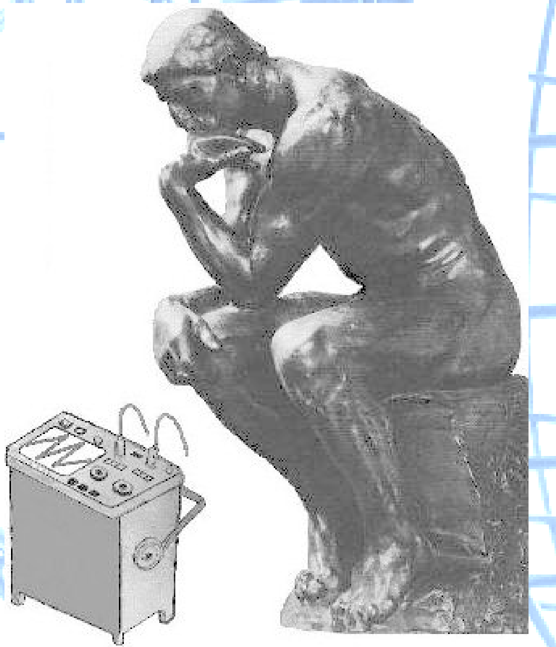


- Introduction
- Industry Review
- Test Equipment
- Test Types
- Main Testing Fields

Presenting:
Zeev Priester
QualiSystems

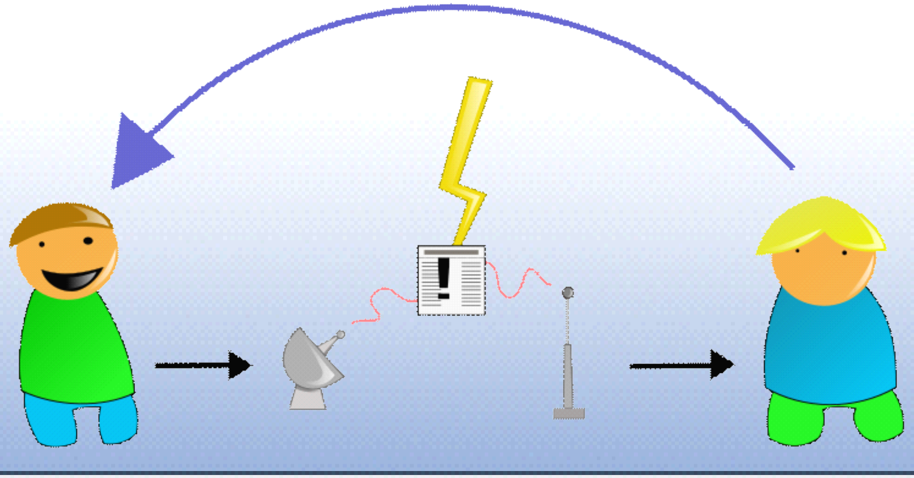
Introduction

- As a preparation of defining the goals of the “Next-Generation” TestShell ™ software, this presentation contains the following subjects:
  - Industries categories review
  - Test Equipment
  - Test Types
  - Main Testing Fields

Main Industry Categories

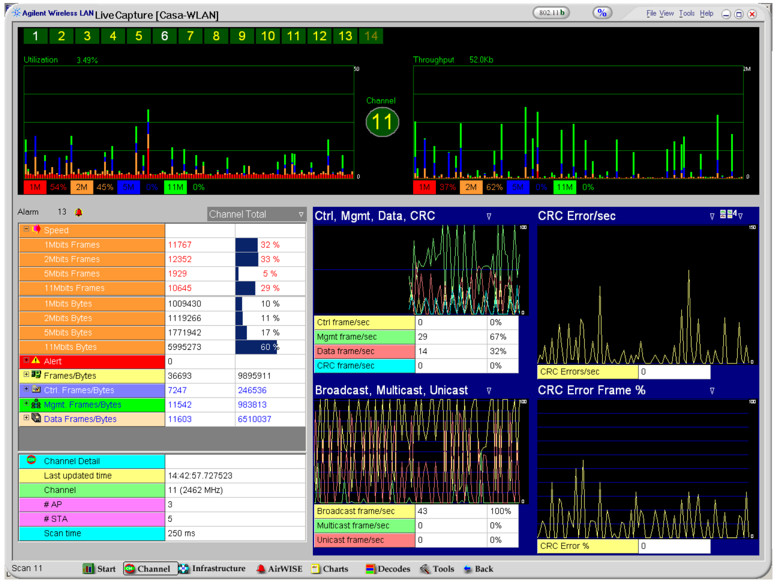
- The Main Industry Categories are:
  - COMMUNICATIONS
  - ELECTRONICS AND DEFENSE
  - LIFE SCIENCES
  - CHEMICAL
  - HOMELAND SECURITY
  - NANOTECHNOLOGY
  - AUTOMOTIVE
  - LIFE SCIENCES & CHEMICAL ANALYSIS SOLUTIONS

- **Communications**
  - Communications industry, broadly defined, the business of conveying information.
  - It covers television and radio broadcasting, telegraphs, publishing, advertising, telecommunications, motion pictures, home videos, public relations, computer databases, and other information industries.



Common Industries

- **Communications**
  - **Wireline communications**
  - **Wireless communications**
  - **Analog**
    - **AM, FM…**
  - **Digital**
    - CDMA / 1xEV-DO
    - GSM / GPRS / EDGE
    - W-CDMA / HSPA
    - MIMO
    - WiMAX Test Equipment
    - OSS, Customer and Network Assurance
    - IEEE 802.11 WLAN



Speed		
1Mbits Frames	11767	32 %
2Mbits Frames	12352	33 %
5Mbits Frames	1929	5 %
11Mbits Frames	10645	29 %
1Mbits Bytes	1009430	10 %
2Mbits Bytes	1119266	11 %
5Mbits Bytes	1771942	17 %
11Mbits Bytes	5995273	60 %
Alert	0	
Frames/Bytes	36693	9895911
Ctrl. Frames/Bytes	7247	246536
Mgmt. Frames/Bytes	11542	983813
Data Frames/Bytes	11603	6510037

Channel Detail	
Last updated time	14:42:57.727523
Channel	11 (2462 MHz)
# AP	3
# STA	5
Scan time	250 ms

Ctrl frame/sec	0	0%
Mgmt frame/sec	29	67%
Data frame/sec	14	32%
CRC frame/sec	0	0%

CRC Errors/sec: 0

Broadcast frame/sec	43	100%
Multicast frame/sec	0	0%
Unicast frame/sec	0	0%

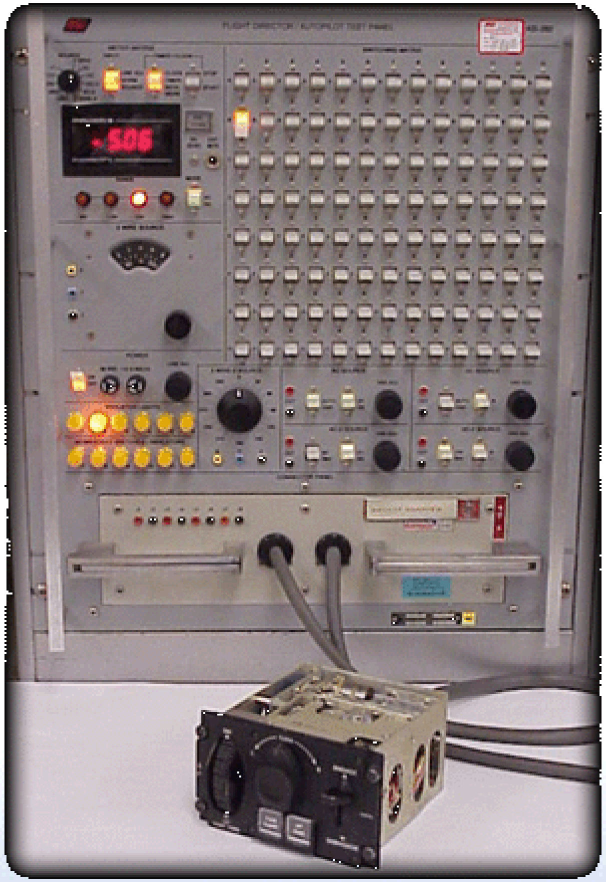
CRC Error %: 0

Common Industries

- Electronics
  - Creating, designing, producing, and selling devices such as radios, televisions, stereos, computers, semiconductors, transistors, and integrated circuits
- Defense
  - Also called the **military industry**, is comprised of government and commercial industry involved in research, development, production, and service of military equipment and facilities. It includes:
    - Defense contractors: business organizations or individuals that provide products or services to a defense department of a government.
    - The Arms industry, which produces guns, ammunition, missiles, military aircraft, and their associated consumables and systems.

Common Industries

- Electronics and Defense fields
  - Aerospace/Defense
  - Signal Integrity
  - Nanotechnology
  - Component Test and Measurement
  - Additional Electronics Applications



Common Industries

- Life Sciences
  - Any of several branches of science, such as biology, medicine, anthropology, or ecology, that deal with living organisms and their organization, life processes, and relationships to each other and their environment. Also called *bioscience*.
    - Genomics
    - Metabolomics
    - Proteomics
    - Pharmaceuticals

Common Industries

- Chemical
  - End markets include consumer products, health care, construction, home furnishings, paper, textiles, paints, electronics, food, and transportation.
  - In fact, most industries use chemicals as their key raw materials. For example, the auto has about $1,500 of chemicals such as paints, lube oils, rubber tires, plastic, and synthetic fibers; a cell phone is feasible because of its use of silicon-based chemicals and a durable plastic assembly; microwave ovens are made with silicon chips, plastic housings, and fire-retardant plastic additives

Common Industries

- Chemical
  - AgChem
  - Fuel Cells
  - Consumer Products
  - Homeland Security
  - Drug Testing
  - Hydrocarbon Processing
  - Environmental
  - Semiconductor
  - Foods & Flavors
  - Specialty Chemical
  - Forensics

Life Sciences & Chemical Analysis Solutions

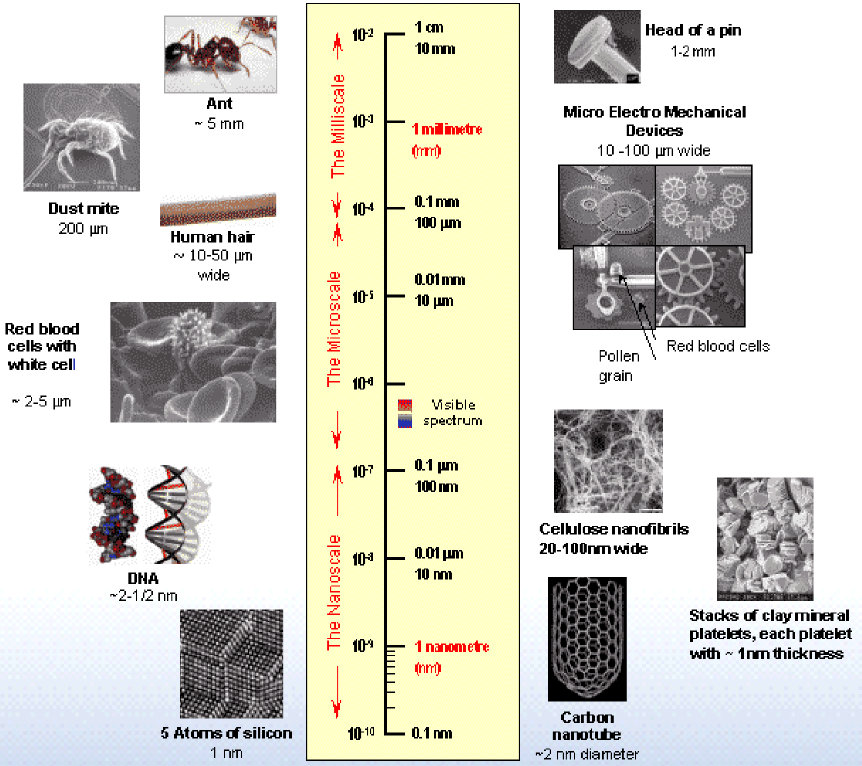
- Capillary Electrophoresis
- Liquid Chromatography
- Consumables & Parts
- Mass Spectrometry
- DNA Microarrays
- Life Sciences & Chemical Analysis Services
- Gas Chromatography
- Informatics & Software
- ICP-MS
- UV-Vis
- Lab-on-a-Chip

Common Industries

- Homeland Security
  - Surveillance & mobile radio interoperability design & test
    - Chemical and Biological Defense
    - Military and Mobile Radio Surveillance

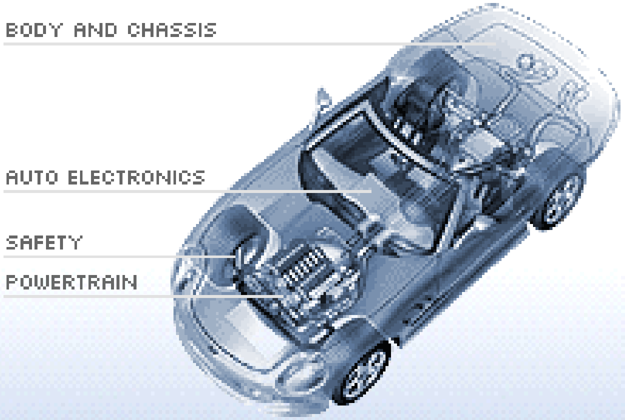
Common Industries

- Nanotechnology
  - ALSO CALLED: Molecular Nanotechnology Industry and Molecular Manufacturing DEFINITION: Nanofabrication is the design and manufacture of devices with dimensions measured in nanometers. One nanometer is 10-9 meter, or a millionth of a millimeter.
  - Nanofabrication is of interest to computer engineers because it opens the door to super-high-density microprocessors and memory chips. It has been suggested that each data bit could be stored in a single atom. Carrying this further, a single atom might even be able to represent a byte or word of data. Nanofabrication has also caught the attention of the medical industry, the military, and the aerospace industry



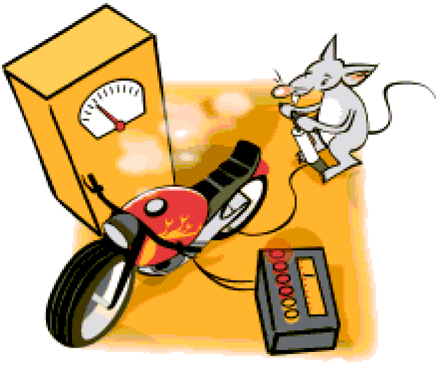
Common Industries

- Automotive
  - Power train
    - Use the Automotive Test Platform to customize hundreds of power train test, measurement, monitor, and control applications including dynamometer, emissions, and temperature.
      - Test Cell Applications
      - Temperature Measurements
      - Noise, Vibration, Harshness
      - In-Vehicle Applications
      - Controller Area Network (CAN)
      - Fuel Cells
      - Dynamometer and Servo



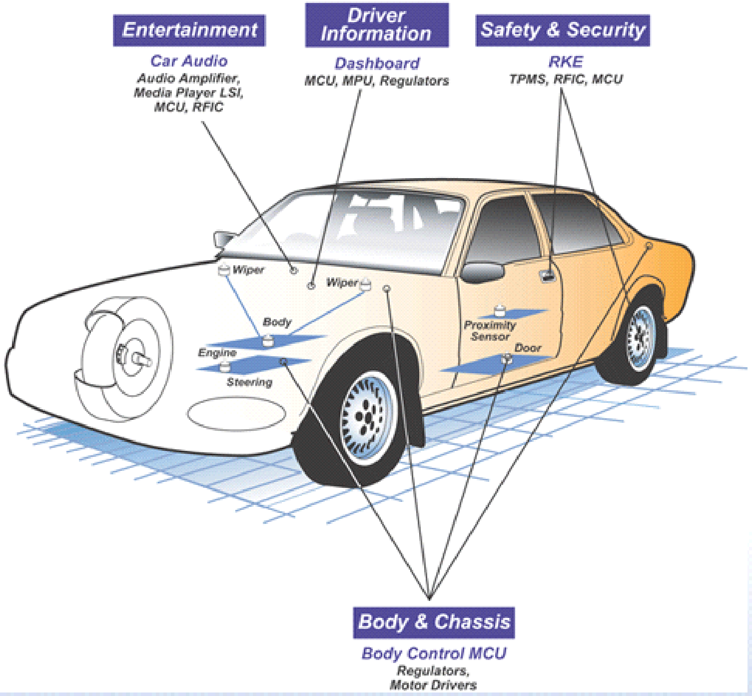
Common Industries

- Automotive
  - Body and Chassis
    - Measuring body vibration to structural strain. High-channel signal conditioning and data acquisition hardware with hundreds of I/O points for your sensor inputs
      - Strain Measurements
      - In-Vehicle Applications
      - Temperature Measurements
      - Noise, Vibration, Harshness (NVH)
      - Dynamometer and Servo
      - Test Cell
      - Controller Area Network (CAN)



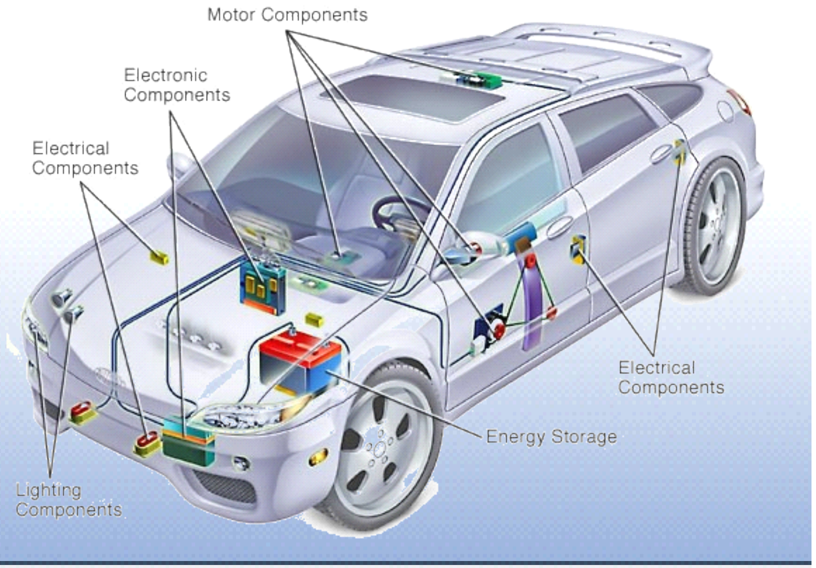
Common Industries

- Automotive
  - Safety
    - Perform vehicle and passenger safety testing from crash test Common Test Instruments
      - Airbag and Seatbelt Applications
      - Brake Test
      - Noise, Vibration, Harshness (NVH)
      - Temperature Measurements
      - In-Vehicle Applications
      - Controller Area Network (CAN)
      - Crash Analysis



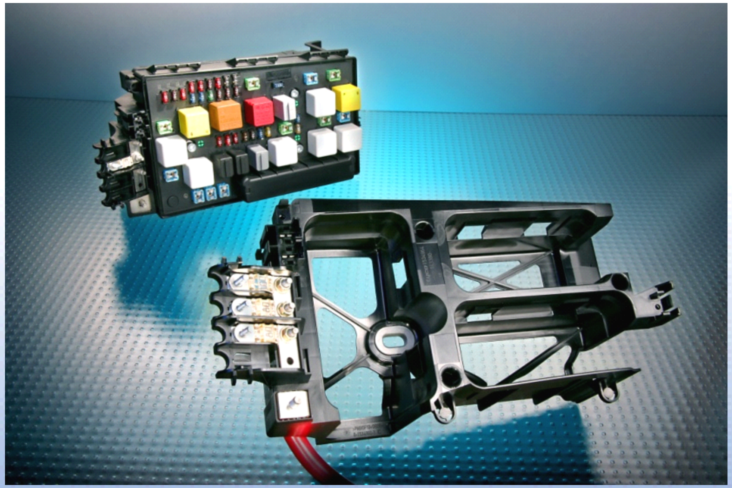
Common Industries

- Automotive
  - Automotive Electronics
    - Perform design validation and manufacturing test of automotive electronic components.
    - Electronic Control Module (ECM)
    - Noise, Vibration, and Harshness (NVH)
    - Radio/Telematics and Audio
    - Fuel Cells
    - Controller Area Network (CAN)
    - In-Vehicle Applications



Common Industries

- Automotive
  - Manufacturing Test
    - Engine Control Unit (ECU) and Electronic Control Module (ECM)
    - Telematics and Audio
    - Component Testing and Inspection
    - Fuel Cells
    - Controller Area Network (CAN)



Test Equipment

QualiSystems

- **Oscilloscopes, Analyzers, Meters**
  - Oscilloscopes
  - Spectrum Analyzers
  - Network Analyzers
  - Logic Analyzers
  - Protocol Analyzer / Exerciser for Computer and Storage
  - Bit Error Ratio Test (BERT) Solutions
  - Digital Multimeters, Voltmeters
  - Power Meters & Power Sensors
  - Frequency Counters
  - Noise Figure Analyzers & Noise Sources
  - LCR & Resistance Meters
  - Impedance Analyzers
  - Signal Source Analyzer
  - Dynamic Signal Analyzers, Mechanical & Physical Test

Generators, Sources, Supplies

- Signal Generators
- Function / Arbitrary Waveform Generators
- Pulse Pattern Generators
- Data Generators & Analyzers
- DC Power Supplies
- DC Electronic Loads
- AC Power Sources / Power Analyzers

Test Equipment

- **Additional Test & Measurement Products**
  - Software, Data Acquisition, Test Systems
  - Wireless Device Test Sets & Wireless Solutions
  - assureME Assurance Solutions
  - Wireline Communications Test Equipment
  - EEsof EDA Design & Simulation Software
  - Antenna, EMI/EMC, Phase Noise, Materials, Physical Layer Test
  - Photonic Test & Measurement
  - Nanoscale Microscopy, Positioning & Optics
  - Parametric Test
  - Printed Circuit Board (PCB) Test and Inspection
  - Flat Panel Display Test
  - Millimeter-Wave and Microwave Devices
  - Test Accessories, Cabinets, Cables

Testing types

Acceptance Test	The test performed by users of a new or changed system in order to approve the system and go live. See user acceptance test.
Active Test	Introducing test data and analyzing the results. Contrast with "passive test" (below).
Ad Hoc Test	Informal testing without a test case.
Age Test (aging)	Evaluating a system's ability to perform in the future. To perform these tests, hardware and/or test data is modified to a future date.
Alpha Test	The first testing of a product in the lab. Then comes beta testing. See alpha test.
Automated Test	Using software to test software. Automated tests may still require human intervention to monitor stages for analysis or errors.
Beta Test	Testing by end users. Follows alpha testing. See beta test.

Testing types

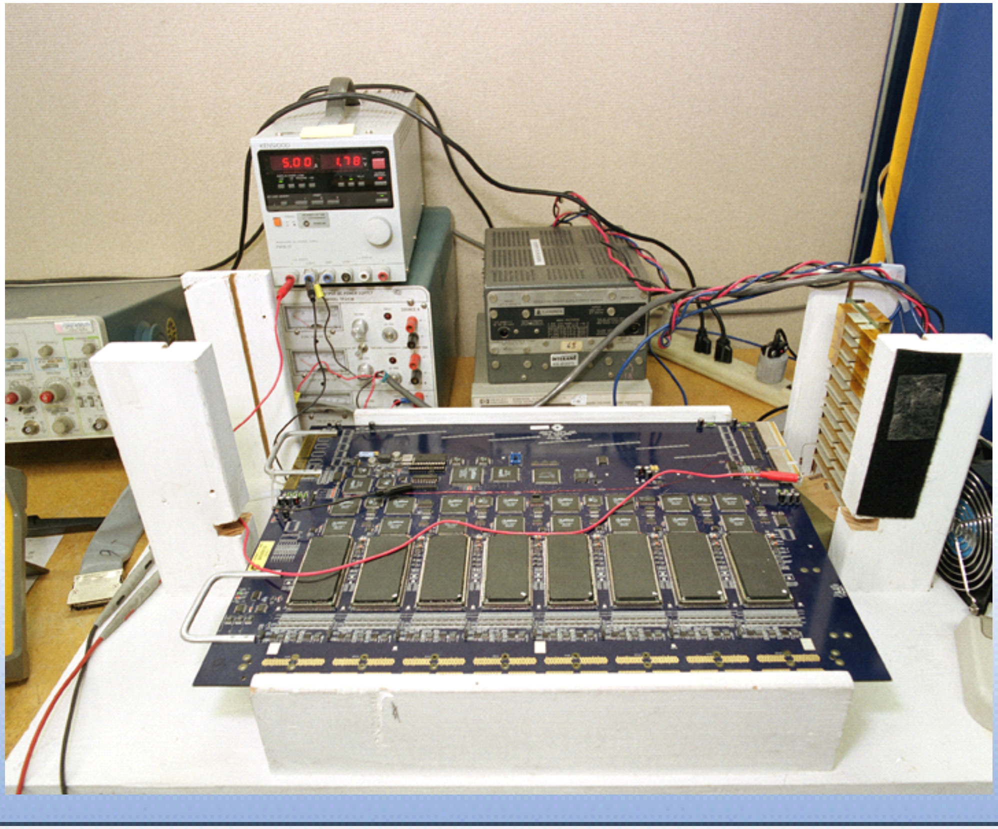
Black Box Test	Testing software based on output only without any knowledge of internal operation. Contrast with "white box test."
Dirty Test	Same as "negative test."
Environment Test	A test of new software that determines whether all transactions flow properly between input, output and storage devices. See environment test.
Functional Test	Testing functional requirements of software, such as menus and key commands. See functional test.
Negative Test	Using invalid input to test a program's error handling.
Passive Test	Monitoring the results of a running system without introducing any special test data. Contrast with "active test" (above).
Recovery Test	Testing a system's ability to recover from a hardware or software failure.
Regression Test	To test revised software to see if previously working functions were impacted. See regression testing.

Testing types

Smoke Test	Turn it on and see what happens. See smoke test.
System Test	Overall testing in the lab and in the user environment. See alpha test and beta test.
Test Case	A set of test data, test programs and expected results. See test case.
Test Scenario	A set of test cases. See test scenario.
Test Suite	A collection of test cases and/or test scenarios. See test suite.
Unit Test	A test of one component of the system. Contrast with "system test."
User Acceptance Test (UAT)	See "acceptance test" above.
White Box Test	Testing software with knowledge of the internal operation. Contrast with "black box test."

Main Testing Fields

- Board Test
    - ICT & Boundary Scan (JTAG) - (**J**oint **T**est **A**ction **G**roup) An IEEE standard for boundary scan technology



Main Testing Fields

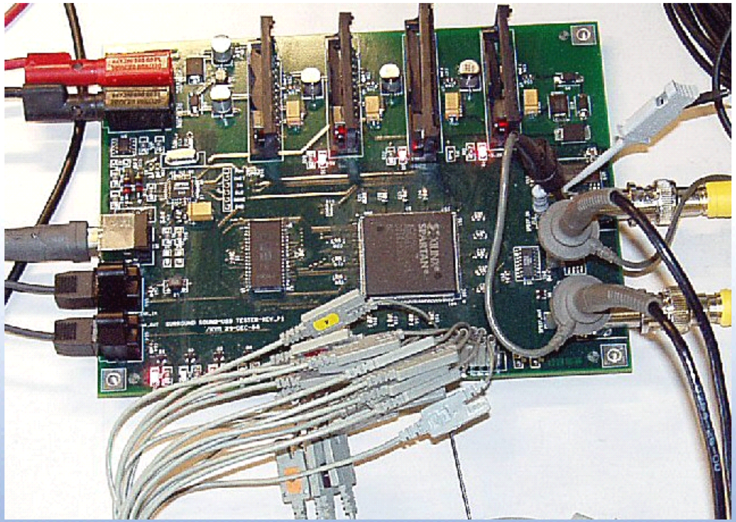
- Defect Tolerance
  - Defect Tolerance deals with a broad range of highly specialized topics in several theoretical, practical, and application areas of defect and fault tolerance in VLSI devices and systems. Main problems addressed by the committee include
  - Analysis of defect distributions and prediction in VLSI devices and systems,
  - Yield analysis and prediction,
  - Yield enhancement, production planning and production process management,
  - Design techniques and methodologies for yield enhancement of VLSI/WSI devices and systems,
  - Design techniques and methodologies to embed testing strategies and supports in the VLSI IC for defect detection and localization,
  - Configurable VLSI architectures to support defect confinement and enhance the yield,
  - Life-time detection and correction techniques, methodologies and supports to detect the presence of errors due to faults and correct them in VLSI devices and systems,
  - Design of self-checking VLSI/WSI architectures,
  - Reconfigurable VLSI/WSI architectures to confine life-time faults,
  - Fault tolerant VLSI/WSI systems,
  - CAD for fault-tolerant VLSI/WSI design and analysis,
  - High-level synthesis and co-design techniques for fault tolerant VLSI architectures

Main Testing Fields

- Economics of Test
  - Test Economics covers a very difficult, emotive and yet crucial area of design choice. Questions such as,
  - • Do I use DFT?
  - • What DFT do I use?
  - • What is it's benefit?
  - • Doesn't test always cost too much?

Main Testing Fields

- FPGA Test
  - Programmable logic in the form of field-programmable gate arrays has become now a widely accepted design approach for low- and medium-volume computing applications. Low development costs and inherent functional flexibility have spurred the spectacular growth of this technology



Main Testing Fields

- MCM Testing
  - (MultiChip Module or MicroChip Module) A chip package that contains several bare chips mounted close together on a substrate (base) of some kind. The short tracks between the chips increase performance and eliminate much of the noise that external tracks between individual chip packages can pick up. MCM also allows CMOS and bipolar technologies to be used in the same package
  - All aspects of MCM testing including but not limited to: wafer level and die level test and burn-in; known-good die technology: temporary pressure- based and fixed contact-based carrier test; known-good die testability approaches; mechanical and contactless substrate testing; MCM yield models; ATE for MCM testing; assembled module level test, testability, diagnosis and repair; MCM level BIST; testing printed circuit boards with MCMs

Main Testing Fields

- Memory Test
  - Memory devices have traditionally been used as test vehicles for new technology, process monitoring and even design concepts.
  - The primary scope of Memory testing is for reliability of stand-alone and embedded memories
  - Testing of embedded memories has become one of the most important topics in last couple of years. The main problem is that multi-mega bits memory takes large test time on logic testers, on top of that the direct access to the memory itself is not available. The hardware overhead and performance penalty restricts the use of built-in self-test.
  - As embedded memories and standard components have different testing requirements.
    - Testing for commercial and space applications
    - What are the best test algorithms, the associated cost
    - How can a test algorithm be implemented on desktop and on tester to generate the patterns
    - What are available built-in self-test methods, their associated costs and benefits
    - Memory redundancy analysis and Built-in self-repair methods
    - Application of any particular test method, failure analysis and repair method
    - How to choose a memory test method for a given situation
    - How to predict storage and life-time reliability

Main Testing Fields

- MEMs Testing
  - Microelectromechanical systems (MEMS) are miniature electromechanical sensor and actuator systems developed from the mature batch-fabricated processes of VLSI technologies. MEMS have wide applications such as miniature inertial measurement units, biochemical analysis on a chip, arrayed micromanipulation of parts, optical displays and micro-probes for neural recording.
  - The technology trend is towards higher degrees of integration that result in greater capabilities by MEMS products to assess and manipulate their surrounding environment. Realizing these projections requires that the open problems in design, test, process and package technology be confronted and adequately addressed.
  - Some existing microelectronics test techniques can be used for testing electrical parts and others are being developed to cope with non-electrical parts of MEMS. However, solutions are needed for MEMS fault modeling, fault simulation, test signal generation and design for test problems, starting from the background on similar digital and analog testing issues, and on MEMS design.

Main Testing Fields

- Mixed Signal Test
  - Interest in analog and mixed-signal testing has grown considerably. There are the following main reasons for this:
    - The first is the complex nature of the issues surrounding system and circuit testing, and is similar to the reason for increased interest in digital circuits which began in the late 1970s
    - The second stems from the rapid increase in high-performance applications in such areas as communications, computer and video technologies, automotive electronics, and others.
  - Generally, a design uses analog components to interface digital processing and to accelerate processing in high-performance systems. The success of these applications, as determined by their quality and reliability, requires the integration of comprehensive test methodologies and tools into design and test environments. Finally, a very aggressive drive to deep submicron technologies and designs is observed. This implies analog effects on digital signals and, consequently, changing even digital testing into analog oriented test. We can observe more and more of signal integrity tests, current, power, noise, and other analog tests applied to each high performance design.

Main Testing Fields

- Nano-based Devices
  - As device geometry shrinks in the nano meter range, new technologies have been proposed for the next generation of electronic systems. These innovations depart substantially from current practice because they rely on physical-based phenomena which become relevant at significantly different (atomistic and/or molecular) implementation levels.
  - These technologies go well beyond the reduction in device geometry to encompass new computational paradigms. Example of these devices are:
    - quantum dots,
    - carbon nanotubes,
    - silicon nanowires,
    - resonant tunneling diodes.
  - In the computational arena, quantum computing (inclusive of cellular automata), organic switches and tunnel logic arrays have been proposed as Nanofabric. For the foreseen future there is little doubt that these technologies will eventually have an impact on the electronic industry; in the near future their interface with CMOS will also be an important feature to be considered while integrating these technologies into commercial designs.

Main Testing Fields

- On-Line Test
  - On-line testing and hardware fault tolerance are among the oldest fields of computer science. They were developed for improving reliability and/or availability of electronic systems. There are three main situations where reliability improvements are mandatory:
  - - when the reliability of components produced by a fabrication process is very low,
  - - when an application requires very high levels of reliability,
  - - when a hostile environment reduces the reliability of components which, in normal conditions, provide acceptable reliability levels.

Main Testing Fields

- On-Line Test - Continued
  - Due to increasing reliability or availability requirements, various industrial sectors have increasing needs for on-line testing features. Such sectors are, for instance, railway control, satellites, avionics, telecommunications, control of critical automotive functions, medical electronics, industrial control, etc. Some of these applications concern mass production and should support the standardization of such techniques and the development of commercial CAD tools supporting them. Since silicon is "cheap", such tools should make popular the design of on-line testable circuits. In addition to these trends, the high complexity of nowadays systems, require more efficient solutions. In fact, complex multi-chip systems of yesterday are today single-chip components. As a matter of fact, fault tolerant and fail-safe system designs of yesterday have to be integrated on chip, appealing for on-line testing techniques for VLSI.
  - While applications with increased reliability needs should support an increased use of on-line testing, another emerging factor will influence these trends drastically. In the past, progress in VLSI processes improved dramatically the reliability of electronic components, restricting the use of on-line testing in specific application domains. We are now in a point where these trends are reversed. Drastic device shrinking, low power supply levels and increasing operating speeds that accompany the technological evolution to deeper submicron, reduce significantly the noise margins and increase dramatically the soft error rates. As a consequence, technological progress will be blocked quickly if no particular actions are undertaken to cope with increasingly high soft-error rates. In this context, design for on-line testability seems to be the most adequate solution for designing soft-error robust circuits and pushing aggressively the limits of technological scaling.

Main Testing Fields

- On-Line Test - Continued
  - The main of topics of on-line testing techniques:
    - Soft-error issues for very deep submicron
    - Radiation hardened/tolerant processes and design techniques
    - Concurrent checking
    - Periodic testing in the field
    - Sensors/detectors for on-line monitoring of current, temperature and other reliability relevant parameters
    - Field Diagnosis
    - Self-Checking digital, analog and mixed-signal circuits
    - Fault-tolerant and fail-safe systems
    - Coding theory
    - On-line testing in automotive, railway, avionics, industrial control and space applications
    - On-line and Off-line BIST
    - Synthesis of on-line testable circuits

Main Testing Fields

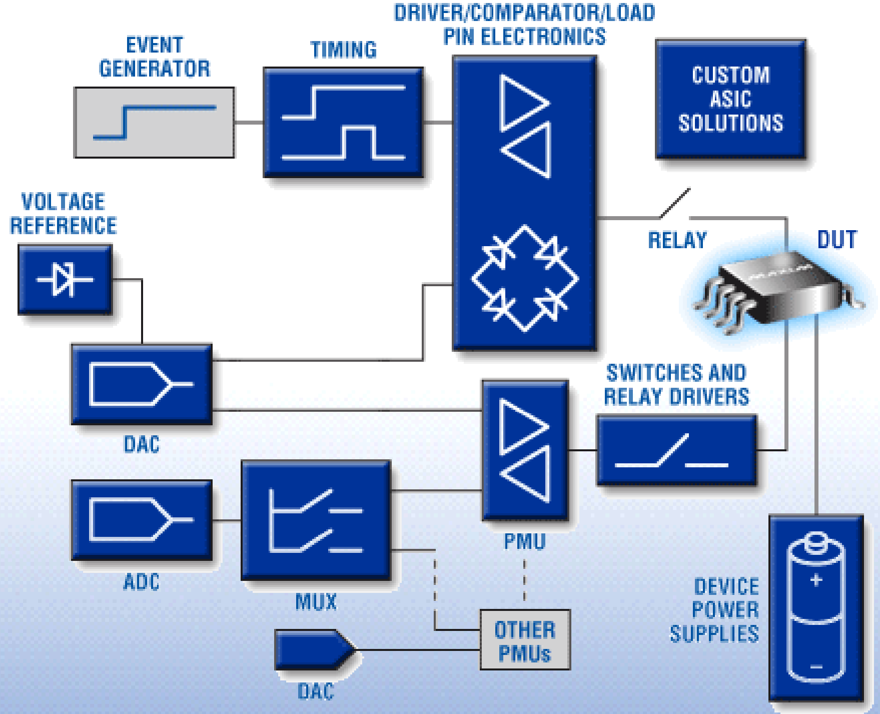
- RF Test
  - The rapid growth in the Wireless communication market has introduced many challenges to the IC design and test community. On one hand, in order to keep up with the market trend, design engineers must be able to produce highly integrated circuits; and on the other hand the test community has the challenge of producing innovative test solutions for these ICs that are more and more combining test challenge of digital, Mixed-Signal and RF. Many questions remained unanswered while operating in RF and Microwave domain

Main Testing Fields

- Silicon Debug and Diagnosis
  - Silicon Debug and Diagnosis (SDD): all aspects of prototype bring-up and debug, from systems to silicon. It includes, but is not limited to; Structured debug architectures, techniques and methodologies, Debug requirements and partitioning, Implementation and synthesis of dedicated Design for Debug (DFD) features, Reuse of existing DFT features (e.g., scan, BIST, etc.) for debug, Design tradeoffs and economics of DFD, and Debug and diagnosis tools.

Main Testing Fields

- System Test
  - Testing a whole system and observe its behavior in different and extreme situations. Multi-station test environments



Main Testing Fields

- Thermal Test
  - Decreasing dimensions of ICs and increasing density of packages make thermal issues more and more important. Enable the exploration of thermal tools, mechanisms, sensors in view to implement Design for Thermal Testability.
  - With silicon microtechnology, we intend to realize electrical networks: these are the integrated circuits. This goal however can never be obtained solely - a thermal network is also generated necessarily. The electrical parts dissipate heat, this is the source of the thermal network. As a result, the temperature of the chip increases, changing the electrical parameters. In some cases, this can even result in burning out the elements. With the decreasing chip feature sizes and package dimensions, with the increasing integration density, the heat production per unit volume increases - continuously enlarging the severity of these problems.
  - This is why during the design of an integrated circuit concentrating only to the electrical operation is not sufficient any more. Today, we have to keep in hand the thermal network as well, overheating and electrical-thermal cross couplings have to be impeded. We need methods to calculate and measure the temperature distribution on the chip.
  - According to recent statistics, the largest part of field detected failures are originated from overheating, due to inappropriate thermal design.
  - Thermally originated malfunctions can be prevented by on-line thermal monitoring. This can be accomplished by thermal sensors integrated in the chip, connected to an evaluator and actuator circuitry.

Main Testing Fields

- Verification and Test
  - As designs get larger every year, the two major problems faced by the semiconductor industry are to ensure that there are no bugs in the design and that the manufactured chips are defect-free. Given the rate of advance of the size, complexity and performance capabilities of integrated circuits, new directions need to be explored to solve problems in verification and test.
  - Simulation is the primary means used to validate the correctness of a design today. This should be the first area where the issues in verification and test are considered at the same time. Ultimately, formal verification techniques should be examined by the test community. (Test generation algorithms are beginning to be used to support formal verification.) We hope that this interaction will spur the development of tools for test generation and for formal verification that employ methods that are common to both domains.