The Benefits of UART with Deep FIFO

for SystemBase's the Enhanced UART Core, SB16C105x

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**Document Information**

Information	Content
Abstract	This document let you know about the benefit of UART with Deep FIFO.
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1. Overview

Since UART offer more functions after their coming out, FIFO sizes of UART are also increased more and more. In this application note, we are going to explain how the size of FIFO influences to systems. Our company made a 16 ports serial card composed of Octal-UART with 256-Byte FIFO, SB16C1058 which is developed recently; we'll report how the function of serial card are improved
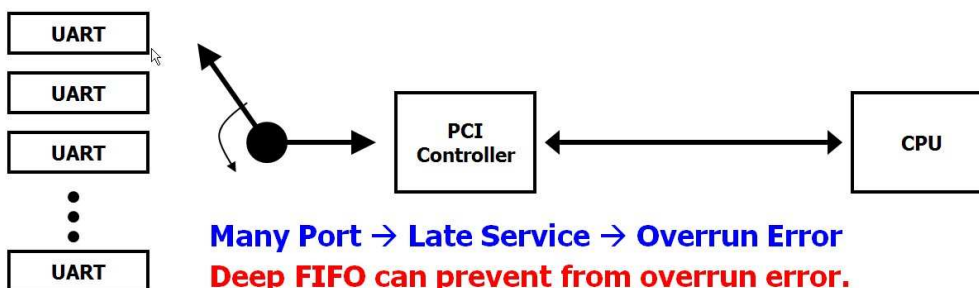

2. Deep FIFO

UART is a communication controller which operates slowly compared to CPU. So UART has FIFO memory in their internal circuit to reduce service time of CPU. If there is no internal FIFO, CPU must service UART, whenever UART transfers/ receives one byte to/from CPU. This phenomenon indicates that CPU can't do other work reducing performance of system. To improve performance of serial communication system, FIFO sizes are broadening more and more.
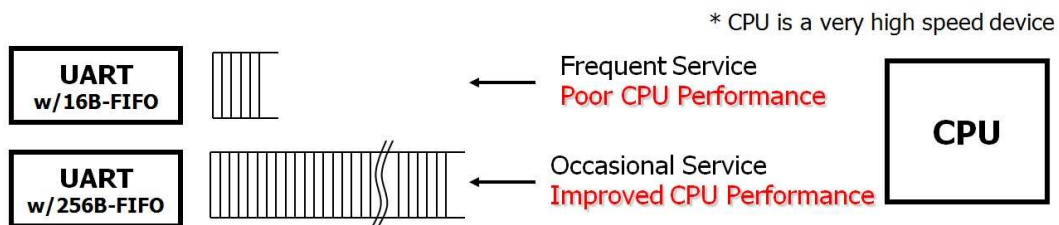
**256-byte FIFO reduces CPU overhead
and allows higher data rates and data throughput.**

When developing serial communication systems, the case to need many serial channels would be happens. Serial Multiport and Device server are the good example.

As the bellow diagram, the many UART channels are existed, the more performances of CPU are needed on account of servicing to UART channels. So the performance of system is decreased when a CPU have many serial channels to deal with. Moreover CPU may need much time to service to UART channels when the baud rate is faster. Because interrupts happens frequently when the baud rate is faster.

**Many Port → Late Service → Overrun Error
Deep FIFO can prevent from overrun error.**

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If CPU has to service to many UART channels, some UART channels might have FIFO of full data during waiting CPU services. This crisis situation causes Overrun Error which is induced by Overwriting to full FIFO. However, if UART has broad size FIFO, Overrun Errors are prevented since there are many space to store data during servicing of channels. This is crucially important in multi-channel communication system.

3. The Statistics of Deep FIFO Effect

To test above descriptions, we made two types of 16 ports Serial Card. One adopted SB16C554A which has 16-byte FIFO. Another adopted SB16C1058 which has 256-byte FIFO. We compare the throughput and CPU usage rate between two multi channel serial cards.


Multi-16C/PCI using SB16C554A
with 16-byte FIFO

Multi-16C/PCI using SB16C1058
with 256-byte FIFO

## 3.1 Comparative table of the throughputs between 16B and 256B FIFO.

Baud Rate	SB16C1058 (256-byte FIFO)	SB16C554 (16-byte FIFO)
1200 bps	120 cps	120 cps
2400 bps	240 cps	240 cps
4800 bps	480 cps	480 cps
9600 bps	960 cps	960 cps
19200 bps	1920 cps	1905 cps
38400 bps	3840 cps	3400 cps
57600 bps	5740 cps	5000 cps
115200 bps	10500 cps	7000 cps
230400 bps	18500 cps	9300 cps
460800 bps	27000 cps	10800 cps
921600 bps	29000 cps	11500 cps
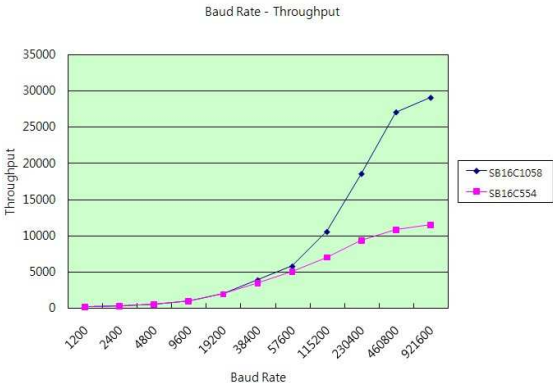
As we can see above data, we can find there is great difference of the throughput in high baud rate. When the baud rate is increased, the multi-channel serial card have Overrun Errors. However, Overrun Error is decreased greatly if the multi-channel Serial Card use UART with deep FIFO included broad FIFO size.

3.2 The comparative table of the CPU usage between 16-byte FIFO and 256-byte FIFO.

Baud Rate	SB16C1058 (%)	SB16C554 (%)
9600 bps	1.802	16.494
19200 bps	4.935	27.631
38400 bps	5.23	69.316
57600 bps	12.341	78.707
115200 bps	21.126	72.888
230400 bps	29.129	85.586
460800 bps	57.342	89.289
921600 bps	71.892	90.052
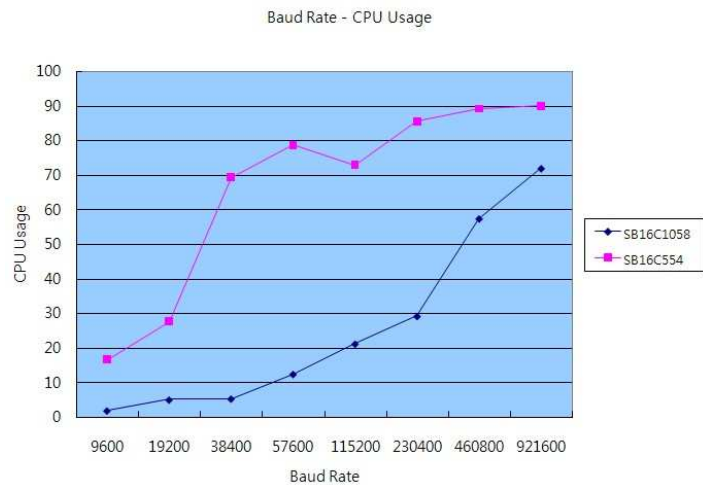
As we can see upper data, when the baud rate is increased, the CPU usage can be bigger. But the enhanced UART with deep FIFO can make more efficient systems.

4. Conclusions

Now SystemBase offers the best scalability in serial communication industry and have UART with the largest FIFO.

If you want to develop serial multi-channel communication system with high performance, it is best solution to select Systembase semiconductor.

SystemBase's UART with Deep FIFO provides bellow features.

- CPU Usage is decreased so that system performances get raised.
- The throughput of serial communication is better.
- Overrun Error can be decreased.

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