

Sena Technologies White Paper:

Latency/Throughput Test
of
Bluetooth-Serial Adapters

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What is Latency?

In general, latency can be described as an expression of how much time it takes for a packet of data to get from one designated point to another. Some may also view latency as a measurement of how much time it takes to send a packet that is returned to the sender or what we call “round-trip time”.

What is Throughput?

Throughput can be described as expression of how much amount of data is sent or transacted during a defined period of time. It depends on the speed and message size.

How are Latency / Throughput Measured?

As it was stated earlier, Sena Technologies is committed to providing highly scalable and cost effective network solutions to the ever changing network and communication environment. We here at Sena Technologies view latency as the time it takes to send one character from a host application to the Bluetooth serial adapter and back again to the host application, or “round trip time” (Due to the variance in different operating system architecture latency measurement times may vary). We also view throughput as the amount of the data sent to and received from the Bluetooth serial adapter. Testing for latency and throughput was done in-house by Sena with the full line of Sena Bluetooth products. Figure 1 shows how Sena carried out its testing methodology for the Bluetooth-serial adapters.

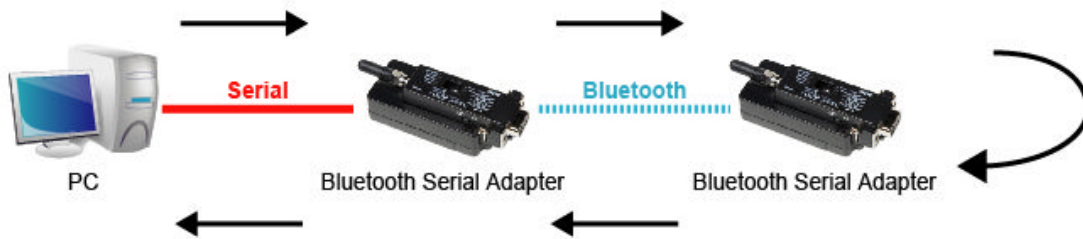


Figure 1: Test System Configuration for Bluetooth-Serial Adapter

The test program (written in Visual C++) sends a packet, consisting of one byte of data, over serial line and Bluetooth, to a remote Bluetooth serial adapter where the data is echoed back to the host PC. A loop-back plug that connects the RS-232 Tx data pin to the Rx data pin was used to echo back the data sent by the host pc. Latency time was measured by the time it takes for the one byte of data to be sent by the Host PC to the Bluetooth serial adapter and back again to the Host PC. For throughput test, the test program sends certain amount of data, measures the time it takes to receive all data and calculates the received data per second in bps. Table 1 displays the parameters that were set to each of the serial ports before testing.

	Performance Test	Latency Test
Baud rate	All the baud rate	9600bps
Data Bits	8bit	
Parity	None	
Stop Bits	1bit	
Flow Control	Hardware Flow Control	
Inter Character Time-out	0ms	
Others	Data Size : Refer to Table 3: Data Size for Throughput Test	Number Of Iteration : 10000 Data Size : 1 byte

Table 1: Latency / Throughput Test Parameters

PC SPECIFICATIONS	
Processor	Intel® Pentium®4 CPU 3.00GHz (2 CPUs)
RAM	1024MB
Operating System	Microsoft Windows XP Professional (5.1, Build 2600)
Network Adaptor	Marvell Yukon 88E8001/8003/8010 PCI Gigabit Ethernet Controller

Network Nodes		
Network Node	Vendor	Connection
NETGEAR FS2108	NETGEAR	10/100Mbps
Marvell Yukon 88E8001/8003/8010 PCI Gigabit Ethernet Controller	Marvell	10/100Mbps

Table 2: Hardware Used in the Test

Baudrate	Data Size(Kbyte)	Baudrate	Data Size(Kbyte)
75	2	4800	140
150	4	9600	284
200	6	19200	569
300	9	38400	1139
600	18	57600	1710
1200	35	115200	3420
1800	53	230400	6966
2400	70		

Table 3: Data Size for Throughput Test

Category	Product Name	Firmware Version	Specification
Bluetooth-Serial Adapter	Parani_SD100	v1.1.4	Bluetooth Class 1
	Parani_SD200	v1.1.4	Bluetooth Class 2
	Parani_ESD100	v1.1.4	Bluetooth Class 1
	Parani_ESD200	v1.1.4	Bluetooth Class 2
	Parani_ESD1000	v1.0.1	Bluetooth Class 1

Table 4: Products List

Latency Test Results

Final test results are shown in Table 5 and 6. Table 5 displays the latency time of a native RS232 serial port. Table 6 displays the latency time of the Bluetooth-serial adapters.

Product		Latency (ms)
Name	Methodology	
COM1	RS232 Serial Port	5.51

Table 5: Latency Test Result of Native Serial Port

Product		Single Port (ms)
Name	Methodology	
Parani-SD100	RS232 Serial Port / Bluetooth	43.05
Parani-SD200	RS232 Serial Port / Bluetooth	43.95
Parani-ESD100	RS232 Serial Port / Bluetooth	42.14
Parani-ESD200	RS232 Serial Port / Bluetooth	42.82
Parani-ESD1000	RS232 Serial Port / Bluetooth	59.02

Table 6: Latency Test Result of Bluetooth-Serial Adapters

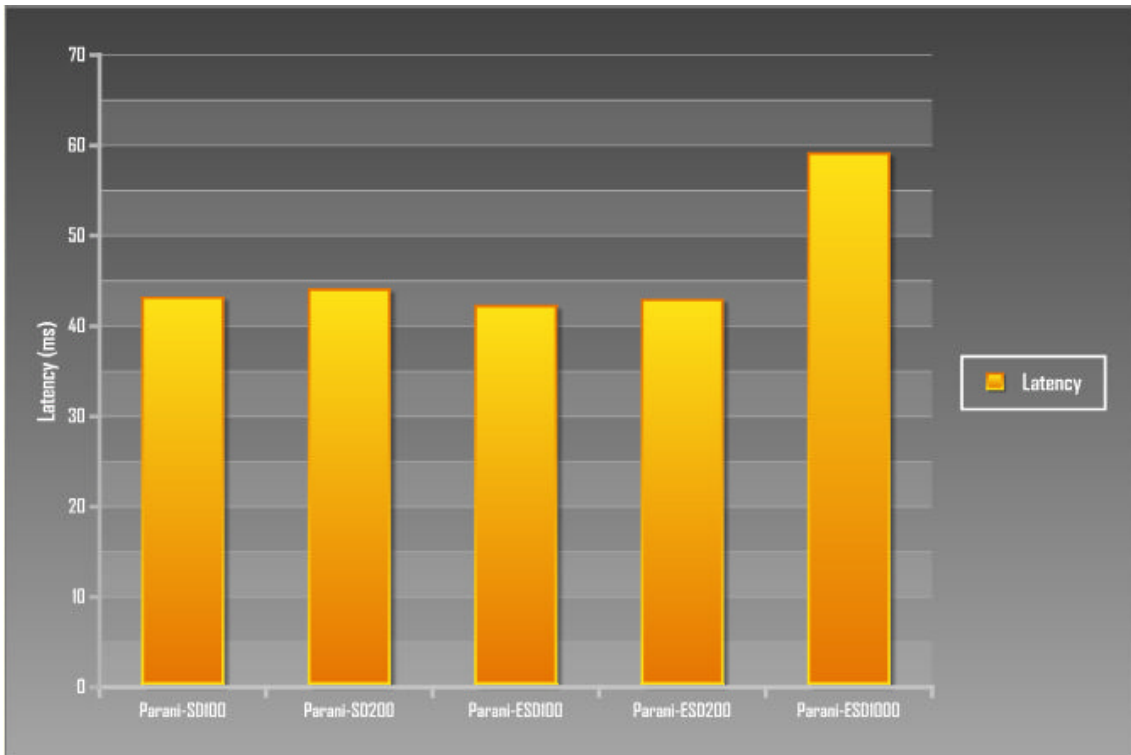


Figure 2: Latency Test Result

Throughput Test Results

Final test results are shown in Table 7 and Figure 3.

Status	Parani-SD100		Parani-SD200		Parani-ESD100		Parani-ESD200		Parani-ESD1000	
Baud rate (bps)	Average Baudrate (bps)	Average Baudrate (%)	Average Baudrate (bps)	Average Baudrate (%)	Average Baudrate (bps)	Average Baudrate (%)	Average Baudrate (bps)	Average Baudrate (%)	Average Baudrate (bps)	Average Baudrate (%)
75	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
150	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
200	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
300	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
600	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1200	983.35	81.95	995.17	82.93	983.22	81.94	994.48	82.87	1195.48	99.62
1800	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2400	2011.80	83.83	2032.22	84.68	2001.19	83.38	2024.68	84.36	2395.08	99.79
4800	4395.44	91.57	4371.14	91.07	4416.81	92.02	4400.50	91.68	4794.41	99.88
9600	9082.66	94.61	9043.40	94.20	9103.99	94.83	9030.68	94.07	9480.09	98.75
19200	18849.53	98.17	18826.69	98.06	18895.38	98.41	18858.13	98.22	19178.11	99.88
38400	37795.16	98.42	37734.02	98.27	37756.99	98.33	37787.57	98.41	38181.81	99.43
57600	56434.01	97.98	55824.10	96.92	56690.89	98.42	56289.42	97.72	57037.13	99.02
115200	79655.00	69.14	77578.85	67.34	78870.17	68.46	79123.56	68.68	73421.18	63.73
230400	80332.90	34.87	81188.63	35.24	72162.87	31.32	84193.69	36.54	77363.82	33.58
460800	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	93508.01	20.29

Table 7: Throughput Test Result of Bluetooth-Serial Adapters

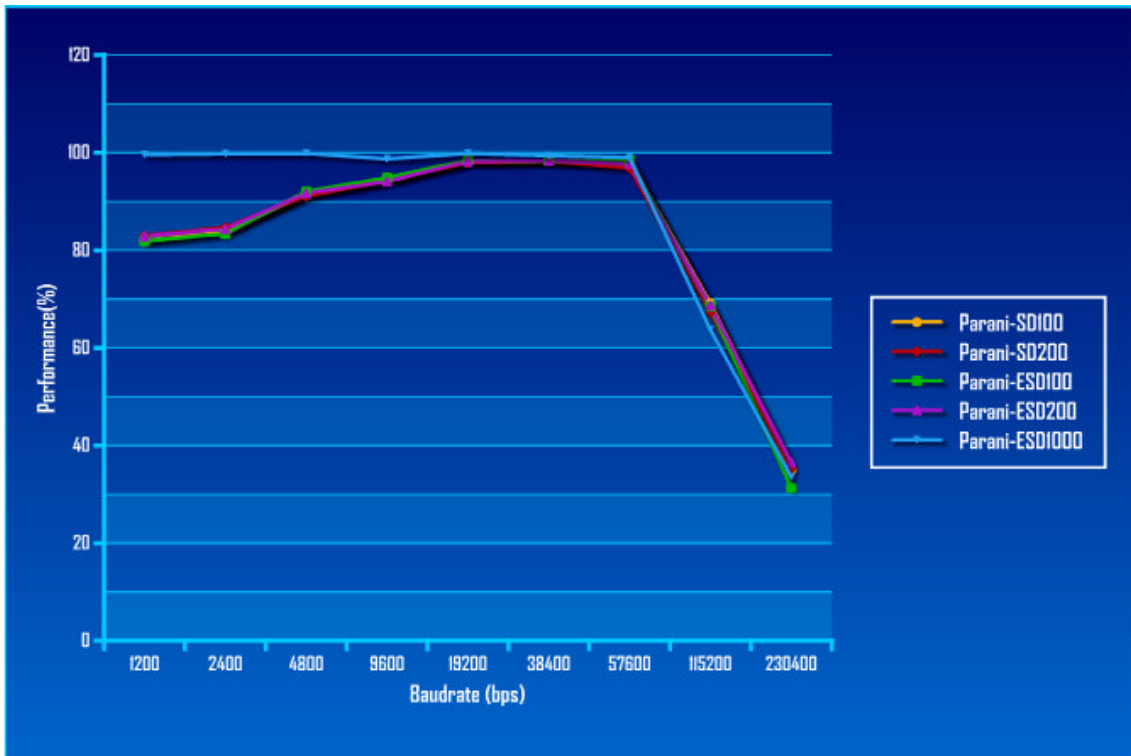


Figure 3: Throughput Test Result of Bluetooth-Serial Adapters