FlyScan: when one plus one is higher than two

The true integration between ATE Flying probes and boundary scan tester proposed by Seica to combine the best of these two test techniques and multiply the advantages for the user

The test of electronic boards requires today more sophisticated tools which must be at the same time fast and easy to use, to meet the requirements of high quality and cost-effectiveness which represent the ideal goal both in the manufacturing and repair environment.
To ensure the highest fault coverage possible and the highest capability of specific fault identification, a good electric test program dedicated to an electronic board is today usually executed combining several measurement techniques, considering the assumption that there are different categories of possible faults while there is not a single test method capable to detect and identify them all.

ATE flying probes = test platform

The automatic test equipment which best suited the philosophy of combining different test techniques in a single program is beyond all doubt, the flying probe ATE, which Seica actually proposed as a test "platform" and not as a system capable of a single specific test. The nature of an ATE flying prober, which does not require a dedicated test fixture for a specific kind of board, considerably enables the set up of different test methods such as in-circuit, vectorless, functional test, AOI, etc. and the possibility to create programs automatically through the CAD files, thus ensuring simplicity of programming and use. An essential requirement for the use of a flying probe system is the possibility to contact the board under test physically placing a probe on every net in order to execute measurements: when this possibility lacks, due to the inaccessibility of the components or of the test points, the flying probe system presents an insuperable limit, which decreases its diagnostic capability on those inaccessible nets. This limit may be broken with the integration in the ATE flying probes of a test technique like boundary scan, which, by virtually accessing to the nets of these components equipped with this technology through a 4 or 5-wire bus, solves the problem of the physical access with a flying probe!

Integration between Boundary Scan and ATE flying probes

When a new test technique is integrated on a flying probe system it is essential to maintain some basic characteristics, typical of the flying probe ATE, to supply a real advantage to the user without increasing its job and the costs for development:

- Fast generation of the test program
- Easy to use
- Increased fault coverage and high ratio capabilities/price
- Fast time of execution
- A single test report for the different techniques employed

For a long time, the boundary scan test technique, historically conceived in the same period of the first rudimentary flying probes test systems, i.e. in the second half of the 80's, remained light-years far from these: then the flying probe systems neither powered the UUT (Unit Under Test) were limited to the MDA test (Manufacturing Defects Analysis) of the passive components of a board, while the boundary scan could not spread due to the cost of the technology needed to equip the electronic components with the JTAG port (acronym for Join Test Action Group: the group of component manufacturers which developed between 1985 and 1990, the directive IEEE 1149.1 which formalizes this standard). Through the years, the flying probes systems had a considerable evolution, while the complexity of electronic boards increased (and subsequently the employment of IC equipped with JTAG port), until both the flying probe and boundary scan testers found their right place in the market of electric test, though remaining quite separated. By the way, in these last years, there have been several attempts to combine these two capabilities, i.e. to equip a flying probe system with boundary scan test capabilities, but the results achieved did not often meet the expectations of the end users, since the integration of two rather complex worlds was not coped up from the core providing the following disappointing results:

- Two different software environments with a partial and slow mutual integration
- Necessity of operation in two different environments to create test programs
- Redundancy of tests instead of measurement optimization
- Two test reports for the same board
- High costs
- Two active suppliers to support a single test equipment

FlyScan: true and deep integration

Aiming to further enrich its range of solutions for the test and repair of electronic boards, Seica, in partnership with Temento Systems , has developed the FlyScan module as a new approach to the integration of the boundary scan technique and flying probe test systems. The true innovation of FlyScan, today available on the complete line of Pilot/Aerial flying probe testers, is full integration at the core system level, ensuring the following capabilities:

- Automatic generation of the test program in a single software environment (Seica VIVA)
- Automatic generation of the boundary scan program also for the nets which are not of the JTAG, using the "extended test" function and the flying probes to transform them into "JTAG testable" nets
- Automatic elimination of test redundancies
- Automatic fault diagnostics, with real-time generation of additional tests executed by the flying probes for the specific identification of the faulty component.
- A single test report in the VIVA environment
- Management of the errors detected by the boundary scan test in the Seica Repair Station environment
- Cost restraint

Even though its development and integration is the result of a significant investment in R&D, the basic idea of the FlyScan module is very simple: it exploits the specific benefits of flying probe and boundary scan testers, ***creating a single test program which utilizes the full capabilities of both, not as two entities working independently, but in a fully integrated system***! Let's now try to explain the possible advantages of an "integration" between flying probe and boundary scan testers:

1. ***In phase of program creation, the CAD data import is performed only once and this benefits both the automatic generation of the MDA/ICT/AOI/functional measurements of the flying prober and the automatic generation of the boundary scan tests (programming time saving)***
2. The opens/shorts test on the JTAG type nets may be executed by the boundary scan much faster than a flying probe tester ***(test time saving)***
3. The nets which may not be accessed by a flying probe tester and related to components equipped with JTAG port (e.g. a net which connects only two pins of BGA components and where no test point is scheduled) can be tested by boundary scan ***(increase of fault coverage)***
4. The nets not related to JTAG components may become JTAG type nets if contacted by the flying probe tester: hence the possibility to include them in the automatic generation of the boundary scan program, without requiring manual cluster test ***(programming time saving and increased fault coverage)***
5. In case of error detected by the boundary scan test, the diagnostic tests are generated real-time and require the use of the flying probe to detect the specific faulty component on the net, in a more specific way if compared to the standard boundary scan, which, for instance, can not distinguish two nets related to a buffer or to a serial resistance ***(increased capability of fault diagnostics)***

The five examples supplied above are among the most significant, but there are other which make the deep integration between flying probe and boundary scan testers considerably more attractive for those who wish a really complete tool to detect and diagnose the faults present on an electronic board, whether it comes from the production line or from a lot of repair from the field. It is important to remember that FlyScan shall not be confused with the usual basic integration performed in the past, i.e. the capsuling of a POD equipped with some TAP port boundary scan into the flying probe system, with the latter which utilizes its own power supplies to power up the UUT! FlyScan provides a low-level dialog between the two operating systems (flying probe and boundary scan) with a steady interaction at the programming level and test execution; together with a constant data exchange, aimed to test time and fault coverage optimization. This is the real "introduction" of the flying probe system in the chain which links the different JTAG components on the UUT: the flying probes work like the pins of a new JTAG component, placed (as indicated by the test program generated automatically) on nets which are not of the JTAG type, and transform them in "JTAG testable nets".
Compared to the classic approach where a board is subjected first to a standard flying probe test and then to a boundary scan test on a separate test station, the core interaction between the worlds of flying probe

and boundary scan enabled by the Seica FlyScan module provides a decidedly improved test result, easily measurable in terms of speed, throughput and fault coverage. The following example explains the situation: for a board with approximately 2000 nets and 5000 components, where are mounted 11 FPGA of 200 pins each in JTAG chain, when executing the tests on a system Seica Aerial M2 (equipped with 2 flying probes) the following results were output (see table 1):

	Test Time [s]	% net coverage
Flying probes	1290	80
Boundary Scan	70	42
Flying probes + Boundary scan	1360	90
FlyScan	700	99.5

Table 1

From the example it's easy to realize that the two test technologies (flying probes and boundary scan) may present some limits when used separately in terms of test time (the former) and fault coverage (the latter). Also when they are used both in sequence (independently the one from the other), the final result is decidedly lower, both in terms of test speed and output results, if compared to the FlyScan! The example shows how the FlyScan implies considerable advantages with regard to test time decrease, quality and fault coverage, hence the combined and integrated application of the two test methods outputs a result which is much higher than the straight sum of the results achieved with each of the two methods.
FlyScan is now available on all Seica's Pilot/Aerial flying probe systems, from the entry-level Aerial M2 mentioned above, right up to the top of the range Pilot V8. This, with its eight flying probes it's much faster than the first, but can anyhow benefit the integration with FlyScan to gain in fault coverage on inaccessible nets.