Embedded System Current Trends
Definition…

Difficult to define in current scenario….

- These are the computing systems which are used in electronic devices for specific purpose.
- Any computing system other then a Desktop PC.
Definition...

Processor based system …

1. General Purpose Systems
2. Embedded System

General Purpose Systems
Like Desktop PC, Laptop etc.

Embedded System
Special purpose system which are either used as standalone or part of a big system.
General Purpose vs special purpose

99% vs 1%
Characteristics of Embedded Systems

- Single Function

- Complex functionality
  - Complex algorithms used in mobile phone etc

- Full of constraints
  - Limited Memory, Low Cost, Less Power Consumptions

- Real time performance

- Safety Critical
  - Aircraft, Lifts, Space shuttle, Medical Instruments
Market of Embedded Systems

AUTOMOTIVE
- Ignition System
- Engine Control
- Brake System

CONSUMER ELECTRONICS
- TV
- Set-top Box
- PDA
- Kitchen Appliances
- Toys/Games
- Telephone/Cell phones
- Camera/GPS

Industrial Control
- Robotics
- Control System
- Various Cards
- Art. Satellites
- Missiles
- Nuclear Reactors
- Space Stations
- Shuttles

Medical
- Infusion Pumps
- Dialysis Machine
- Prosthetic Device
- Cardiac Monitor

Networking
- Router
- Hubs
- Gateways

Office Automation
- Fax
- Copier
- Printers
- Scanners
- Card Readers
- Monitors
Heart of Embedded System…

- Off course MICROCONTROLLER
Microcontroller Definition

A microcontroller is a computer-on-a-chip optimized to control electronic devices. It is a type of microprocessor emphasizing self-sufficiency and cost-effectiveness, in contrast to a general-purpose microprocessor, the kind used in a PC. A typical microcontroller contains all the memory and I/O interfaces needed, whereas a general purpose microprocessor requires additional chips to provide these necessary functions. -Wikipedia
The first microprocessor was developed by what was then a small company called Intel (short for Integrated Electronics) in the early 1970s.

The client, a Japanese company called Busicon, declined to buy the chipset and Intel, faced with a development cost and no customer, decided to market the chipset as a "general purpose" microprocessing system for use in applications where digital logic chips would have been used.

The chipset was a success and within a short while Intel developed a general purpose 4 bit microprocessor called the 4004.

► http://www.computerhistory.org/semiconductor/timeline.html#1970s
## Microcontroller 1970’s .............today

<table>
<thead>
<tr>
<th>YEAR</th>
<th>INTEL MAKE</th>
<th>MOTOROLA (FREESCALE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td>8008</td>
<td>6800 (Features as 8080)</td>
</tr>
<tr>
<td></td>
<td>8080 (+5 V operation)</td>
<td>HC12 (16 bit...)</td>
</tr>
<tr>
<td></td>
<td>8085</td>
<td>HC16</td>
</tr>
<tr>
<td></td>
<td>8086 (16 bit ....)</td>
<td>68K</td>
</tr>
<tr>
<td></td>
<td>80186</td>
<td>PowerPC</td>
</tr>
<tr>
<td></td>
<td>80196 ...</td>
<td>MCORE</td>
</tr>
</tbody>
</table>
# Microcontroller 1970’s ……………today

## 8080 Vs 6800

<table>
<thead>
<tr>
<th>Intel</th>
<th>Motorola (freescale)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8048</td>
<td>6800 (features as 8080)</td>
</tr>
<tr>
<td>8085</td>
<td>Zilog</td>
</tr>
<tr>
<td>80186</td>
<td>Z80 etc</td>
</tr>
</tbody>
</table>
Microcontroller .............today

- Power (PowerPC), ColdFire, MCORE,
- ARM7, ARM9, ARM11, Cortex, SecureCore, OptimoDE Data Engine
- MSP430, DaVinci, OMAP
- PICmicro, dsPIC, PIC32
- AVR, 8051, SAM(ARM), AVR32
- Others…
32-bit Microcontrollers and Processors

Freescale 32-bit Microcontrollers and Processors

32-bit Microcontrollers and Processors

32-bit Processor Portfolio

Our 32-bit processor portfolio continues a rich legacy of innovation - and it sets the standard for tomorrow's control-intensive applications across a diverse mix of industries. So when your applications require control, power and intelligence, count on Freescale.

Power Architecture™ Processors

Power Architecture technology provides exceptional performance and superb precision. That's why we offer the broadest portfolio of processors built on Power Architecture technology, including our top-selling PowerQUICC™ processors. Whether you want to design a high-end computing application or a precise automotive application, you'll find the performance and integration expertise you need with Freescale's Power Architecture processors.

68K/ColdFire

Aggressive pricing and performance are in high demand, which is why we engineered the 68K/ColdFire family. This natural extension of our 8- and 16-bit portfolio gives you the freedom to design with power, control and flexibility - all at a low cost.

ARM® Processors

Freescale's ARM-based processors offer low component count, long battery life and exceptional performance. From multimedia entertainment to file sharing, our i.MX family of application processors delivers. With i.MX, rich multimedia experiences spring to life. Plus, i.MX's renowned integration can help you speed through development.

MCORE Processors

It's reliable and it's proven. The MCORE processor is known in the market for delivering reduced power consumption. Designed for high-performance and cost-sensitive control applications, its uses include portable and mobile battery-operated products.
Processor Families

With performance up to 2000 MIPS with the Cortex™-A8 processor, power consumption figures measured in microwatts per Megahertz, the industry's broadest feature set, and full architectural compatibility, the ARM processor range provides solutions for open platforms in wireless, consumer and imaging applications, embedded real-time systems for storage, automotive, industrial and networking applications, and secure applications for smart cards and SIM cards.

There are currently eight product families which make up the ARM processor range:

- ARM7 processor family
- ARM9 processor family
- ARM9E processor family
- ARM10E processor family
- Cortex processor family
- SecurCore processor family
- OptimoOE Data Engines
- Intel® XScale™ microarchitecture

Further implementations of the ARM architecture are available from our Partners such as the Intel® XScale™ microarchitecture.
Market of Embedded Systems

AUTOMOTIVE
- Ignition System
- Engine Control
- Brake System

CONSUMER ELECTRONICS
- TV
- Office Automation
  - Fax
  - Copier
  - Printers
  - Scanners
  - Card Readers
  - Monitors

Industrial Control
- Robotics
- Control System
- Various Cards
- Art. Satellites
- Missiles
- Nuclear Reactors
- Space Stations
- Shuttles

Medical
- Infusion Pumps
- Dialysis Machine
- Prosthetic Device
- Cardiac Monitor

Networking
- Router
- Hubs
- Gateways

ARM
- ColdFire
- 8051
- AVR
- MSP430

ARM
- POWER QUICC
- 8051
- AVR
- MSP430
- DaVinci

Freescale
- EmbeddedCraft
Power Architecture™ Products and Markets

Freescale offers the broadest portfolio of processors built on Power Architecture™ technology in the world, enabling applications in networking, automotive, consumer and industrial control.
ARM offers a broad range of processors to address a wide variety of applications while delivering optimum performance, power consumption and system cost. These processors are designed to meet the needs of three system categories:

**Embedded real-time systems**

- Embedded real-time systems for storage, automotive body and power-train, industrial and networking applications

**Application platforms**

- Devices running open operating systems including Linux, Palm OS, Symbian OS and Windows CE in wireless, consumer entertainment and digital imaging applications

**Secure applications**

- Smart cards, SIM cards and payment terminals

ARM CPU processors cover a wide range of performance and features enabling system designers to create solutions that meet their precise requirements. ARM offers both synthesizable and hard macro products, together with a range of coprocessors and debug facilities. The table below provides an at-a-glance guide to ARM processors and their performance characteristics, with links to each.
The ARM processor range provides solutions for:

- Open platforms running complex operating systems for wireless, consumer and imaging applications.
- Embedded real-time systems for mass storage, automotive, industrial and networking applications.
- Secure applications including smart cards and SIMs.

The Processor Selection Guide lists the key features of each ARM processor. The ARM Connected Community now provides a wealth of standard development tools, operating systems, optimized application software, and design services which together ensure rapid time to market for ARM processor-based designs.

### PROCESSORS RANGE

ARM offers a wide range of processor cores based on a common architecture, that deliver high performance together with low power consumption and system cost.

<table>
<thead>
<tr>
<th>Application Processors</th>
<th>Embedded Processors</th>
<th>SecureCores</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARM Cortex-A8</td>
<td>ARM Cortex-M1</td>
<td>SecurCore SC100</td>
</tr>
<tr>
<td>ARM Cortex-A8 MPCore</td>
<td>ARM Cortex-M3</td>
<td>SecurCore SC200</td>
</tr>
<tr>
<td>ARM Cortex-A9 Single Core Processor</td>
<td>ARM Cortex-R4(F)</td>
<td></td>
</tr>
<tr>
<td>ARM1020E</td>
<td>ARM1026EJ-S</td>
<td></td>
</tr>
<tr>
<td>ARM1022E</td>
<td>ARM1026EJ-F</td>
<td></td>
</tr>
<tr>
<td>ARM1026EJ-S</td>
<td>ARM1166T2(F)-S</td>
<td></td>
</tr>
<tr>
<td>ARM11 MPCore</td>
<td>ARM1176T2F-S</td>
<td></td>
</tr>
<tr>
<td>ARM1136J(F)-S</td>
<td>ARM1176JF-S</td>
<td></td>
</tr>
<tr>
<td>ARM20T</td>
<td>ARM926EMFI</td>
<td></td>
</tr>
<tr>
<td>ARM920T</td>
<td>ARM922T</td>
<td></td>
</tr>
<tr>
<td>ARM922EJ-S</td>
<td>ARM926EJ-S</td>
<td></td>
</tr>
<tr>
<td>ARM926EJ-S</td>
<td>ARM936E-S</td>
<td></td>
</tr>
</tbody>
</table>
Atmel offers a broad range of microcontrollers based on the 8051 architecture. The product line includes MCS-51® industry standard socket drop-in devices, In-System Programming capability, and small footprint 20-pin derivatives in ROMless, ROM, OTP & Flash flavors (see on-line selection table). Some of the devices also take advantage of the high-speed core (X2) mode which doubles the internal clock frequency for CPU and peripherals upon selection.

The 8051 derivatives also include Application Specific Products with specialized functions to serve dedicated markets:

- CAN Networking
- MP3 Applications
- Smart Card Readers
- USB Applications

Atmel also offers 8/16 bit microcontrollers based on the powerful C251 architecture. Our C251 devices allow a direct and easy performance increase by upgrading existing 80C51-based applications.
Embedded System Development

- Cross platform development
- Debug in target, which is separate Hardware
- Limited visibility
Cross Platform Development...

- code is developed on one platform
  but will execute on different platform

Coding, Compilation  Programmer  Target
Cross Platform Development

Coding, Compilation

In Circuit Emulator

Target
Difference Between In Circuit Emulator
Difference Between In Circuit Emulator
Embedded System Development

Programming Language Used…

• Assembly Language (Specific to Microcontroller)
• C or Embedded C
• Ada
  http://en.wikipedia.org/wiki/Ada_(programming_language)
• Embedded C ++
Embedded System Development Tools

Medium and Small Level Development Tool

Designing phase

- Coding & Compilation
- Hardware Debugging
- Target Board

Commonly Used Tools

- KEIL™ (An ARM® Company)
- IAR SYSTEMS
- Code Composer Studio™ IDE
- Codewarrior
- Emulator
- Programmer

8051, MSP430, AVR etc
Embedded System Development Tools 32/64 bit Processors

Designing phase

- Designing Phase
- Compilation
- RTOS, Middlewares
- Hardware Debugging
- Testing Tool
- Target Board
- Reliability Prediction

Commonly Used Tools

- ARTisan Software
- Telelogic
- Rational Rose
- Green Hills
- WIND RIVER
- Codewarrior
- GCC
- LDRA
- PolySpace Technologies
- Relex

- UML and SysML Tools
- Compilers, IDE, RTOS
- Reliability and Maintainability analysis software tool

Target Board: ARM, PowerPC, DSP etc.
Embedded System Development Commonly used RTOS

Linux Kernel 2.6.x

VxWorks

Wind River

Other Linux Flavor

1. Montavista Linux
2. Windriver Linux
3. Symbian

Symbian
Wind River Home : Products : Run-Time Technologies : Operating Systems

Operating Systems

Operating systems (OSes) for device software play an integral role in how manufacturers develop, deploy, and market their devices. Over the past 25 years, our real-time operating systems include:

- VxWorks 6.x
- VxWorks 653
- VxWorks 5.x
- Wind River Linux
- pSOS
Professional RTOS…

INTEGRITY® - A modern, certified POSIX conformant, Real Time Operating Systems (RTOS) designed for total reliability and absolute security. INTEGRITY uses full memory protection in a message-passing design with an extensive range of middleware and board support packages.

INTEGRITY-178B - Securely partitioned Real Time Operating Systems (RTOS) for demanding safety critical applications containing multiple programs with different levels of safety criticality, all executing on a single processor.

INTEGRITY PC™ – Operating System technology provides secure management of data and applications from multiple security domains on a single workstation.

velOSity™ kernel is a small footprint RTOS with full range of middleware and board support packages.

µ-velOSity™ real-time kernel is small, fast, easy-to-learn operating system for the most cost-sensitive and resource-constrained devices

ThreadX® - Express Logic’s RTOS is available from and supported by Green Hills Software. Includes kernel-aware graphical interface with advanced source-level and multi-task debugging with the MULTI development environment.

Supported Processors

» PowerPC | Ada
» ARM/Thumb
» XScale/StrongARM
» DaVinci
» OMAP
» MIPS | Ada
» x86/Pentium | Ada
» ColdFire | Ada
» 68K/68032 | Ada
» V800
» Blackfin
» ARC
» StarCore
» M32R
» FR
» ZSP
» TriCore
» ST100
» i960
» M*CORE
» Alpha
» Intrinsity
» Lexra
» RAD5000 | Ada
» RH32 | Ada
» SH
» SPARCite
MontaVista Linux Professional Edition

With real-time performance and reductions in footprint, Pro provides the ultimate customizable platform for a new generation of intelligent devices.

The Latest in Commercial-Grade Open Source Linux

MontaVista Linux Professional Edition (Pro) is the ideal platform for developers who want all the benefits of an open source development platform, as well as the ability to achieve rapid time to market. Pro enables state-of-the-art development across a wide array of intelligent device markets, including networking and communications, instrumentation and control, aerospace and defense, SOHO devices, and medical electronics.

MontaVista Pro 5.0 addresses the twin challenges faced by product teams selecting a development environment: speed and control. As an integrated, pre-tested environment, MontaVista Linux can be installed quickly and developers can be up and running right away. Consisting entirely of open source Linux, teams have complete control to customize it themselves and leverage the vast open source Linux code base.
Welcome to the Linux Kernel Archives. This is the primary site for the Linux kernel source, but it has much more than just Linux kernels
Frequently Asked Questions

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTTP</td>
<td><a href="http://www.kernel.org/pub/">http://www.kernel.org/pub/</a></td>
</tr>
<tr>
<td>RSYNC</td>
<td>rsync://rsync.kernel.org/pub/</td>
</tr>
<tr>
<td>Protocol</td>
<td>Location</td>
</tr>
<tr>
<td>----------</td>
<td>------------------------</td>
</tr>
<tr>
<td>HTTP</td>
<td><a href="http://www.eu.kernel.org/pub/">http://www.eu.kernel.org/pub/</a></td>
</tr>
<tr>
<td>RSYNC</td>
<td>rsync://rsync.eu.kernel.org/pub/</td>
</tr>
</tbody>
</table>

The latest stable version of the Linux kernel is: 2.6.23.9 2007-11-26 17:57 UTC F V VI C Changelog
The latest prepatch for the stable Linux kernel tree is: 2.6.24-rc4 2007-12-04 05:01 UTC B V VI C Changelog
The latest snapshot for the stable Linux kernel tree is: 2.6.24-rc4-git4 2007-12-06 19:01 UTC B V VI C Changelog
The latest 2.4 version of the Linux kernel is: 2.4.35.4 2007-11-17 17:44 UTC F V VI C Changelog
The latest prepatch for the 2.4 Linux kernel tree is: 2.4.36-pre2 2007-11-17 19:28 UTC B V VI C Changelog

EmbeddedCraft
The Linux/Microcontroller project is a port of Linux to systems without a Memory Management Unit (MMU).

Pronounced “you-see-linux”, the name uClinux comes from combining the greek letter “mu” and the english capital “C”. “Mu” stands for “micro”, and the “C” is for “controller”. uClinux first ported to the Motorola MC68328 DragonBall Integrated Microprocessor. The first target system to successfully boot is the PalmPilot using a TRG SuperPilot Board with a custom boot-loader created specifically for our Linux/PalmPilot port.

July 2007
Greg Ungerer has been posting patches against the dist for those wishing to follow the mid-release updates. The Patches can be found at the following link: http://www.uclinux.org/pub/uClinux/dist/patches/. Feed back on these patches can be posted to the uClinux-dev mailing list. If you wish to subscribe to the mailing list you can do it here https://mailman.uclinux.org/mailman/listinfo/uclinux-dev/.

July 2007
The current uClinux-dist release is dated January 30, 2007. Here is a quick links to the tar.gz and tar.bz2 packages.

http://www.uclinux.org/pub/uClinux/dist/uClinux-1.0.3.tar.gz
http://www.uclinux.org/pub/uClinux/dist/uClinux-1.0.3.tar.bz2
Since 1980, manufacturers have relied on QNX OS technology to power their mission-critical applications — everything from medical instruments and Internet routers to telematics devices, 9-1-1 call centers, process control applications, and air traffic control systems. Small or large, simple or distributed, these systems share an unmatched reputation for operating 24 hours a day, 365 days a year, nonstop. Time-tested and field-proven, the QNX Neutrino RTOS sets the industry standard for reliability, fault tolerance, and scalability.

What makes QNX Neutrino real-time operating system (RTOS) so remarkable? It's a true microkernel...

Transferring data from www.qnx.com...
Networking and Communication

Communications Software

Green Hills Software provides a complete and scalable suite of integrated networking products to support a broad range of network connected devices - from devices requiring basic IPv4 connectivity to those that demand the most comprehensive and robust network security and advanced routing functionality. These products were developed from the ground up to address the requirements of embedded systems spanning a range of markets, including Wireless, Automotive, Consumer, Military, Aerospace, Networking and Telecommunications. The scalable feature set and footprint can be configured to support devices from low power handsets to enterprise class routers.

The Green Hills suite of networking products is seamlessly integrated with the u-velOSity kernel, the velOcity real-time operating system, INTEGRITY real-time operating system, INTEGRITY-178B and MULTI development environment, providing a total solution for all your networking needs.

Please click on the image to receive information about each section.
RTOS Middlewares ...

File Systems

There is no one size fits all solution when it comes to file system support for embedded devices. For example, the requirements of a file system for a digital camera differ greatly from an in car infotainment system or carrier grade telecommunications system. Green Hills Software offers a wide variety of file system support integrated with INTEGRITY and velOSity to meet the specific needs of your device.

INTEGRITY and velOSity use a file system framework model, commonly referred to as a virtual file system (VFS), to make it easy to add and remove support for various file systems. The file system server (VFS server) provides file system services to applications that utilize file system APIs such as C stdio (fopen(), fread(), fwrite(), etc.), C++ iostreams (cout, cin, etc.), or the low-level POSIX interfaces (open(), read(), write()).

Wear Leveling Flash Storage (WLFS)

WLFS gives you the ability to access a bank of flash memory through the file system as if it were a disk. Wear leveling technology manages the underlying flash in a manner that guarantees wear on the flash will be evenly distributed across the entire device, and is also resilient against power failures and other unexpected interruptions. Both NOR and NAND flash device types are supported with WLFS. Any of the supported file system formats may be used in conjunction with WLFS.

File System format types available with INTEGRITY and velOSity

- **Unix/Linux Compatible Fast File System (FFS)** — The Berkeley Fast File System (FFS) is an inode-based file system that first appeared in the BSD UNIX distribution from the University of California. The FFS file system, sometimes referred to by its predecessor’s name, UFS (UNIX File System), is used by many BSD derivative operating systems such as NetBSD, FreeBSD, and OpenBSD.

- **DOS/FAT 12/16/32** — The MSDOS file system originated with the Microsoft DOS operating system. It is sometimes referred to by its primary data structure, the file allocation system (FAT). Like FFS, MSDOS is a hierarchical, disk-based file system. The MSDOS file system comes in several variants named after the number of bits in each entry in its file allocation table: FAT12, FAT16, and FAT32. The original MSDOS file system supported filenames of up to 8 characters followed by a dot, and a 3 character extension. With Windows 95, Microsoft layered a long filename scheme onto the FAT file system. This long filename support is sometimes referred to as VFAT. INTEGRITY supports all of these variants.

- **CDROM ISO9660/CDFS/CDA** — The ISO9660 file system is commonly found on Compact Disc media. INTEGRITY supports the generic ISO9660 standard format as well as the Rockridge and Joliet extensions. The Joliet extension is favored in the MS Windows world. It allows Unicode characters to be used for all text files, which includes file names and the volume name. The RockRidge extension is favored in the Unix world. It lifts file name restrictions, but also allows Unix-style permissions and special files to be stored on the CD.

- **UDF DVD (read only)** — The UDF file system (Universal Disk Format) is the file system used on DVD’s as well as other media. INTEGRITY’s UDF library allows
Green Hills Software offers complete, high-performance USB 2.0 solutions for the royalty-free INTEGRITY Real-Time Operating System (RTOS) and vel0Sity kernel. Both Host and Device (Function) stacks are available in addition to numerous class drivers and example applications for using both stacks. The stacks and drivers are all delivered with full source code. These products allow developers to quickly and easily add USB connectivity to INTEGRITY and vel0Sity based devices.

**Host Stack:**
- Responsible for enumerating the USB devices connected to the host
INTEGRITY® Real-Time Operating System - Graphics and Video

Graphics support

The Portable Embedded GUI (PEG) is integrated with INTEGRITY and provides a comprehensive library for creating graphical user interfaces for touch screens and LCD displays while requiring a minimal memory footprint.

PEG consists of a C++ based library and device drivers that make it simple to include powerful graphics in embedded real-time applications. PEG applications can be run in either virtual address spaces or in kernel space, and reside in less than 100KB. It is small, fast, and royalty-free, yet powerful enough for advanced real-time graphics needs.

Three dimensional graphics, including OpenGL and highly tuned graphics accelerator drivers for next generation displays, are also integrated with INTEGRITY.

ALT Software’s embedded graphics products support a wide range of CPUs, safety standards and ASICs. Intended applications range from low-powered portable devices to high-performance leading edge products designed for automotive, avionics, industrial controls, and 3D visualization. These OpenGL drivers conform to specifications for OpenGL 1.2, 1.2.1, 1.3, and support several OpenGL 1.4 and 2.0 functions as well as most OpenGL extensions.
Selecting Good Tools Embedded System Development

**Code Generation**
1. Highly optimized Compiler
2. optimization in term of speed or size
3. Able to generate different output file formats
4. Customizable and easy to use IDE

**Programmer**
1. Universal programmer
2. Stand alone operation
3. Flash memory programming capability
4. Fast Downloading speed

**In Circuit Emulator**
1. Fast Downloading speed
2. Universal Emulator
3. No of hardware breakpoint
4. Trace capability

**Single Board Computer**
1. Maximum peripherals
2. Port pins open
3. Modular Approach
For beginning ....

Microcontroller  8051
Programming Language  C and Assembly
Knowledge of Electronics  Recommended
Intel 8051

From Wikipedia, the free encyclopedia
(Redirected from 8051)

The Intel 8051 is a Harvard architecture, single chip microcontroller (μC) which was developed by Intel in 1980 for use in embedded systems. It was popular in the 1980s and early 1990s, but today it has largely been superseded by a vast range of enhanced devices with 8051-compatible processor cores that are manufactured by more than 20 independent manufacturers including Atmel, Infineon Technologies, Maxim Integrated Products (via its Dallas Semiconductor subsidiary), NXP (formerly Philips Semiconductors), Winbond, ST Microelectronics, Silicon Laboratories (formerly Cygnal), Texas Instruments and Cypress Semiconductor. Intel’s official designation for the 8051 family of μCs is MCS-51.

Intel’s original 8051 family was developed using NMOS technology, but later versions, identified by a letter ‘C’ in their name, e.g. 80C51, used CMOS technology and were less power-hungry than their NMOS predecessors - this made them eminently more suitable for battery-powered devices.
8051 Microcontroller Family…

8048 Used by IBM in Keyboards, still present in some keyboards

8031 Same as 8051 but without ROM

8051

8052 Advance then 8052
### ATMEL 8051 Microcontroller Family

<table>
<thead>
<tr>
<th>Model</th>
<th>Flash</th>
<th>RAM</th>
<th>Ports</th>
<th>Speed</th>
<th>Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>89S52</td>
<td>8KB</td>
<td>256 B</td>
<td>32</td>
<td>33 Mhz</td>
<td>40 to 44</td>
</tr>
<tr>
<td>89x51</td>
<td>4KB to 64 KB</td>
<td>512 B to 8448 B</td>
<td>32-34</td>
<td>Up to 60 Mhz</td>
<td>40 to 44</td>
</tr>
<tr>
<td>89x4051</td>
<td>4 KB</td>
<td>128 B - C 256 B - S</td>
<td>15</td>
<td>24 Mhz</td>
<td>20</td>
</tr>
<tr>
<td>89x2051</td>
<td>2 KB</td>
<td>128B - C 256 B - S</td>
<td>15</td>
<td>24 Mhz</td>
<td>20</td>
</tr>
<tr>
<td>8051</td>
<td>Flash</td>
<td>RAM</td>
<td>Ports</td>
<td>Speed</td>
<td>Pin Package</td>
</tr>
</tbody>
</table>

- **89S52**: 8KB Flash, 256 B RAM, 32 Ports, 33 Mhz Speed, 40 to 44 Pin Package
- **89x51**: 4KB to 64 KB Flash, 512 B to 8448 B RAM, 32-34 Ports, Up to 60 Mhz Speed, 40 to 44 Pin Package
- **89x4051**: 4 KB Flash, 128 B - C 256 B - S RAM, 15 Ports, 24 Mhz Speed, 20 Pin Package
- **89x2051**: 2 KB Flash, 128B - C 256 B - S RAM, 15 Ports, 24 Mhz Speed, 20 Pin Package
ATMEC 8051 Microcontroller Family

89S52
AT89S52

89x51
AT89S51
AT89C51xx

89x4051
AT89S4051
AT89C4051

89x2051
AT89S2051
AT89C2051

S = ISP
C = CMOS
And after 8051...

ARM 7 as per me.

Because of following reasons
1. ARM7 is considered as link between 8 bit and 32 bit processors
2. Free Toolchain are also available
3. Books are also available.
4. Cheap ARM Development boards are also available