

EDA TERMS

By

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Our mission is to provide cost effective, technology independent, good quality reusable Intellectual Property cores with quality and cost factor are our important constraints so as to satisfy our customers ultimately. We develop and continuously evaluate systems so as to pursue quality in all our deliverables. At our team, we are completely dedicated to customer's requirements. Our products are designed and devoted to empower their competitive edge and help them succeed.

A

ABEL (Advanced Boolean Expression Language) - An early hardware description language developed for PLD-based designs.

Accelerator - A specialized piece of hardware that speeds up a software-based task. Usually used for speeding up simulation.

ADC = Authorized Design Center, an USS marketing term for ASIC design companies who are under contract to use our products in their designs. They are trained on the products and we refer work to them.

Algorithm - A recipe for performing an operation such as computing an average value.

Analog - A continuously varying signal. For example, if an analog signal's range is from 0 to 5 volts, the signal can assume any voltage within that range such as 1.2, 2.4, or 4.7 volts. Microprocessors and microcontrollers usually cannot process analog signals directly and require conversion by an A/D converter before they can process the signal.

Analog Simulation - Modeling or simulation of an electronic circuit using representations of the actual circuit voltages, currents, and component values instead of simplified digital state representations.

Analog-to-Digital Converter (also A/D, ADC) - An electronic circuit that converts a continuously varying signal (temperature, pressure, voltage, etc.) into digital zeroes and ones that can be processed by a microprocessor or microcontroller.

Analyzer, Logic - An instrument that allows you to observe the behavior of digital signals in an embedded system.

ASIC (Application-Specific Integrated Circuit) - A custom integrated circuit designed specifically for one end product or a closely related family of end products.

ASIC Emulation (also Logic Emulation) - The use of programmable circuits, usually based on FPGAs, to emulate the design of an ASIC or an IC before it is built. ASIC emulation allows designers to check the operation of a design before committing the time and money required to fabricate the IC. Emulation serves the same purpose as simulation design verification, but is much faster because it is based on hardware rather than software.

Assembler - A computer program that translates from assembly language (a language programmers can read) into machine code (consisting of just zeroes and ones) which a microprocessor can read.

Assembly Language (also Assembly Code) - A simple computer

programming language, specific to each microprocessor or microcontroller, which has a direct, one-to-one correspondence between each assembly-language instruction and the associated machine-code instruction.

ASSP (Application-Specific Standard Part) - A complex integrated circuit designed to perform a narrowly defined task such as video compression, sound generation, or telephone modem telephony.

Asynchronous - A circuit that operates independently of any regular, periodic time-controlling mechanism such as a clock.

ATPG (Automatic Test Pattern Generation) - The automatic creation of test patterns or "vectors" used to verify the operation of an electronic circuit. The "goodness" of a set of test vectors is based on "fault coverage" or the ability of the set of test vectors to identify any manufacturing or design defects in the circuit.

Autorouter - An EDA tool that can automatically generate the thousands or millions of connecting lines between electronic components on a pc board or inside of an integrated circuit.

B

Back Annotation - The updating of a circuit design using simulation and other post-processing information that reflects implementation-dependent characteristics of the design such as pin selection, component location, or parasitic electrical characteristics.

Bandwidth - A measure of a circuit's ability to carry or process information. More or greater bandwidth means more carrying capacity or greater processing power, usually achieved at greater cost.

Behavioral Model - A high-level representation of an electronic design that describes the behavior of various modules or subsystems in the design, usually without regard to the underlying technology used to implement the design.

Behavioral Compiler - An EDA tool that can synthesize circuitry from a very high level description of the circuit's behavior.

BiCMOS (Bipolar, Complementary-Symmetry Metal Oxide Semiconductor) - An integrated circuit fabrication technology that combines the two major IC technologies, bipolar and CMOS, on one IC.

Bidirectional - A signal or port that can act as either an input to or an output from an electronic circuit.

Binary - The base-2 number system almost universally used by modern computers, microprocessors, and microcontrollers.

Bipolar - The original semiconductor manufacturing process technology. Usually characterized by high-speed, high-power operation.

Block Diagram - A graphical representation of a system using a very high level of abstraction.

Bus – A multi-wire path for interconnection of several devices. Unlike an interface, a bus arbitrates multiple cores that are connected together. A bus allows a dynamic sharing of resources where an interface is simply a one-to-one connection.

Bit (contraction of Binary digiT) - One digit in the base-2 numbering system used by virtually all modern computers, microprocessors, and microcontrollers. A bit can have a value of either zero or one.

Bluetooth = wireless data and voice cable replacement for mobile business devices

Board, Circuit (also pc board) - A thin card, usually made from fiberglass or plastic, which is covered with copper lines and is used to hold the various integrated circuits in an embedded system.

Bond-Out Chip - A special version of a microprocessor or microcontroller which brings critical internal signals from inside the chip out on special package pins so that developers can more easily observe what's happening inside of the processor. Usually used to build In-Circuit Emulators (ICEs).

Boolean Algebra - A mathematical system developed in the 1800s to express the philosophical logic of Aristotle which was coincidentally ideal for the description of digital circuits 100 years later.

Breadboard - A hand-made system prototype built as a proof of concept. In the early days of electronics (even before transistors were invented), engineers actually mounted circuit components on blocks of wood; hence the term "breadboard."

Buffer - An isolation circuit used to insulate sensitive analog or digital circuits from higher-power or higher-current levels in other portions of an electronic design. Often seen, for example as an I/O buffer which separates the sensitive circuits inside of an IC from the signals on the circuit board to which the IC is attached.

Bus - A group of two or more signals that carry closely-associated signals in an electronic design.

Byte - A binary word consisting of eight bits. When used to store a numeric value, a byte can represent a number from 0 to 255.

C

CAD (Computer Aided Design) - The overarching generic term for all

software tools that enable or aid in the creation of engineered systems. Sometimes, CAD refers only to the electronic versions of mechanical-drafting tools. Sometimes, it refers to all such tools including EDA tools.

CAE (Computer Aided Engineering) - The original term for electronic design automation (EDA). Now, often refers to the software tools used to develop the manufacturing tooling for the production of electronic systems such as for the panelization of circuit boards.

CFI (CAD Framework Initiative) - A consortium of EDA tool companies tasked with the development of framework standards for EDA tools.

CISC (Complex-Instruction-Set Computer) - A design approach for microprocessors and microcontrollers which employs relatively complex instructions that execute over multiple clock cycles. A program written using CISC instructions requires fewer such instructions to perform a task as compared to a program written using RISC (Reduced-Instruction-Set Computer) instructions.

Clock - A master timing signal that sets the operating pace of all other components in the embedded system.

Clock Skew - Variation from the ideal clock timing across an entire electronic design (usually in an IC) caused by parasitic elements. Seymour Cray was an early combatant of clock skew and had to design serpentine traces on the Cray I supercomputer's circuit boards to compensate for clock skew.

Clock Tree - A tree-like configuration of circuitry designed to minimize the effects of clock skew.

CMOS (Complementary Symmetry Metal Oxide Semiconductor) - An IC process technology developed in the 1960s which typically runs at lower power than bipolar circuitry. Early on, CMOS was much slower than bipolar but has steadily gained in speed over the decades to rival today's bipolar speeds. Most ICs are now made using CMOS technology.

Co-design - See Hardware/Software Co-design.

Compiler - A computer program which translates programs written in an high-level language (HLL) into assembly-language instructions or machine code.

Concurrent Design - The ability to develop many parts of a complex electronic design in tandem using EDA tools such as simulation to stand in for portions of the system yet to be designed fully.

Concurrency - The ability of an electronic circuit to do several (or at least two) different things at the same time. Contrast with computer programs which usually execute only one instruction at a time unless the program is running on a processor with multiple, concurrent execution units.

Controller - An electronic system that directs the operation of some larger system.

Core - A predesigned block of logic employed as a building block for ASIC design.

Soft Core = RTL source code (synthesizable HDL)
Firm Core = Netlist = gate level HDL
Hard Core = Layout (GDSII file)

Co-simulation - Simulation of hardware and software together, simultaneously.

COT – Customer Owned Tooling – An OEM creates their design using no outside libraries – or owns rights to all the IP in the design. It allows them more flexibility on production and cost control.

Coverage - A measure of the "goodness" of a test or test suite. Usually refers to fault coverage and is expressed as a percentage of the circuit covered by the test. Usually, it is too expensive to achieve 100% coverage and test engineers shoot for coverage in the high 90s. Scan-test technology can improve coverage results, at the expense of additional silicon on the chip and some additional design time.

Crosstalk - A condition where signal activity on one wire in an electronic circuit couples to another wire and causes noise through electrostatic (capacitive) or electromagnetic (inductive) coupling.

CPLD (Complex Programmable Logic Device) - A programmable IC which is more complex than the original Programmable Logic Devices such as AMD's (originally MMI's) PALs but somewhat less complex than Field Programmable Logic Arrays.

CPU (Central Processing Unit) - The core circuitry of a computer including the ALU (arithmetic logic unit), address-control circuitry, and bus-control circuitry. Usually implemented with a microprocessor or microcontroller in an embedded system.

CUPL - A hardware description language originally developed for PLDs.

D

Debugging - The art of finding and eliminating errors in system designs.

DECT – Digital Enhanced Cordless Telecommunications (www.dect.ch)

Design Capture (also Design Entry) - The process of entering an electronic system design into a computer using EDA tools.

Design Error - An flaw designed into an electronic circuit which is then faithfully reproduced in every manufactured system (as opposed to a manufacturing error which is a flaw created by the manufacturing process)

itself). Emulation, simulation, and design-rule-checking tools all help to minimize or eliminate design errors.

Design Productivity Gap – the gap in IC design effectiveness created by the physical technology accelerating faster than the capacity of the EDA tools to create and verify designs. As silicon process geometries get smaller, certain physical phenomenon start to happen that affect timing delays, power requirements, heat dissipation, routing, size, packaging, and bonding. These behavioral changes are yet to be accommodated by the EDA tools, which are often failing in high-performance deep sub micron processes with problems such as post-layout timing violations.

Design Flow, ASIC, Typical:

- Design entry
- Enter the design into a design data base.
- Logical verification
- Check that the design is logically correct.
- Test generation
- Generate programs and/or logic for production test.
- Timing estimation
- Predict the timing, and check against requirements.
- Floorplanning
- Place blocks on chip.
- Place and Route
- Timing verification
- Check timing after layout.
- Output to GDSII for mask

Complete detailed illustration from design to silicon: [here](#)

The three basic levels of chip design are

Functional Level	=	Design
Logical Level	=	Netlist/HDL
Gate Level	=	Layout

Design Rule Check - Verification of an IC or pc board layout for conformance to the physical or electrical limitations of the implementation technology in use.

DFT (Design for Test) - A design methodology that includes special attention to the design of a circuit and the addition of special circuitry that eases the testing of that design.

Digital - An approach to circuit design based on the binary number system. Signals in digital circuitry can only assume well-defined levels; intermediate levels are invalid. For example, in a digital system with a signal range of 0 to 5 volts, the digital signal may have the logical value of 0 if the signal voltage is within the range of 0 to 0.5 volts and a logical value of 1 if the signal voltage is within the range of 2 to 5 volts. Signal voltages of between 0.5 and 2 volts are invalid and are not allowed.

Digital Simulation - A computer simulation of an electronic circuit that uses simple Boolean or logic states to represent the instantaneous state of the circuit. Because the representation is simplified from the actual voltage and currents present in the circuit, digital simulation is much faster than analog simulation.

Digital-to-Analog Converter (also D/A and DAC) - A circuit that translates a signal from a numeric, digital representation used by microprocessors and microcontrollers into an analog signal.

Documentation - All of the paper and electronic documents supplied with a component or system which are absolutely critical to fully utilizing the product. For embedded-systems designers and developers, there is never enough documentation.

DRC - See Design Rule Check.

DSP (Digital Signal Processor or Digital Signal Processing) - A specialized microprocessor or electronic system designed to be very fast at processing continuous signals such as sound and video.

E

EDA (Electronic Design Automation) - A large collection of software tools that enhance and aid in the development of complex electronic systems.

EDIF (Electronic Design Interchange Format) - A standard representation format for describing electronic circuits, used to allow the interchange of circuit design information between EDA tools.

EEPROM (Electrically-Erasable Programmable Read-Only Memory) - An integrated circuit that stores programs and data in many embedded systems. EEPROM stores and retains information even when the power is off. Early EEPROM was expensive on a cost-per-bit basis and was infrequently used. Newer "Flash" EEPROM is much less expensive and its cost-per-bit approaches that of DRAM making Flash EEPROM a very attractive memory device for embedded-systems design.

EMI (Electromagnetic Interference) - Noise generated by electronic systems which can interfere with other electronic systems by traveling through the air, over communications wires, and through power wiring.

Emulator (also ICE or In-Circuit Emulator) - A complex, expensive, and often bulky electronic system that simulates the presence of an embedded-system's microprocessor or microcontroller. Used often and extensively in the development and debugging of embedded-system programs.

EPROM (Erasable Programmable Read-Only Memory, also UVEPROM) - An integrated circuit that stores programs and data in many embedded

systems. EPROM can only be programmed once. To erase an EPROM's contents, it must be exposed to intense ultraviolet light for many minutes.

ESDA (Electronic System Design Automation) - High-level EDA tools used to design and describe entire electronic systems.

Event - A point in time where a change occurs in the state of an electronic circuit.

Event-Driven Simulator - A simulator that only calculates circuit conditions when events (changes) such as the start of a new clock cycle occur in the state of the system. In contrast, timing simulation computes the state of a system using elapsed time (usually in nanoseconds or picoseconds).

F

FASIC – Function and Algorithm Specific Integrated Circuit, such as an MPEG or Dolby decoder or GPS decoder. Usually a home for a DSP.

Fast Prototype - A working product model built quickly to try out product concepts. May lack the fit, finish, and complete capabilities of the planned final product while still giving users an idea of how the product will work. Often assembled specifically for a conference or other dog-and-pony show.

Fault - An actual problem in an electronic circuit that disables or degrades the performance of the circuit. Also, for EDA purposes, a point in the circuit where a potential flaw could damage the circuit's operation.

Fault Coverage - The percentage of potential faults identified and tested by a test program or suite of test programs. If the tests can uncover all potential faults, the fault coverage for those tests is 100%.

Fault Simulation - Simulation of the operation of an electronic circuit with the introduction of simulated manufacturing faults to determine the amount of fault coverage provided by a set of test vectors. These test vectors are then used to test the actual manufactured circuit so they must be able to identify a large percentage of the possible manufacturing faults.

Finite Element Modeling - A relatively complicated numerical method (computer algorithm) that can model complex electrical phenomena such as electromagnetic wavefront propagation.

FFT – Fast Fourier Transform, refers to benchmark test for IC's

Floorplanning - The task of determining where each major block of circuitry will go within an IC design.

Formal Design – Using mathematics to prove logic designs work.

FPGA (Field Programmable Gate Array) - An integrated circuit containing a

large number of logic cells or gates that can be programmably configured after the IC has been manufactured. Some FPGAs use fuses for this programming and others store the configuration in an on-chip EEPROM or RAM memory. Fuse-programmed parts cannot be reprogrammed so they can only be configured once. EEPROM-based FPGAs can be erased and reprogrammed so they can be configured many times. RAM-based FPGAs can be reconfigured quickly, even while the circuit is in operation.

Framework - A unifying graphical user interface, database format, and inter-tool communication scheme which allow a user to combine EDA tools from various vendors to create a desired tool suite for the design of electronic systems.

G

GaAs (Gallium Arsenide) - A high-speed IC process technology that does not use silicon. Instead, GaAs uses the semiconductor element Gallium doped with the impurity Arsenic. GaAs process technology currently produces the fastest ICs possible but advanced CMOS processing has greatly reduced the speed gap in the past few years. GaAs is most often used today for very high frequency radio circuits such as the transmitter circuits in cellular phones.

Gate - An electrical switch that is the most basic logic element in a chip. Millions of these gates or "switches" can be found on a single chip.

Gate Array - A type of ASIC in which the transistors, gates, and other active circuit elements are fixed on a wafer called a "master slice." The customization for a particular application is done using the metal interconnection layers on the chip. Thus, the IC vendor can fabricate and stockpile master slices well in advance of a customer order and then finish the fabrication by adding the metal layer or layers when the order is received. Because of this style of fabrication, gate arrays are the easiest ASICs to design and offer the fastest turnaround time between order and shipment of the finished parts. In the extreme, Chip Express offers laser-programmed gate arrays with 24-hour turnaround time (or less if you really have the money.)

Gbyte (gigabyte) - 1,073,741,824 bytes.

GDSII – Pronounced GDS2, A photoplotting file format usually employed for integrated circuit mask plotting files. Originally developed by GE Calma, an early EDA vendor.

Gerber Photoplot (or Gerber File) - A de-facto file format standard originally developed for Gerber Scientific for its line of photoplotters. Usually used for representing printed-circuit board designs.

Ground Bounce - Noise signals coupled into the grounding network of an electronic system which cause a variety of operating problems in the circuit.

H

Hard Macro - A relatively complex block of logic or "core" such as a

multiplier or an entire microprocessor that has been completely predesigned for use on a particular ASIC or FPGA technology. Generally, a hard macro cannot be edited except by the company that created it. In exchange for this relative lack of flexibility, hard macros usually provide better performance using a smaller amount of silicon when compared to a "soft macro" or "synthesizable core."

Hardware/Software Co-design - The simultaneous development of product hardware and software. This design approach is more difficult than a serial design which first develops the hardware and then the software that will run on the hardware but the benefit is a reduced time to market. To develop software before hardware is ready, software developers often create a behavioral model of the hardware which can run the software and thus prove its function.

HDL (Hardware Description Language) - A synthetic computer-based language used for the formal description of electronic circuits. An HDL can describe a circuit's operation, its design, and a set of tests to verify circuit operation through simulation. The two most popular digital HDLs are VHDL and Verilog. An analog HDL called AHDL is under development by many vendors. HDLs make it easier to develop very large designs through formal software engineering methods that define ways to divide a large team project into smaller pieces that can be implemented by individual team members.

Hierarchy - A method for describing and modeling an electronic system using different abstraction levels. At the bottom level of the hierarchy is the actual physical layout of the design (a concrete level, not at all abstract). At the top of the hierarchy is a functional description of the system or a block diagram (a very high level of abstraction). Intermediate levels include the register-transfer level (RTL), the gate level, and the transistor level.

HLL (High-Level Language) - A relatively complex computer programming language that allows the programmer to work at a mathematically abstract level instead of the low, physical level of the microprocessor or microcontroller. For example, instead of dealing directly with registers and memory locations, the HLL programmer works with variables and arrays. Java, C, Pascal, Fortran, and BASIC are all examples of high-level languages.

I

IBIS (I/O Buffer Information Specification) - A standard simulation format used to model the behavior of an integrated circuit's input/output (I/O) pins. Used in designing and simulating the operation of circuit buses.

IC (Integrated Circuit) - A silicon chip containing hundreds, thousands, or millions of circuit elements such as transistors, resistors, capacitors, and inductors. RAM, ROM, microprocessors, and microcontrollers are all examples of integrated circuits. Integrated circuits, or "semiconductor chips," are typically fabricated by depositing two or more layers of metallic, insulating, or semiconductor material on a semiconductor substrate. The deposited material is laid out

in a predetermined pattern so that the spatial layout or "topology" of the layers of material performs electronic circuitry functions.

Chips are made by growing silicon into a giant crystal, which is sliced into thin, round wafers, polished and coated with chemicals, producing layers of patterns etched into the wafer. The wafer is then cut into small squares and packaged in plastic, connecting the parts of the chip with tiny gold wires, which is ultimately placed onto a final product, such as a remote control or an anti-lock braking systems in automobiles.

I/O (Input/Output) - The wide range of circuits and sensors used to bring information into an embedded-system processor and to transport processed information back out of the processor. Serial and parallel ports, keyboard and keypad controllers, floppy and hard disk drives, and displays are all examples of I/O devices.

K

Kbyte (kilobyte) - 1024 bytes.

L

Linear - See Analog.

Logic - Digital circuitry, whether in an IC, an ASIC, a microprocessor, or a microcontroller.

Logic Emulation - See ASIC Emulation.

Logic Synthesis - See Synthesis.

Languages – “Current system modeling languages like Rosetta and Ptolemy II are good for some verification tasks. Algorithm expressions in languages like C or C++ are also only good for verification. RTL in either Verilog or VHDL is for verification and synthesis, and gate-level expressions in Verilog or Vital are used for verification and synthesis. Spice is used for the transistor -level analysis. Because the system level requires modeling across multiple domains, the semantics for the language must allow for the verification, synthesis, and analysis of the devices from all levels of abstraction.”

M

MAC – Media Access Controller – the host core

Mask or Photomask – used in physically manufacturing the chip, the output of a chip design is a series of related images or "masks" of the predetermined three-dimensional pattern of material present or removed from the layers of a semiconductor chip. Each mask represents a layout of material deposited or removed from the chip during one step of a multi-step process required to manufacture the chip. For example, a wire in a semiconductor is created by masking off an area where electricity is to flow. Light is passed through the mask, and the photochemically reactive materials that are on the face of the wafer are selectively illuminated and cured to create the wire.

Mbyte (megabyte) - 1,048,576 bytes.

MCM (Multi-Chip Module) - A hybrid manufacturing technique which places several IC chips into a single package. MCMs are a way of "creating" an integrated circuit using otherwise incompatible IC fabrication technologies (such as CMOS and GaAs). MCMs are also a way of extending the reach of existing ASIC technologies which may lack the ability to implement an entire system design on one chip.

Microcontroller (also mC) - A real "computer on a chip" incorporating a microprocessor, memory, and I/O circuits on one integrated circuit. In many embedded systems, the microcontroller may well be the only integrated circuit in the design.

Mixed-Mode - Operation in both the digital and analog domains (usually refers to simulation as in "mixed-mode simulation").

Mixed-Signal - An electronic circuit that has both analog and digital sections. Because many "real-world" systems have analog interfaces (for example, most temperature, pressure, sound, and video sensors are analog), most electronic systems must accommodate analog signals. However, signal processing is now most efficiently performed by digital circuits. Therefore, almost all modern electronic systems are mixed-signal systems although individual ICs in such systems need not be mixed-signal chips. Instead, a design can achieve mixed-signal operation by combining separate analog and digital ICs.

Mixed-Signal Simulation - A simulation that combines the abilities of an analog simulation and a digital simulation. Used to verify the operation of mixed-mode circuitry.

Microprocessor (also mP and uP) - The original "processor on a chip" introduced by Intel in 1971. An integrated circuit that contains all of the processing components of a computer CPU including the ALU, program sequencer, and bus interface. Newer microprocessors also incorporate cache memory for increased processing speed. Comes in 4-, 8-, 16-, 32-, and 64-bit varieties. Usually requires other ICs to make up an embedded system.

Microprocessor Emulator - A piece of equipment that substitutes in a circuit for the circuit's microprocessor. The emulator gives more control over the circuit's operation and eases debugging and troubleshooting efforts.

MIPS (Millions of Instructions Per Second) - A performance figure of merit (numeric score or rank) for microprocessors and microcontrollers.

Moore's Law - An empirical law developed and later revised by Intel's Gordon Moore which predicts that the IC industry is capable of doubling the number of transistors on a silicon chip every 18 months (originally every year) resulting in declining IC prices and increasing performance. Most design cycles in the electronics industry including embedded-system development firmly rely on Moore's law.

Multitasking - A programming style that splits the overall job to be performed by the embedded system into a number of smaller tasks which then execute on the system's processor in a time-shared fashion.

N

Nanosecond - One billionth of a second.

Net - 1. For ASICs, an individual signal path including all of its branches and extensions. 2. An abbreviation for the Internet.

Net Extraction - The identification and cataloging of all signal paths in a circuit. The combination of all nets and circuit elements (transistors, resistors, capacitors, ICs, etc.) of an electronic design completely describes an electronic circuit.

Net List (or Netlist) - A computer file (sometimes a printed listing) containing a list of the signals in an electronic design and all of the circuit elements (transistors, resistors, capacitors, ICs, etc.) connected to that signal in the design.

Network Simulation - Simulation of a communications network to determine if it has the desired communications capacity, noise insensitivity, and fault tolerance.

Node - A single point in an electronic circuit.

O

Object-Oriented Programming - A programming style that combines data blocks and the associated software processing algorithms into "encapsulated" modules with narrowly defined entry and exit points. This programming style was developed as a way of dealing with extremely large and complex software programming projects by breaking the project down into smaller chunks more easily handled by an individual programmer. The narrowly defined entry and exit points of each module prevent one programmer's module from disrupting another's.

OHCI = Open Host Control Interface which is processor independent, versus the Intel standard of UHCI or Universal HCI -- which is tied to the Pentium for certain tasks of the USB interface. UHCI is a PC standard where OHCI is for embedded systems.

P

PAL (Programmable Array Logic) - The first truly successful family of programmable logic, originally introduced by Monolithic Memories in the early 1980s.

PALASM (PAL Assembler) - The HDL originally developed by John Birkner of Monolithic Memories for the creation of PAL-based designs.

Patch - A small piece of code used to repair an error in an existing embedded system program.

PCB (printed circuit board, pc board, also PWB or Printed Wiring Board) - A laminated board made from alternating layers of copper and plastic (usually impregnated with glass fibers for strength). The pc board serves as the physical carrier for other electronic components in an electronic design and also provides the electrical connection between these electronic components.

PGA (Pin Grid Array) - A type of IC package, usually square, with many interconnection pins (often hundreds).

Parameterized – refers to SIP that can have parameters added or subtracted before synthesis in order to optimize the core for the specific application. For example, adding or subtracting ports from a USB Host.

PHY = **Physical** analog circuitry for actual connection to the physical connector. Very difficult (relative to soft IP) to do because it is process dependent.

Photomask – see Mask

Picosecond - One trillionth of a second.

Place and Route - A layout task that positions major functional blocks or electronic components within an IC or on a pc board (Place) and the subsequent routing of appropriate electrical connections to those components (Route).

Platform - Market speak for a computer, operating system, or framework.

PLCC (Plastic Leaded Chip Carrier) - A low-cost IC package (usually square). PLCCs have interconnection leads on either two (usually only for memory chips) or all four sides (for logic and ASIC chips).

PLD (Programmable Logic Device) - The generic term for all programmable-logic ICs including PLAs (programmable logic arrays), PALs, CPLDs (complex PLDs), and FPGAs (field programmable gate arrays).

Point Tool - Market speak for an EDA tool that performs only one function.

Power Simulation - A simulation that determines the power consumption of an electronic circuit operating under a variety of normal and abnormal conditions.

Price Point - Market speak for price. Adapted from the consumer markets where there really is a difference in sales between products priced at \$9.99

and \$10.

PROM (Programmable Read-Only Memory) - An integrated circuit that stores programs and data in many embedded systems. PROM stores retains information even when the power is off but it can only be programmed or initialized once.

Pure Play Foundry – a foundry, such as TSMC, which does only the physical manufacturing.

R

RAM (Random-Access Memory) - An integrated circuit that stores programs and data in many embedded systems. RAM does not retain information when the power is off and must therefore be reinitialized every time the embedded system is switched on. There are many varieties of RAM including the two most popular types: Dynamic RAM (DRAM) and Static RAM (SRAM).

RAPID - Reusable Application-specific Intellectual property Developers association.

RapidScript – a product from USS that allows USS customers to configure cores without having to work directly with the source code.

RC Extraction - The mathematical computation of an electronic circuit's fundamental circuit elements: resistors (abbreviated R), and capacitors (abbreviated C). RC extraction allows a simulator to determine the expected behavior of the electronic circuit through the mathematical modeling of simple circuit elements.

Register - A location inside of a microprocessor, microcontroller, or I/O controller chip that stores control or status information.

Reuse: refers to re-usable core or design which has been designed from the start with a universal nature. The code is well commented and is structured to be parameterized. Technologies and markets evolve too quickly to afford designers the luxury of starting from scratch with each new product design. Design reuse is the only way to cope. Unfortunately, designing intellectual property (IP) components for reuse (as compared to single use) could require two to four times the effort, and reusing those same IP components within another design may save only 30 to 50 percent of the effort compared to designing them from scratch. USS saves companies the high upfront costs of designing for reuse by providing mature reusable cores with all the tools needed for a speedy implementation.

RISC (Reduced-Instruction-Set Computer) - A design approach for microprocessors and microcontrollers, originally developed at IBM, which employs relatively simple instructions that usually execute in one clock cycle. This approach results in a faster, simpler processor design that uses fewer transistors. However, a program written using RISC instructions requires more instructions to perform a task as compared to a program written using CISC (Complex-Instruction-Set Computer) instructions.

ROM (Read-Only Memory) - An integrated circuit that stores programs and data in many embedded systems. PROM stores retains information even when the power is off but it can only be programmed or initialized once and only at the semiconductor factory.

ROM Emulator - An embedded-system development tool that substitutes RAM for program ROM and aids in the debugging of the program.

RTL (Register Transfer Level or Register Transfer Logic) - A register-level description of a digital electronic circuit (see "Hierarchy"). Registers store intermediate information between clock cycles in a digital circuit, so an RTL description describes what intermediate information is stored, where it is stored within the design, and how that information moves through the design as it operates.

S

Scan - A specialized test approach that places special shift-register circuits inside of an electronic design just for test purposes. The shift register allows automatic test equipment to introduce test patterns deep into the circuitry and to read out status information that results from the circuit's response to those test patterns.

Schematic - A graphical representation of an electronic circuit. Until the 1980s, schematics were really the only representation system used to describe circuits. However, with the advent of HDLs and an explosion in circuit complexity, schematics are becoming less important as a representation tool.

Schematic Entry - The process of drawing a schematic using EDA tools. When done with paper and pencil, schematic entry is called schematic drafting or schematic drawing.

SCSI (Small Computer System Interface, pronounced "scuzzy") - An eight-bit parallel computer peripheral interface standard used to connect to a wide variety of peripherals devices including hard-disk and CD-ROM drives, tape-backup units, and optical scanners.

SGN Format – Synthesized Gate level Netlist format of a design. The result of processing RTL code. This is equivalent to compiling the code because in this form it is usually design or application specific and cannot be used for anything other than the single design for which it was synthesized.

SIA – Semiconductor Industry Assen

Silicon - The most commonly used element in semiconductors due to its abundance (the same element that is found in sand) and ease of processing.

Simulation - Modeling of an electronic circuit (or any other physical system)

using computer-based algorithms and programming. Simulations can model designs at many levels of abstraction (system, gate, transistor, etc.). Simulation allows engineers to test designs without actually building them and thus can help speed the development of complex electronic systems. However, the simulations are only as good as the mathematical models used to describe the systems; inaccurate models lead to inaccurate simulations. Therefore, accurate component models are essential for accurate simulations.

Simulation Model - A software representation of a system component that describes how that component operates under various electrical and physical (temperature, pressure, light, etc.) stimulus.

SIP – Silicon Intellectual Property: the designs that get synthesized into integrated circuits

Soft Macro - A predefined block of logic (such as a multiplier or microprocessor), which can be used as a building block for creating ASIC designs. In contrast to "HardMacro"s, soft macros can be decomposed into component-level parts and edited for a particular application.

SoC – System on a Chip – a circuit that integrates a process, custom function such as MPEG encoding or Dolby processing with a processor, memory, and interface such as an USS core.

SPICE (Simulation Program with Integrated Circuit Emphasis) - The granddaddy analog simulation program developed at the University of California at Berkeley in the early 1970s.

SRAM (Static Random-Access Memory) - An integrated circuit that stores programs and data in many embedded systems. SRAM does not retain information when the power is off and must therefore be reinitialized every time the embedded system is switched on. SRAM is more expensive than DRAM on a cost-per-bit basis but is usually easier to connect to a microprocessor or microcontroller.

Standard Cell - A form of ASIC design that employs predefined logic cells and circuit components to create an ASIC. All mask layers of a standard-cell ASIC are custom for that ASIC, in contrast to a "Gate Array" in which only the metal-layer masks are custom. Standard-cell ASICs usually run faster and use less silicon (and are therefore usually cheaper on a per-part basis) than Gate Arrays. However, because the standard-cell ASIC uses predefined circuit components, it's usually easier to design (and therefore requires less time to design) than a full-custom ASIC where every resistor, capacitor, and transistor is custom built.

State Diagram - A graphical representation of a state machine's operation. State-diagram editors are EDA tools specifically designed to aid in the development of state machine designs.

State Editor - A design-entry EDA tool used to create state diagrams.

State Machine - A digital circuit built from registers and gates that controls the operation of other circuitry. For example, microprocessors contain many state machines that sequence the flow of information over the processor's bus and through its data-manipulation circuits.

Static Timing Analyzer - An EDA tool that exhaustively checks every signal path in a circuit to identify timing-related design problems.

Symbol - A graphic, schematic library element that represents an electronic component such as a resistor, a capacitor, a transistor, or an IC.

Symbol Editor - An EDA tool for maintaining and creating schematic symbols.

Synchronous - A digital circuit where all of the operations occur in lock step to a master clock signal.

Synthesis (also Logic Synthesis) - A computer process that transforms a circuit description from one level of abstraction to a lower level, usually towards some physical implementation. Synthesis is to hardware design what compilation is to software development. In fact, logic synthesis was originally called hardware compilation.

T

Test Synthesis - The automatic creation of test patterns and a test program for the verification of manufactured ICs.

Test Vector - A stimulus pattern applied to a circuit to verify the circuit's operation.

Timing Diagram - A graphical representation of the signals in an electronic circuit that shows how the signals change over time in relationship to each other.

Timing Simulation - Simulation of an electronic circuit's operation over time using calculated circuit parameters such as resistance, capacitance, inductance, and timing delays.

Transmission Line - A conductor or wire that is suited to carrying high-frequency signals.

Transistor - A device used to amplify a signal or open and close a circuit. In a computer, it functions as an electronic switch.

TSMC – Taiwan Semiconductor Manufacturing Company: the largest Taiwanese foundry. UMC and Charter are other top pure-play foundries.

Top-Down Design - A design methodology that starts the design of an

electronic system at the very highest level of abstraction and then methodically broadens the design through lower abstract layers until finally reaching the concrete, physical design layer which accurately represents the implementation technology for the system.

TymeWare™ - USS's VCI I/O implementation. VCI is a standard by which any variety of IP cores can be interlinked with standard protocols in order to speed SoC implementation.

U

UHCI – see OHCI

Unit Delay Simulation - A simplified form of timing simulation where every digital gate is assumed to introduce one unit of delay to a signal. In reality, different gates have different speeds, but unit delay simulation trades off accuracy for simulation speed.

USB – Universal Serial Bus, a four wire serial plug 'n play computer peripheral interconnect standard that utilizes standard drivers, allows for multiple device connections to a single host port, and allows hot swapping of peripherals.

USS's type of USB is OHCI = Open Host Control Interface which is processor independent, versus the Intel standard of UHCI or Universal HCI -- which is tied to the Pentium for certain tasks of the USB interface. UHCI is a PC standard where OHCI is for embedded systems.

UMC - United Microelectronics Corp., Taiwanese foundry

V

VC – Virtual Component, the software description of an electronic component

VCX – Virtual Component eXchange - a member-driven organization that is creating a structured marketplace where buyers and sellers of Virtual Components can trade using supporting tools and services.

VCI, Virtual Component Interface is based on the VSIA standard and is a "Point to Point interface (like the RS-232 standard). An interface, not a bus.

Verification - The task of establishing the correctness of a design using EDA tools to automatically check the timing, connections, and rules used to design the circuit.

Verilog - A hardware description language developed by Gateway Design Automation (now part of Cadence) in the 1980s which became very popular with ASIC and IC designers.

VHDL (VHSIC Hardware Description Language) - A hardware description language developed in the 1980s by IBM, Texas Instruments, and Intermetrics

under US government contract for the Department of Defense's VHSIC (Very High Speed Integrated Circuit) program. VHDL enjoys a growing popularity with ASIC designers as VHDL development tools mature.

VSIA – Virtual Socket Interface Alliance, a consortium of SIP companies who are working to establish open standards for interfacing and reusing data formats, test methodologies and IP interfaces.

W

Word - A unit of memory usually consisting of two bytes (16 bits).

WSTS – World Semiconductor Trade Statistics org.