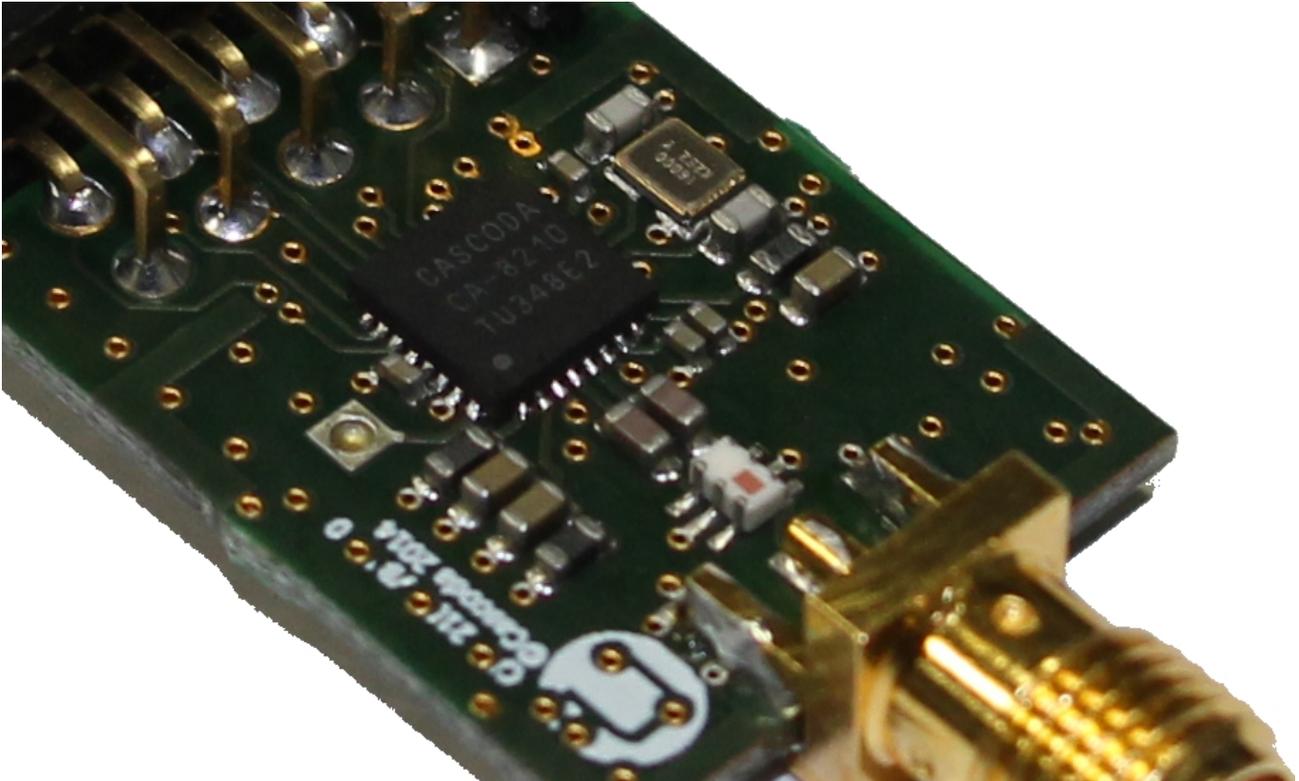


Case Study

Innovative UK SME's collaborate to disrupt the smart city market

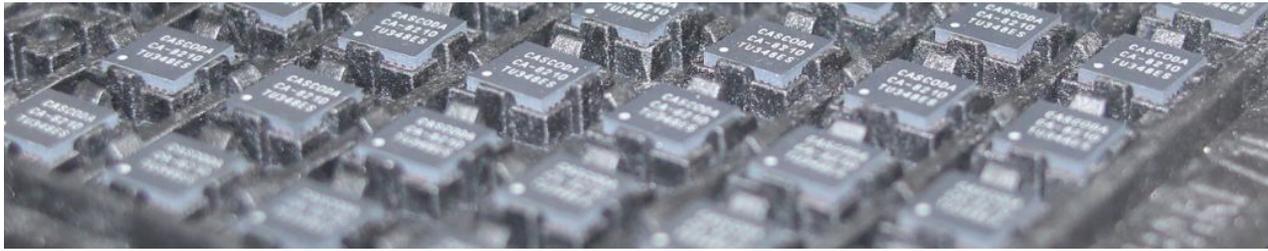


“As a new entrant into the market for IEEE 802.15.4 low power wireless transceivers, failure on quality was not an option. We knew our patented bat™ radio architecture would stand out from the crowd and disrupt the market, but our target global market leading customers would expect more than just compliance to the standard. Our software protocol stack had to be tested for every conceivable functional use case, which is well above and beyond the compliance test case set. We did not have the people or the time manually to push our development and QA testing to this level, so we chose to work with Vertizan's Vitaq® intelligent testing tool suite.”

Bruno Johnson, CEO, Cascoda Ltd

“In less than three months Cascoda’s software engineer created a complete IEEE 802.15.4 Vitaq® test environment. By combining stress testing with difficult-to-reach corner cases, Vitaq® has automatically created millions of valuable tests. This allowed Cascoda to discover, fix and re-verify issues which would have been virtually impossible to find using predetermined test sequences.”

Sean Redmond, CEO Vertizan Limited



The need for MAC robustness testing

The IEEE 802.15.4 specification is a complex document and the MAC has many different modes of operation, where each packet has many parameters and security options which can each take a wide variety of legal values. To add further complexity, the network topology can change dynamically as new nodes join or leave the network. The task of fully testing such a system is enormous, and it was a major concern for Cascoda to ensure that its new MAC hardware and software system would function correctly under all circumstances.

Traditional methods of test writing require that the test engineer writes a test (or test script) for each use case scenario that is of interest. This requires manual crafting of hundreds or possibly thousands of tests. Apart from the sheer amount of work involved in doing this, the biggest issue is that with such manual methodology it is only possible to test for the use cases that can be imagined. What about the particular use case scenarios that could happen but that were not imagined?

Additionally, for a system as complicated as a wireless network it is extremely difficult, if not impossible, manually to write tests which can co-ordinate packet transfers across multiple devices while ensuring that all possible combinations of packet transfers and parameter values have been fully tested.

Since Cascoda's business model is to open up its MAC layer, so as to allow its customers to license in or develop their own higher-layer protocol stacks, Cascoda required a MAC layer that is bug-free. As a result of this, Cascoda needed a way to push the level of its development and QA testing way beyond the norm while achieving this with limited resources and in a short space of time.

The challenges

Vitaq[®] provides a means to describe a test environment in terms of a number of 'actions' linked together in an action diagram. Each action corresponds to some activity that would normally be written as part of a particular use case – such as generating and sending a packet of a particular type from one device in the network to another.

In a traditional test methodology, each test strings together a number of specific actions in a specific order, to exercise a particular use-case scenario – such as sending a request to connect to the network and checking that the request packet is correctly received at the receiving device. Hundreds, if not thousands, of tests are then required to test all the combinations of packet types, packet parameters, data payload and different combinations of sequences that can possibly occur.

With Vitaq[®], however, when each action is executed it automatically generates random but sensible (or 'controlled') values for the parameters. The choice of which action to execute next is also randomised according to rules defined by the test engineer - with a single starting 'seed' number defining exactly how the flow of a test run proceeds. Change the seed, and a new random but sensible test scenario plays out - using the same test environment.

Fully to test the IEEE 802.15.4 protocol, complex end-to-end testing scenarios are required, with devices joining and leaving the network, and the requirement to build a reactive test environment capable of co-ordinating packets sent and received by multiple network devices simultaneously. This is extremely difficult with manual tests, trying to imagine all the possible combinations of network traffic.

The screenshot shows the 'Vitaq Coverage Viewer and Analyser' window. It displays a table with columns: Name, Seed, Start Date/Time, Weight, Target, Hits, Grade, and Pass/F. The table lists various test cases with their corresponding grades, such as 'MCPS-DATA Request' at 52%, 'MLME-ASSOCIATE Request' at 71%, and 'Status' at 100%. The interface includes a menu bar (File, View, Database, Help), a toolbar with icons for search, refresh, and save, and a status bar at the bottom indicating '0 selected' and '201 / 201 tests loaded'.

Name	Seed	Start Date/Time	Weight	Target	Hits	Grade	Pass/F
▷ MCPS-DATA Request			1			52%	
▷ MCPS-PURGE Confirm			1			100%	
▷ MCPS-PURGE Request			0			0%	
▷ MLME-ASSOCIATE Confirm			1			33%	
▷ MLME-ASSOCIATE Indication			1			76%	
▲ MLME-ASSOCIATE Request			1			71%	
▷ LogicalChannel			1			6%	
▷ CoordAddrMode			1			100%	
▷ SecurityLevel			1			12%	
▷ KeyIdMode			1			0%	
▷ CapabilityInformation:Alternate PAN ...			1			100%	
▷ CapabilityInformation:Device Type			1			100%	
▷ CapabilityInformation:Power Source			1			100%	
▷ CapabilityInformation:Receiver On W...			1			100%	
▷ CapabilityInformation:Security Capabi...			1			100%	
▷ CapabilityInformation:Allocate Address			1			100%	
▲ MLME-ASSOCIATE Response			1			53%	
▷ AssocShortAddress			1			100%	
▷ Status			1			100%	
▷ SecurityLevel			1			13%	

Vitaq database records detailed information on tests run

Cascoda was able to connect via USB from the Vitaq[®] environment to its development boards, and thereby build a system with multiple network nodes talking to each other. This allowed randomised, interleaved network transactions to be easily tested while recording into the Vitaq[®] database exactly what had been tested, in order to highlight any areas still needing further effort.

Benefits and results

Within a few days of the initial working Vitaq[®] environment being available, Cascoda was able to identify issues in its MAC which, statistically, would have been virtually impossible to find using predetermined test sequences. Over the course of the three-month development and QA testing programme, Cascoda found that it was able to discover, fix and re-verify in an astonishingly short space of time.

The company quickly got into the habit of running the Vitaq[®] test platform overnight. Each night, many thousands of combinations of parameter values and sequences of events were run to verify fully the MAC system, while recording in a database exactly what had been tested. This enabled Cascoda to test its system with a single engineer and to demonstrate to its potential customers the thoroughness of the testing, and also dramatically reduce the probability of problems in the field.

Working with Vertizan

Cascoda found adopting Vitaq[®] and the new methodology to be very straightforward. After a three-day training course, and with a couple of days' initial on-site support from one of Vertizan's engineers, Cascoda was quickly able to ramp up and became expert within a month. "The support we received from Vertizan was outstanding", says Johnson, who describes the engagement as being a "great partnership".

Cascoda is so impressed with the results from using Vitaq[®] that it is actively promoting this unique and powerful software test solution to its customers. Cascoda also plans to take the Vitaq[®] test environment and extend it to deploy for testing on the application stacks for upper layers of IoT software.

About Cascoda

Cascoda is a fabless semiconductor company which specialises in wireless communications for the Internet of Things (IoT). Cascoda's bat[™] technology is based on a completely new type of radio receiver which delivers much improved area coverage for no penalty in power consumption.

For more information, visit <http://www.cascoda.com/>

About Vertizan

Vertizan is the developer of the Vitaq[®] dynamic software/system functional verification tool suite.

For more information, visit <http://www.vertizan.com/>