



Hello and thank you for your interest in Microchip's 8-bit PIC® Microcontrollers. My name is Primo Castro, Product Marketing Manager here at Microchip Technology.



Agenda

PART 1

- **8-bit Architectures**

- Baseline
- Midrange
- Enhanced Mid-Range
- PIC18

PART 2

- **Technologies / Peripherals / Tools**

- nanoWatt XLP Technology
- mTouch™
- LCD
- Communications: USB, Ethernet, CAN
- Development Tools

- **Additional Information**

- **Summary**

Today's presentation will focus on Microchip's 8-bit PIC® microcontroller portfolio. In part 1, I will focus on the various 8-bit PIC® architectures. In part 2, I will touch on 8-bit PIC® microcontroller technologies, peripherals, and development tool options available from Microchip today, along with guidance on where to go to find additional resources and information to assist you in getting started. So let's begin.



Why Microchip?

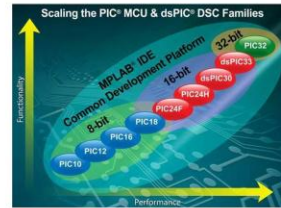
- **Extensive Product Portfolio**

- 8-, 16-, 32-bit PIC® Microcontrollers and dsPIC® Digital Signal Controllers
- Analog & Interface Products
- Stand-alone Memory Products
- Wireless Solutions

- **Easy Migration:**

- Through entire product portfolio
- Pin-to-pin compatibility
- Reuse your existing code!

- **Commitment to customer satisfaction**



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So why Microchip?

Well, for one, Microchip provides an extensive product portfolio to meet the needs of hundreds of diverse customer applications worldwide. Microchip's portfolio includes 8-, 16- and 32-bit PIC® Microcontrollers and dsPIC® Digital Signal Controllers, along with a broad line of Analog, Interface, Memory and Wireless Solutions. So, whether you are designing a simple application or a complex and highly integrated design, Microchip likely has the perfect solution for your embedded design needs.

Secondly, to offer customers a low-risk development environment, PIC® microcontrollers offer seamless migration within the complete range of products. The 8-bit PIC® microcontroller family is pin-compatible within a given pin count as well as code compatible between the architectures. Being able to migrate easily between various PIC® MCUs allows flexibility to react to changing design requirements and feature enhancements. This allows you to maximize re-use for future developments and preserve your investment in hardware, software and tools.

All of this is further enhanced by Microchip's commitment to customer satisfaction, from its world-class customer support and training, to its wide product availability and shortest lead times in the industry. It is this outstanding level of technical support along with dependable delivery and product quality that makes Microchip the supplier of choice for embedded designers.



Target Markets

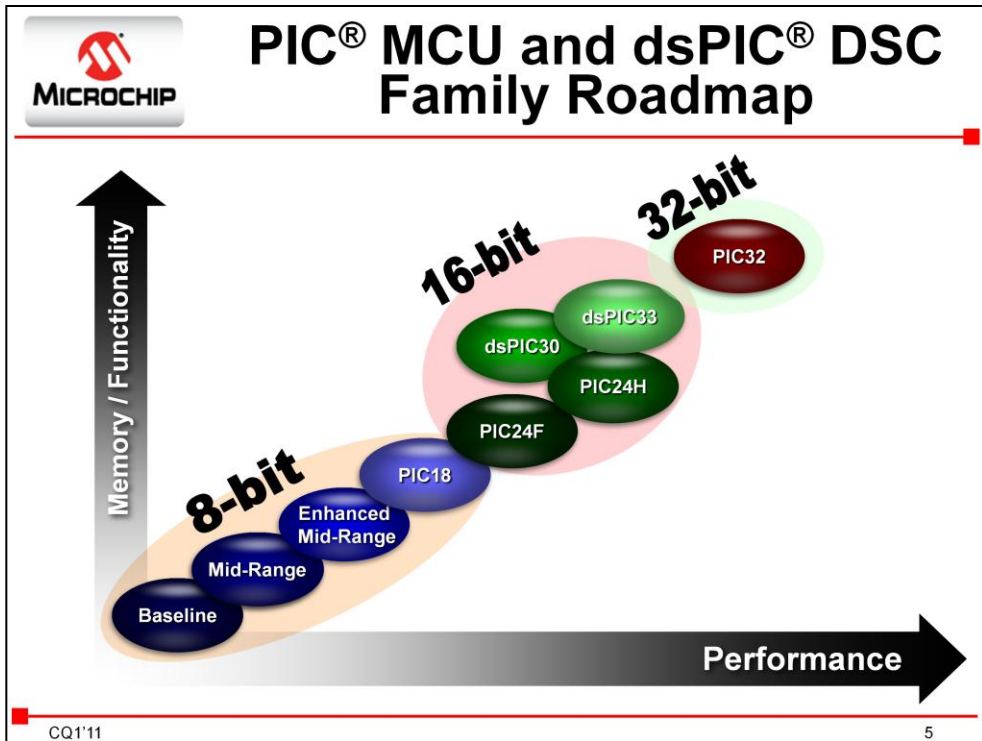
We develop solutions for:

- Home Appliances
- Consumer
- Industrial
- Automotive
- Medical
- Lighting
- Touch Sensing
- Secure Data
- and more!



In regards to target markets, 8-bit PIC® Microcontrollers are well suited for a wide variety of applications – from control logic to fully integrated systems involving USB, Ethernet, CAN, LCD, and Touch Sensing; basically anything with a sensor, user interface, control, or display, along with some “smarts” or intelligence to it.

Applications using 8-bit PIC® microcontrollers today include home appliances (such as smart energy appliances, refrigerators, and blenders); consumer electronics (such as phone chargers, electric shavers, and vacuum cleaners); industrial systems (such as electronic door locks, cargo tracking, lighting, and HVAC control); automotive (such as keyless entry, power seats, and garage door openers), medical devices (such as diagnostic devices and portable medical meters), and the list goes on!



Shown here is Microchip's PIC[®] Microcontroller and dsPIC[®] Digital Signal Controller family roadmap. As you can see, they are categorized as 8-, 16- and 32-bit product families, which translates directly to the microcontrollers' associated data memory width. Furthermore, note that as you move up and to the right of this roadmap, products will have more memory, along with increased performance and more advanced functionality.



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8-bit Architectures

So let's take a closer look at the various 8-bit microcontroller architectures within Microchip's portfolio.



Microchip's 8-bit Architectures

	Baseline Architecture	Mid-Range Architecture	Enhanced Mid-Range Architecture	PIC18 Architecture
Pin Count	6-40	8-64	8-64	18-100
Interrupts	No	Single interrupt capability	Single interrupt capability with hardware context save	Multiple interrupt capability with hardware context save
Performance	5 MIPS	5 MIPS	8 MIPS	Up to 16 MIPS
Instructions	33, 12-bit	35, 14-bit	49, 14-bit	83, 16-bit
Program Memory	Up to 3 KB	Up to 14 KB	Up to 28 KB	Up to 128 KB
Data Memory	Up to 134B	Up to 368B	Up to 1.5 KB	Up to 4 KB
Hardware Stack	2 level	8 level	16 level	32 level
Features	<ul style="list-style-type: none"> Comparator 8-bit ADC Data Memory Internal Oscillator 	In addition to Baseline: <ul style="list-style-type: none"> SPI/I²C™ UART PWMs LCD 10-bit ADC Op Amp 	In addition to Mid-Range: <ul style="list-style-type: none"> Multiple Communication Peripherals Linear Programming Space PWMs with Independent Time Base 	In addition to Enhanced Mid-Range: <ul style="list-style-type: none"> 8x8 Hardware Multiplier CAN CTMU USB Ethernet 12-bit ADC
Highlights	Lowest cost in the smallest form factor	Optimal cost to performance ratio	Cost effective with more performance and memory	High performance, optimized for C programming, advanced peripherals
Total Number of Devices	16	58	29	193
Families	PIC10, PIC12, PIC16	PIC12, PIC16	PIC12F1XXX, PIC16F1XXX	PIC18

Small, cost-effective solutions
Disposable electronics
Add intelligence to existing mechanical functions

Excellent for cost effective mixed signal interface
Low-to-high levels of peripheral integration applications

Improved Performance & Code Density
Faster Interrupt response
Increased Memory & Peripheral integration

High performance involved applications
Advanced communication
Hardware single cycle Multiplier

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At a high level, Microchip has **four** 8-bit architectures, which fill a wide range of pricing and performance options:

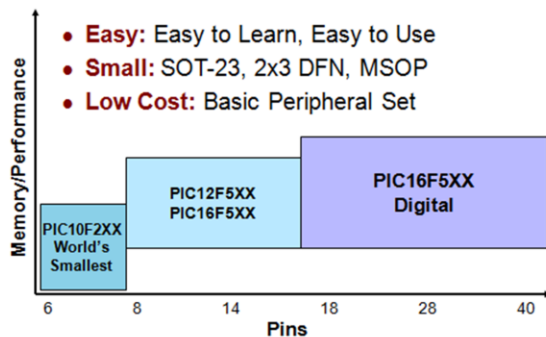
- The low-cost and small sized Baseline family contains PIC10, some PIC12 and some PIC16 devices.
- The Mid-Range family brings optimal cost to performance ratio featuring members of the PIC12 and PIC16 families.
- The Enhanced Mid-Range Family expands on the Mid-Range devices adding more performance and memory at a cost-effective price point. These devices will be identified by the 1 and three subsequent digits following the F in the product identification number.
- PIC18 devices, feature the highest performing members in the 8-bit family adding advanced peripherals such as Ethernet, USB, CAN and Real Time Clock Calendar.

Microchip's 8-bit families feature products in a variety of packages with pin counts ranging from 6 to 100 pins providing flexibility to meet most customer design and space requirements.

Let's now take a look at each of the four 8-bit microcontroller architectures in more detail.



Baseline Architecture



- **Easy**: Easy to Learn, Easy to Use
- **Small**: SOT-23, 2x3 DFN, MSOP
- **Low Cost**: Basic Peripheral Set

Baseline Peripherals:

- **GPIO**
- **8-bit Timer**
- **8-bit ADC**
- **Comparator**

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Baseline devices utilize a 12-bit program word architecture and enable the most cost-effective product solutions. Now, embedded developers can use microcontrollers in applications where they have never been used before. Baseline PIC Microcontrollers provide a pricing structure that makes them nearly disposable, with form factors as small as 2x3 mm they can easily be implemented into the most space constrained designs. This microcontroller family includes an internal oscillator, a comparator, ADC and Data Memory for data-logging, giving engineers the ability to add smarts in various entry level applications. Its low cost and easy implementation can also help designers to replace multiple discrete components with an integrated MCU solution, resulting in additional savings in board space.

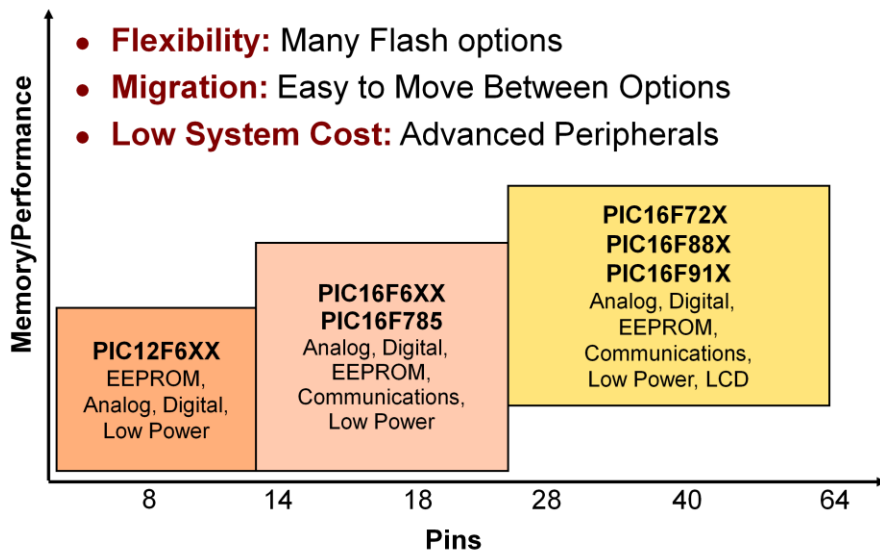
The Baseline family of microcontrollers has a long history – It started with the 16C54, Microchip's first PIC® microcontroller and still continues to this day. There are a lot of firsts in this family:

- The first PIC® microcontroller for Microchip
- The first ever 8-pin microcontrollers - the PIC12C508 and 509
- The first ever 6-pin microcontroller in a SOT23 package

Today these products are all available with Flash Program Memory along with the recent addition of peripherals to the architecture. We've also expanded to a higher pin count at 40-pins where the previous high was 28-pins for the family. As previously mentioned the Baseline architecture



Mid-Range Architecture



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Mid-Range devices feature a 14-bit program word architecture and are available in 8 to 64-pin packages.

These microcontrollers provide 1.8 to 5.5V operation, speeds up to 20 MHz, interrupt handling and an 8-level deep stack, and are available in a variety of peripheral and memory configurations.

They are capable of achieving up to 5 MIPS of performance and some of the newer Mid-Range products also feature nanoWatt XLP, Microchip's industry leading low power technology. With low sleep and dynamic current consumption, these MCUs are highly suited for energy efficient and battery powered applications.

Microchip continues to increase functionality and performance of its products with each successive generation, providing features that help simplify the design of embedded control systems. The Mid-Range families share several features that make designing control architectures for multi-dimensional, interconnected systems easier.

The 8-pin 3x3 mm DFN, 28-pin 4x4 mm UQFN, 40-pin 5x5 mm UQFN allow designers to squeeze high levels of performance into space constrained applications.



Mid-Range Peripherals

General Purpose I/O

Multiple PORTs

Timer-based

(1) 16-bit Timer

(2) 8-bit Timers

Capture/Compare/PWM

Analog

10-bit ADC

Comparator(s)

Voltage Reference

Communication

SPI/I²C

AUSART/EUSART

Human Interface

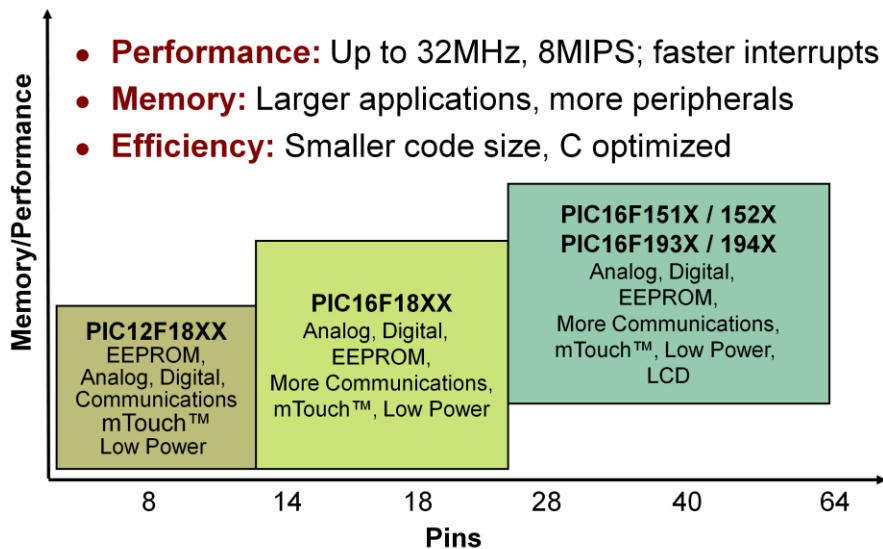
Capacitive Touch

LCD

Midrange devices are available in various peripheral configurations and feature serial analog and digital peripherals, all of which are summarized in this slide. This on-chip integration is valuable since it is often necessary to interface the main microcontroller with external memories, digital sensor ICs, display devices or other controllers in a system. The EUSART and Master SPI/I²C peripherals allow flexibility in configuration to many communication protocols. Furthermore, Microchip's precision 10-bit ADCs and dual comparators with S/R Latch mode can replace costly external ADCs, 555 timers, simple op amps and other analog function ICs, thereby reducing system BOM and PCB footprint.



Enhanced Mid-Range Architecture



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The Enhanced Mid-Range core builds upon the best elements of the Mid-Range core and provides additional performance, while maintaining compatibility with Mid-Range PIC® microcontrollers for true product migration.

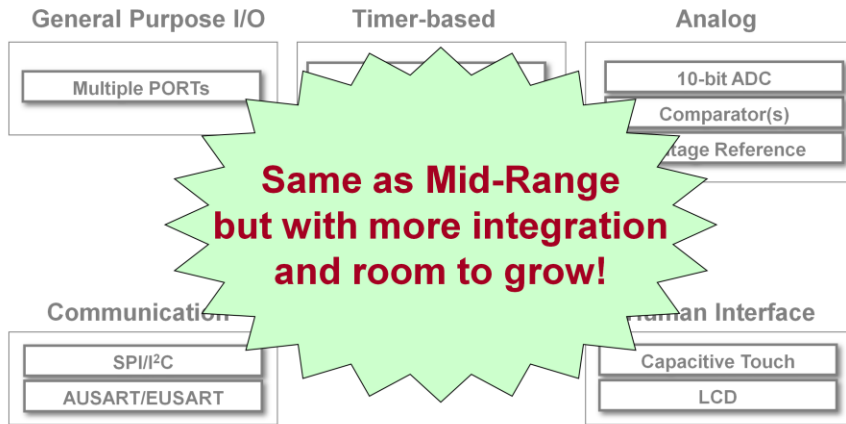
Some of the highlights of the enhanced midrange architecture include:

- Performance increases up to 50%,
- Code-size reductions up to 40%,
- Up to 56 KB of Flash Program Memory,
- Up to 4 KB of Data Memory,
- Up to 32 MHz internal oscillator,
- Optimizations for 'C' programming, and
- 1.8V to 5.5V operation.

In essence, the Enhanced Mid-Range core provides the ability to migrate with minimal effort among existing Mid-Range PIC® MCUs, as well as up or down with PIC12, PIC16 and PIC18 MCUs. All of these result in application longevity, scalability, ease of design and versatility. 8-bit PIC® microcontrollers have always provided a general purpose approach to bringing a higher level of intelligence and reliability into cost sensitive applications. PIC® microcontrollers with the Enhanced Mid-Range core will empower embedded designers to create applications that enrich the user experience.



Enhanced Mid-Range Peripherals

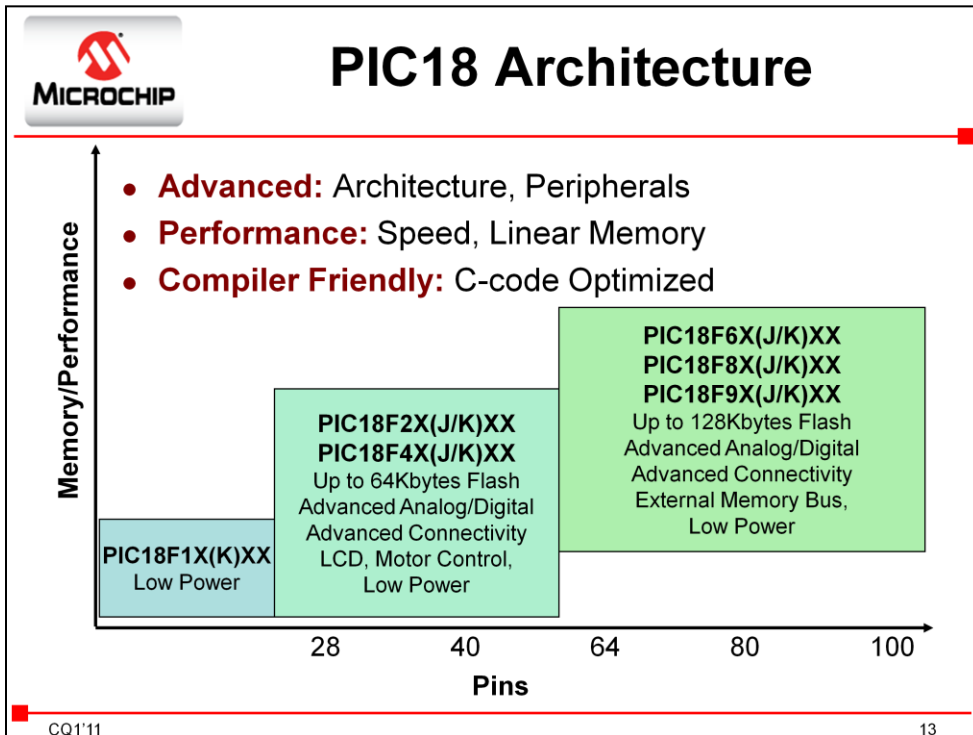


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From a peripheral perspective, the Enhance Mid-Range Peripherals are the same as the previously mentioned Mid-Range peripherals. The primary difference is the Enhanced Mid-Range devices pack much more integration on-chip with more room to grow! More specifically, the increased peripheral support on the enhanced midrange devices include:

- Multiple Comparators
- Multiple SPI/I2C, USART
- Multiple Capture/Compare/PWM
- mTouch Sensing Solutions
- Operational Amplifiers
- LCD Drive Capability
- Analog-to-Digital Converters



The final architecture that we'll discuss today delivers the highest performance in Microchip's 8-bit microcontroller portfolio. The PIC18 family provides up to 16 MIPS with a 16-bit instruction word and linear memory. PIC18 is the most popular architecture for new 8-bit designs where customers want to program in C. Choose from over 150 PIC18 products supporting both 3V and 5V applications with packages ranging from 18 to 100 pins. The PIC18 family has a flexible range of self-programming Flash memory from 4KB to 128KB and up to 4KB RAM. Many PIC18 products conserve power with nanoWatt XLP technology and specialized clocking and sleep modes for battery applications.

The PIC18 J-series balances high performance and complex peripherals with cost-effectiveness. Offering 12 MIPS performance and peripherals for USB, touch sensing, Ethernet and LCD, the J-series products also feature low power performance and advanced analog functionality with a 12-bit A/D converter. The J-series also offers a nice migration path to Microchip's PIC24F 16-bit family since they share the same manufacturing process.

The PIC18 K-series offers eXtreme Low Power technology, on-board EEPROM and high endurance Flash program and data memory. The K-series offers the highest performance in the PIC18 architecture with 16 MIPS, operating voltages from 1.8V to 5.5V, and a 12-bit A/D converter.

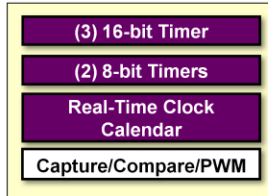


PIC18 Peripherals

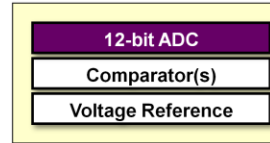
General Purpose I/O



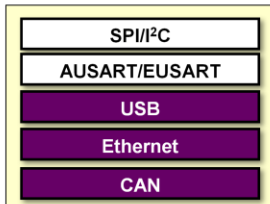
Timer-based



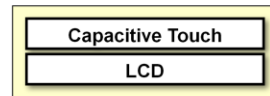
Analog



Communication



Human Interface



Integration is key on the PIC18, with support for advanced connectivity and human interface peripherals including: CAN, USB, Ethernet, Touch Sensing and LCD display drivers – all with free supporting software and application notes to help you get to market faster. We'll expand on each of these advanced communication and human interface technologies on subsequent slides.

Please proceed to Part 2



This marks the end of Part 1. Please proceed to Part 2 of this presentation. Thanks.