Falling Wireless IC Costs Intensify Test Challenges

Electronic Design

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The other day, I was chatting with a colleague about his Wi-Fi troubles, which, by the way, involved a pre-draft 802.11ac router and frequent rebooting. Chalk one up to the case for standardization. I was intrigued to hear him count exactly 12 Wi-Fi devices in his home. Ten years ago, anyone who owned a dozen Wi-Fi devices would have been a likely candidate for a mental institution.

Today, more wireless devices exist in the world than people, and having a few more than your fair share is considered relatively normal. Technologies such as Wi-Fi, Bluetooth, GPS, LTE, and others have become ubiquitous. In fact, analysts estimate that there are nearly 2 billion smartphones around the globe, and that number will grow to nearly 5 billion by 2020. Although astounding, these numbers represent just the beginning. Analysts predict that by 2020, there will be more than 50 billion total connected devices with around 40 billion using wireless technology.

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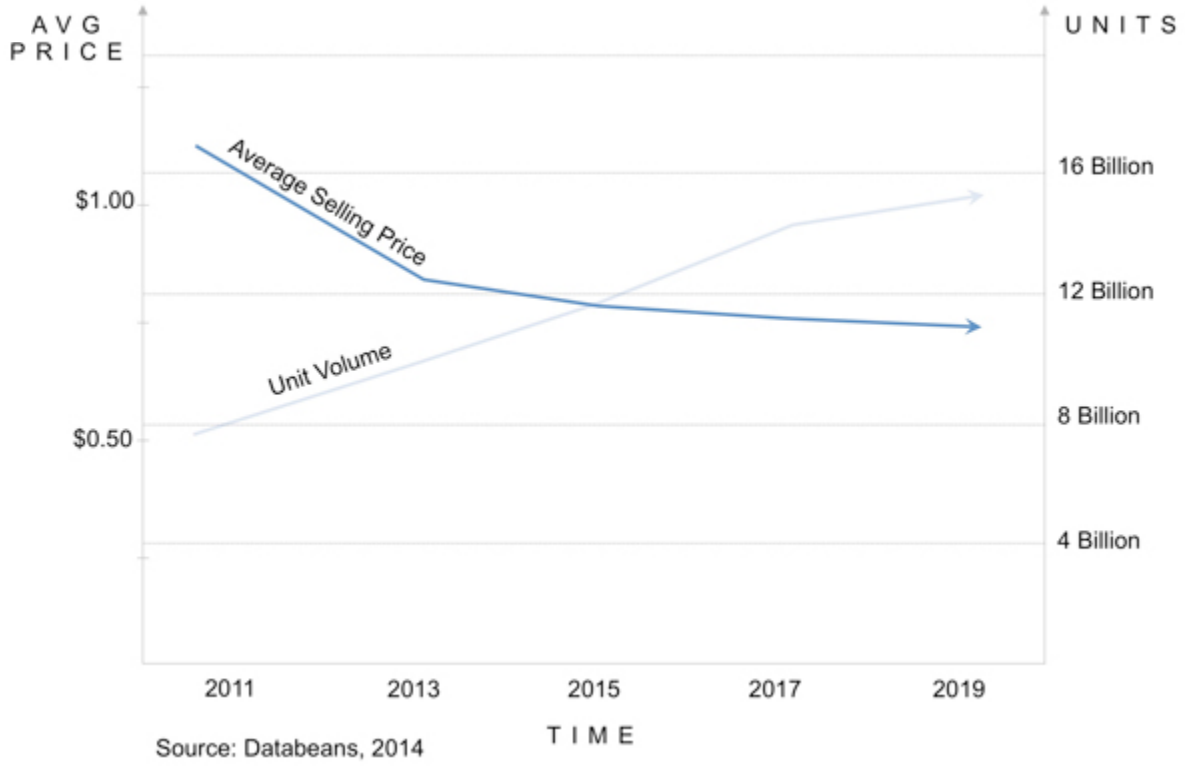
The prevalence of wireless technology holds tremendous promise, but the massive increase in both volume and complexity of today's wireless technology is fundamentally changing the cost dynamics of producing these devices. In fact, device manufacturers are pressed with the challenge of dramatically reducing product costs and increasing production capacity, despite the fact that the devices they're producing have become increasingly complex. These forces continue to be a major factor driving innovation in the test and measurement industry. More specifically, these forces are driving faster, lower-cost instrumentation and new test techniques.

Wireless IC Forecasts Predict Lower ASPs

Along with the increase in wireless-device unit volume, the cost of wireless chipsets has been on a steady decline for more than a decade and will continue to do so in the foreseeable future. In fact, recent market forecasts by both Databeans and IC Insights predict that the average selling price (ASP) of mobile-device analog ICs will decline by more than 30% from 2011 to 2019 *(Fig. 1)*.

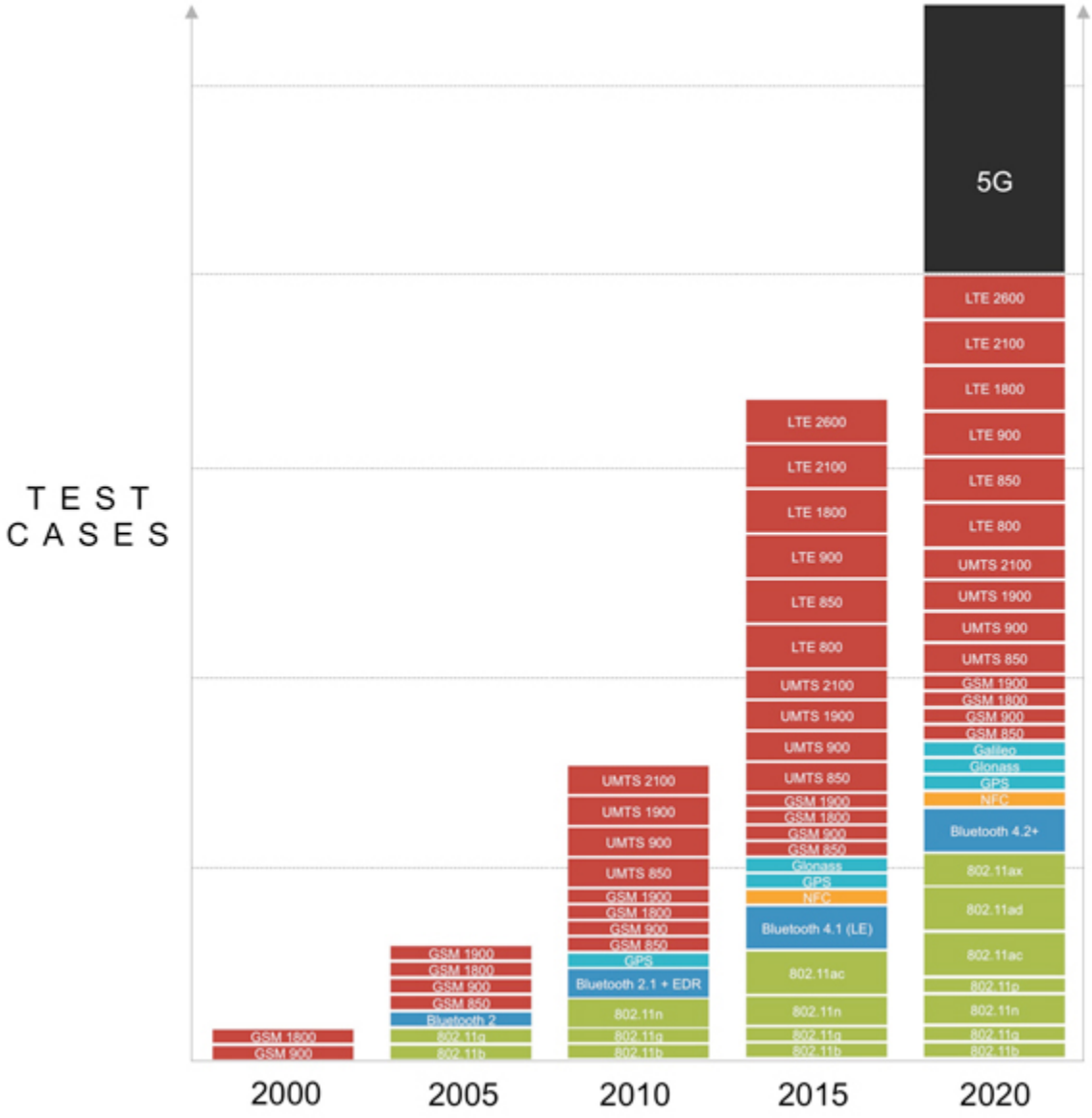


The trend of declining wireless IC prices isn't surprising, but it contributes to a growing challenge for engineers testing both RFICs and mobile devices. Given the falling price point, test costs must also decline to ensure that products remain economically viable.

Yet, the challenges of wireless-device or IC testing are much more extreme than a mere 30% reduction over an eight-year period, as the ASP data would suggest. In fact, manufacturing cost pressures are coupled with an even more dramatic rise in product complexity. Factors such as increasing cellular bands, new waveform types, and more Wi-Fi configurations invariably lead to more test cases. Thus, the real challenge for today's test engineers is not to validate the same number of test cases for 30% less, but to validate across 10X or 100X test cases for at least 30% less.

Mobile-Phone Complexity

One of the most telling examples of mobile complexity is the smartphone. Consider the increasing number of radios present on a mobile device over the past 15 years. In 2000, it was common for a mobile phone to support two GSM bands. By 2005, GSM bands doubled to four (marketed as "world band phones") in addition to Bluetooth and Wi-Fi on smartphones. By 2010, mobile phones began to augment GSM/EDGE radios with UMTS technology (again requiring more radios), and wireless technologies such as Wi-Fi, Bluetooth, and GPS. This trend has continued over the past five years with the rollout of LTE, 802.11n/ac, and even NFC *(Fig. 2)*.

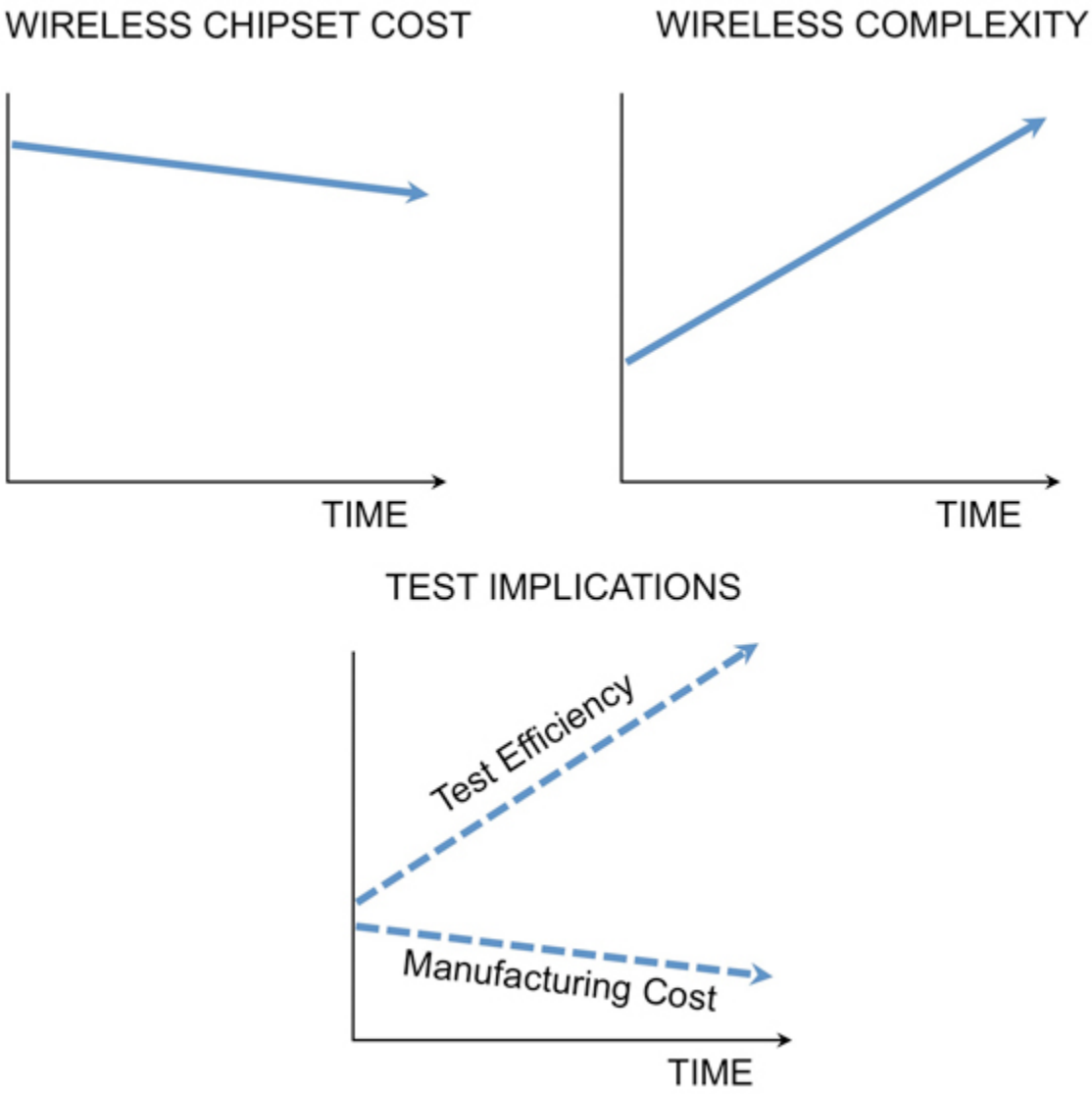


Looking forward to 2020, the trend toward growing complexity will continue. Our industry may yet see widespread adoption of additional Wi-Fi technologies such as 802.11p, 802.11ad, 802.11ah, and 802.11ax. In addition, the fifth generation of cellular communications is likely to produce test challenges that far exceed those of LTE.

Driven by the need for higher throughput (among other requirements), current proposals include the use of millimeter waves and massive MIMO. Should these proposals be adopted, testing 5G radios will require test organizations to completely retrofit existing test infrastructure to support wider signal bandwidths, higher frequencies, and more antenna ports. Of course, this is added to the fact that 5G will entail new test cases.

The Impact on Test

Although the idea of cheaper, more connected, and higher-throughput wireless devices is certainly appealing to us as consumers, it's already changing how engineers in the wireless industry conduct product testing *(Fig. 3)*. Over the past decade, we have seen both test methodologies and test equipment dramatically evolve to become more efficient. If the forecasts for wireless ASP and predictions on 5G are correct, engineers and test vendors alike must continue the rapid pace of innovation.



Nowhere has this trend been more apparent than in the way engineers conduct high-volume manufacturing test of mobile phones. A decade ago, a piece of test equipment literally placed a cell-phone call with the mobile device, and testing a single device could take 10 minutes or more. Since then, the mobile-phone industry has seen a gradual shift to the use of "non-signaling test," a practice that involves setting the device into a test mode to test the RF.

Going forward, the next major innovation in wireless test is the use of massively parallel test systems. Today, engineers are replacing their 1-up or 2-up test stations with sexier 4-up and 8-up alternatives. Tomorrow, systems that test no fewer than 16 or 32 devices in parallel will be considered insufficient.

The Future

Although the future of wireless presents a difficult challenge to today's test engineers, I'm optimistic about our industry's ability to address them. Over the past decade, improvements in CPU and FPGA technology have led to dramatically faster test equipment. At the same time, the adoption of modular instrumentation systems has allowed for an easier migration to parallel test architectures.

Finally, the personal motives that drove many of us to become engineers in the first place have not gone away.

gineers choose engineering because they enjoy difficult technical challenges. Thus, an 8-up, million-parts-
-year tester is simply nothing more than the next engineering challenge, and we at NI are more than willing to help.

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