BBridge: Communication Interfaces Measurements

PEG-GX

Porsche Engineering
driving technologies
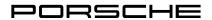
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Open points in this document

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1 Measurements

This document provides measurements done with the current BBridge software (v1.4). The timings registered were collected using a Protocol Analyzer tool (Beagle) and double-checked with an Oscilloscope. The measurements below also provide theoretical estimated values from best and worst case scenarios.

1.1   Definitions

Message in TI BLE scope = 20 bytes of application payload + 11 Bytes of Bluetooth stack headers
Message not in TI BLE scope = 20 bytes of application payload + 6 (max) for SPI/transport layer
Hardware and Software used:

- BBridge software v1.4
- TI BLE Stack 1.4.1
- Panther sample code (one and two way communication)

1.2 Results

The average time of 180ms for data round trip (measurement column E) can be decreased to the average time of 40ms (measurement column B) by decreasing the Connection Interval parameters and using 1ms ticks for application and SPI state machines. This is shown in Table 1.

The measured average time of 9ms for one way data transfer (measurement column A) matches the theoretical best case scenario calculated by analyzing the system state machines step by step. This is shown in Table 2.

#	SPI	A	B	C	D	E	
1	Prescaler	32	32	32	256	256	
2	Clock Period	384 ns	384 ns	382ns	~3us	~3us	
3	Frequency (Baud Rate)	2.6 MHz	2.6 MHz	2.6 MHz	333 KHz	333 KHz	
Bluetooth Connection Interval (x*1.25ms) (8->10ms)							
4	Min	8	8	8	8	80	
5	Max	8	8	8	8	80	
Application "Tick" times (Panther side)							
6	SPI-related works	1ms	1ms	1ms	1ms	1ms	
7	APP State machine	1ms	1ms	10ms	10ms	10ms	
Time to receive feedbacks after a TX command is given to the BBridge API							
8	Transp. Layer ACK	2ms	2ms	2ms	2ms	~2ms	
9	Comm. Layer ACK: SEND CMD ACK	~4ms	4ms	4ms	4ms	~4ms	
10	Time needed for the Bluetooth Transfer	1-10 ms	1-10ms	1-10 ms	1-10 ms	1-100 ms	
11	Average time to receive TX complete ACK	~6ms	~6ms	~6ms	~6ms	~90ms	
Panther sample code							
12	Two way: Round Trip Time		~40ms	~60ms	60ms	180ms	Average time to receive messages
13	One way: TX/RX only	~9ms					Average time to receive TX complete messages

Table 1 – Configuration and timing measurements

1.2.1 Timing calculation

Scope	Module	Best case	Worst case
Panther	**Panther Main** (1ms State Machine Tick)	1ms	2ms
Panther	**Transport Layer** (1ms State Machine Tick)	5ms	15ms
Panther	**SPI Driver** (1ms State Machine Tick)	1ms	3ms
BBridge	**BBridge APP** (System Clock State Machine Tick)	~1ms	1ms
TI BLE	**BLE Stack**	1ms	10ms
Timings calculated		~9ms	~31ms

Table 2 – Execution scope and timing estimates: Time to transfer a single message over the Bluetooth channel (without round trip)

Configuration values considered:
- Connection Interval = 10ms
- Panther sample code = one way mode
- SPI Frequency: 2.6MHz
- SPI-related tick works (Panther side): 1ms
- Application tick works (Panther side): 1ms