Save Time and Money on Wireless Device Testing

Switching can reduce capital investment and increase throughput

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Unlike most other electronic products, many wireless devices are 100 percent tested either as complete products or as radio modules. With fierce competition among manufacturers driving down profit and the very high volume of devices produced, controlling the cost of test is critical. This article describes how adding switching to achieve better utilization of test assets through parallel testing can offer significant time and money savings on wireless device testing.

With such wide variety of wireless devices, it is no wonder that there are a number of test methodologies. For this discussion, three categories of test will be discussed. For some manufacturers, for example a printer producer (Figure 1), the wireless aspect of the product is just an accessory. In many of those cases, the manufacturer will buy a complete radio module and integrate it into their end product. A test methodology often used is to inspect and test the radio modules when received. The thought is that if the radios are good when received, they won't get broken when integrated into the product.

For other manufacturers, for example a mobile phone manufacturer (Figure 2), the radio is the core of the product. Those manufacturers often make their own radios and will calibrate and test the radio during production. A third category is somewhere in between. In this case, the manufacturer, for example a wireless mouse producer (Figure 3) may buy a radio module for integration into their product, but may choose not to test it until the product has been completely assembled.

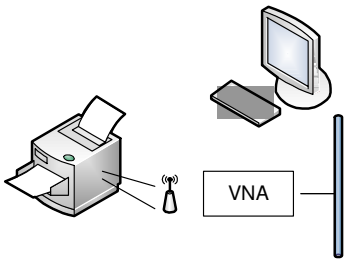

Figure 1

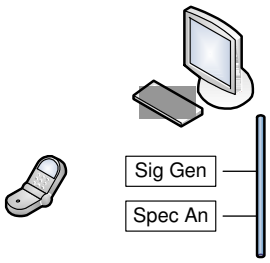

Figure 2

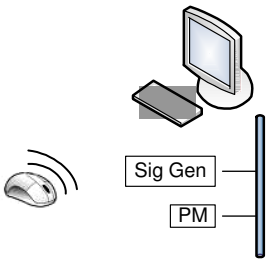

Figure 3

There are many different ways to look at how switching can save time and money. In very high volume device manufacturing, saving even a little time can equate to huge returns. For example, mobile phone manufacturers often perform a board-level test of the radios within the phone. Based on the number of phones produced per year, the average selling price, and the amount of time spent on board-level test, one manufacturer calculated that it cost them $1.5/min for test.

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The mobile phone manufacturer would use a signal generator to test the radio receiver and then use a signal analyzer to test the transmitter. A common test time was 1 minute per board during which up to 10 seconds could be spent on loading, connecting, disconnecting and unloading each mobile. Four mobiles would correspondingly take 4 minutes to test. By adding a 1x4 multiplexer, the manufacturer could prepare three phones while one was testing and quickly switch to the next phone when the preceding test was complete.

The end result was an overall test time reduction of 30 seconds for a set of four mobiles. At $1.50/min, that equates to $0.75 savings or 20¢ per phone. If a production line made 2.4 million phones per year and a typical product had 8 production lines running, that is a saving of close to $4 million per year!

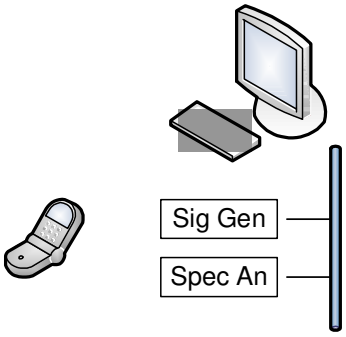

Figure 4

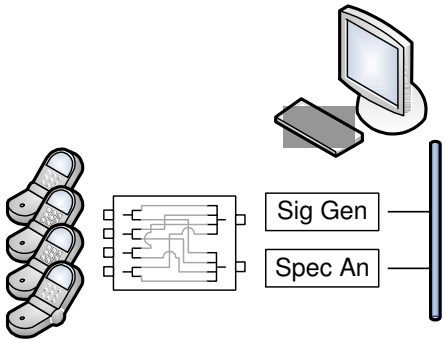

Figure 5

Figure 6. Giga-tronics ASCOR Series 8000 1x4 multiplexer switch used in the example.

Per Unit Test Time Savings from Switching

	Base Case	With Switching
Board-level Test Time:	1 min per board 4 boards = 4 min	4 boards = 3.5 min
Test Cost Rate:	$1.50/min	$1.50/min
Total Test Cost:	4 min x $1.50/min = $6.00	3.5 min x $1.50/min = $5.25
Cost per Phone:	$1.50	$1.31
Savings from Switching:		**~ 20¢ per phone**

Total Savings = ~ $0.20/phone x 2,400,000 phones/year
= ~ $0.5 million/year per production line

8 production lines = ~ $4 million/year!

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Another way in which to judge savings due to switching is to examine asset utilization. If we stay with the scenarios above, in the base case with a 1 minute per board test time, a factory working 2 shifts a day for 50 weeks a year could make 240,000 phones per test station. Therefore, it would need 10 test stands to produce 2,400,000 phones. If test time could be reduced to 52 seconds per board (3.5 min/4 phones), it would take less than 9 test stands to reach the same volume level. At a typical test stand cost of around $100,000 in test equipment alone, a small time improvement can provide substantial cost savings. Add the other savings achieved resulting from the need for less floor space and fewer operators, lower maintenance costs, etc., and the advantages of adding switching to wireless device testing grow.

If a higher production volume is required, realization of test time reduction would allow the same 10 test stands to produce 2.74 million phones. This is essentially a 14% capacity expansion with the nearly the same test assets.

Asset Utilization from Switching

1 Production Line: Board- level Test Time:	2 shifts (80 hours/week) x 50 weeks/year = 240,000 min available test time **60 seconds**/ board/ test station = 240,000 phones/ year/ test station
10 test stands:	**= 2.4 million phones/ year**
1 Production Line: Board- level Test Time:	2 shifts (80 hours/week) x 50 weeks/year = 240,000 min available test time **52 seconds**/ board/ test station = 274,000 phones/ year/ test station
9 test stands:	**= 2.46 million phones/ year**
1 Production Line: Board- level Test Time:	2 shifts (80 hours/week) x 50 weeks/year = 240,000 min available test time **52 seconds**/ board/ test station = 274,000 phones/ year/ test station
10 test stands:	**= 2.74 million phones/ year**

Another advantage for utilizing switching in conjunction with wireless device testing is potential for increased production yield. Automation reduces the number of uncontrollable variables, such as routine tasks of test station operators. Changing manual connection between a device under test (DUT) and test equipment can often be less repeatable and reliable than when automated through switching. Better predictability can allow a manufacturer to widen production limits for greater throughput or adoption of more demanding production test limits for a greater confidence in product quality. Either outcome can yield substantial savings in time and money.

The key to successful incorporation of switching into wireless device test is selecting a switching system that is essentially transparent to the tests being conducted. This requires having an understanding of the overall test system as well as the knowledge and experience to construct a switching system with the necessary performance.

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Key switching performance criteria include system bandwidth, power handling capability, insertion loss, return loss/ VSWR (voltage standing wave ratio), isolation, and operating life. Additional considerations include connectors and connector layout, EMI/EMC environment and ease of integration. An automated test system is only as strong as its weakest link. It doesn't matter how high performance or expensive the test equipment if the switching system is poorly designed.

Figure 7.
Test system expertise is critical to achieving the advantages offered by incorporating switching into automated test.

With wireless devices increasingly finding their way into everyday life and relentless competition among suppliers, it is critically important to produce them less expensively. It is clear that adding switching to automated test of wireless devices can offer significant value. The value can be measured in many ways, such as lower test time, higher throughput, and increased capacity.

To achieve the highest gains, a switching solution provider must be selected that understands all aspects of the test system, not just the switching, to ensure that the inclusion of switching does not deteriorate test system performance, as well as understands the business goals, to allow full achievement of savings in time and money.

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