The Benchmark Test Results of QNX RTOS

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1. Introduction

A Real-Time Operating System(RTOS) is an Operating System(OS) intended for real-time applications. Benchmarking is a point of reference by which something can be measured. The QNX is a Real Time Operating System(RTOS) developed by QSSL(QNX Software Systems Ltd.) in Canada. The ELMSYS is the brand name of commercially available Personal Computer(PC) for applications such as Cabinet Operator Module(COM) of Digital Plant Protection System(DPPS) and COM of Digital Engineered Safety Features Actuation System(DESFAS). The ELMSYS PC Hardware is being qualified by KTL(Korea Testing Lab.) for use as a Cabinet Operator Module(COM). The QNX RTOS is being dedicated by Korea Atomic Energy Research Institute (KAERI). This paper describes the outline and benchmarking test results on Context Switching, Message Passing, Synchronization and Deadline Violation of QNX RTOS under the ELMSYS PC platform.

2. Benchmark Methods and Results

2.1 Methods of Benchmarking

Benchmarking is a systematic comparison of organizational processes and performance to create new standards or to improve upon current processes.
There are four types of benchmarking methods

a. Internal (benchmark within a corporation, for example between business units)
b. Competitive (benchmark performance or processes with competitors)
c. Functional (benchmark similar processes within an industry)
d. Generic (comparing operations between unrelated industries)

Main elements of customer service and their relative importance from FUNATIONAL methodology were selected for benchmarking. One of the special tests on dedication methodology of QNX RTOS was selected, a benchmarking test, for functional and performance measurements. According to the special test plan and test procedure, benchmark test, items were selected. Benchmark test among selected test items were executed as a special test under ELMSYS PC platform and QNX RTOS testing environment.

2.2 Test Items for Benchmarking

First of all, safety features test such as priority inversion/inheritance and deadlock have been done prior to begin of these tests(Reference No 1). Four major test items such as Context Switching, Message Passing, Synchronization and Deadline Violation were selected for functional requirements and performance requirements as shown in Table 1.

Table 1. Test Items of Benchmarking

Critical Characteristics	Test Items	Results/ Unit: us(micro second)
1. Context Switching	1.1 Yield	0.541
	1.2 Yield(Inter-thread)	0.539
	1.3 Yield(Inter-process)	0.930
2. Message Passing	2.1 No data	1.413
	2.2 Reply Data	1.610
	2.3 Send Data	1.781
	2.4 Send+Reply Data	1.988
3. Synchronization	3.1Mutex	0.710/0.947 [Min/Max]
	3.2Pulse Message	0.363/0.405 [Min/Max]
	3.3 Semaphore	0.779/2.800 [Min/Max]
4. Deadline Violation	4.1 Test-#1	2.0
	4.2 Test-#2	1.0
	4.3 Test-#3	0.9

2.3 Benchmarking Test Results

Context switching operations are frequent in a real time operating system under hardware interrupt, priority scheduling, and the manipulation of synchronization etc. An efficient context switching mechanism is very important to overall system performance. There were satisfied the testing about Yield(self), Yield(inter-thread, inter-process) as shown in Figure1. Message passing is a method of communication where messages are sent from a sender to one or more recipients. Figure 2 are message-passing facilities as core primitives. Four test

items are used, which are no data, send data, reply data, send+reply data with various message size.

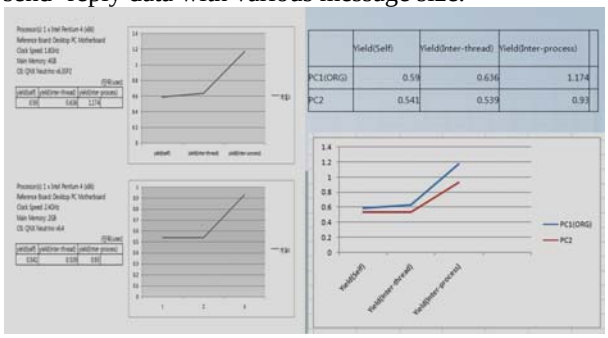

Figure 1. Context Switching

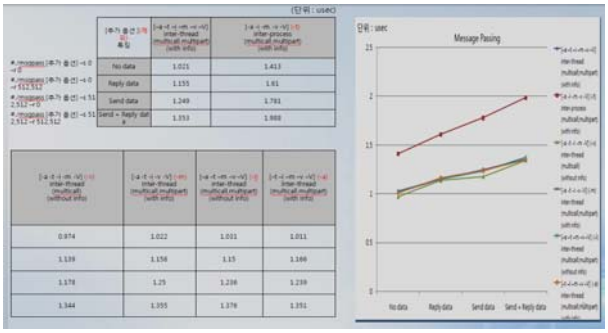

Figure 2. Message Passing

Three synchronization primitives are tested. A mutex is an appropriate simple synchronization object. A pulse is a non-blocking, unidirectional message with a small data. Pulse is commonly used as a notification mechanism within interrupt handler. A semaphore is a flexible synchronization object that has a positive integer count. These facilities support full thread synchronization mechanism. It is appropriate to use COM-DPPS and COM-DESFAS(Figure 3).

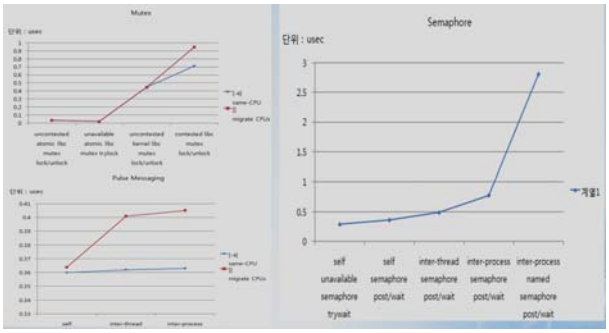

Figure 3. Synchronization on Mutex, Pulse Message, and Semaphore

The deadline test is an approaching for real time violation on deterministic scheduling and communication. The deadline tests were checked using deterministic conditions within 2ms interval scheduling during execution of critical portion of the code(Figure 4).

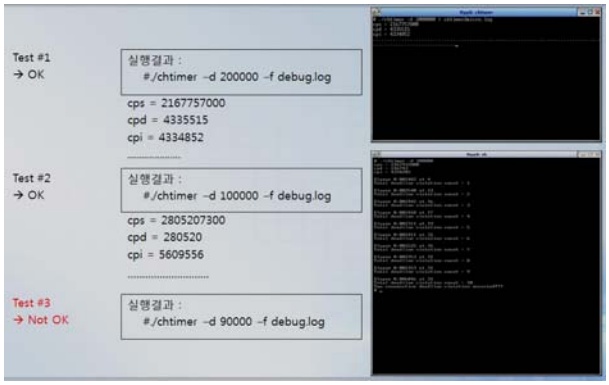

Figure 4 Deadline Violation

3. Conclusions

The benchmarking tests are reliable indicators of functional and performance. The results of benchmarking have been described as a series of steps. In most cases, Elmsys PC platform satisfies the benchmarking test results. In order to use of real time operating system in safety-related application, these results can be used as selecting strategy with which to compare other commercially available real time operating system in the market. The other benchmark testing of functional and performance for QNX RTOS will continue under the ELMSYS PC environments.

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