier Keys	KeyData	Time	Time Stamp	
7193	H	IN	4	1	Keyboard			239.949 ms	00465.7117 0379	
Transfer	L	Interrupt	ADDR	ENDP	HIDDev	Modifier Keys	KeyData	Time	Time Stamp	
7194	H	IN	4	1	Keyboard		a	135.971 ms	00466.1036 4847	
Transfer	L	Interrupt	ADDR	ENDP	HIDDev	Modifier Keys	KeyData	Time	Time Stamp	
7195	H	IN	4	1	Keyboard			727.847 ms	00466.2124 3129	
Transfer	L	Interrupt	ADDR	ENDP	HIDDev	Modifier Keys	KeyData	Time	Time Stamp	
7196	H	IN	4	1	Keyboard	<Shift>		415.912 ms	00466.7947 1429	
Transfer	L	Interrupt	ADDR	ENDP	HIDDev	Modifier Keys	KeyData	Time	Time Stamp	
7197	H	IN	4	1	Keyboard	<Shift>	C	119.975 ms	00467.3274 3673	