Welcome to this web seminar. This is an overview of Microchip’s Development Tools for developing embedded system applications. This seminar will take about 20 minutes. My name is Darrel Johansen and I’m a manager in the Development Systems group here at Microchip Technology.
We'll start with an overview of MPLAB, then look at the specific software components: the project manager, editor, language tools and simulator.

Then we'll briefly cover the hardware tools, including MPLAB ICD 2, the PICSTART Plus and other device programmers such as MPLAB PM3, and then MPLAB ICE 2000 and 4000 in circuit emulators.

We'll highlight some of our Evaluation and Demonstration Kits and PC boards.

And, finally, point out a few of the many additional tools that are available from Microchip.
The centerpiece of our tool set is the software Integrated Development Environment, or “IDE.” MPLAB® IDE has enjoyed many years of evolution, tracking Microchip’s increasing catalog of microcontrollers.
To reach the largest possible audience, MPLAB IDE runs on 32-bit Windows computers,
Microchip Development Tools: MPLAB® IDE and Components

- Runs on MS Windows® PCs

- Hardware and Software Components

... has many hardware and software component tools
Microchip Development Tools:
MPLAB® IDE and Components

- Runs on MS Windows® PCs
- Hardware and Software Components
- MPLAB IDE is Free!

... and is free. It can be downloaded from our website.
The components of MPLAB IDE are hardware and software tools that assist in the creation, design, and implementation of embedded systems using Microchip microcontrollers.

The MPLAB Integrated Development Environment can be viewed as a platform for the rest of the Microchip Technology toolset. A straightforward graphical user interface helps you get your applications finished FAST.
The Programmer's Editor allows you to write and edit source code. The editor is aware of programming constructs and uses color keying on comments, different number types, labels, and reserved words to help you quickly spot syntax errors. It has advanced features such as bookmarks, block indent, brace matching, and block comment/uncoment.

Version control systems can be easily integrated into the MPLAB IDE, so all your editing can be done here.
The Source Level Debugger allows MPLAB IDE to use software or hardware debuggers as your application executes. The capabilities of the software or hardware debugger may differ slightly, but setting breakpoints, stepping through code, and accessing variables and memory values are the same. This provides an easy learning curve when switching from a simulator to an in-circuit emulator.
Introduction to Microchip’s Development Tools

MPLAB and Components

The Project Manager allows you to create and associate source files with the compilers, assemblers, librarians, and linkers to build your final application. All the language tools operate seamlessly when you build a project. Click on compile or link errors to bring up the source code window in the Programmer’s editor so you can quickly fix the problem and rebuild it.

Source files can be used to set breakpoints and single step through your code, so the Editor, Debugger, and Project Manager work together to help you write and finalize your code.
Microchip provides three compilers for PICmicro® and dsPIC® microcontrollers: MPLAB C17, MPLAB C18, and MPLAB C30. These are optimized, ANSI compliant compilers that integrate directly with the Project Manager. MPLAB IDE provides graphical dialogs to set up memory models, to help determine the best optimization, and to control compiler switches.
MPLAB has built-in Assemblers and Linkers for all the PIC® microcontrollers and dsPIC digital signal controllers. A linker is used to combine the output files of the compilers, assemblers, as well as library files, into the final application.

Language tools are configured in the project manager and are called automatically to build your source files into machine code and to produce debugging and documentation files. Compiler optimizations, memory models, warning messages and errors can be set for individual files.
MPLAB IDE includes simulators for all the PIC microcontrollers and dsPIC digital signal controllers.

Simulators are software programs that mimic the operation of the microcontroller, executing instructions, responding to stimulus events on pins or registers, while allowing you to use the MPLAB Source Level Debugger to verify that your code is operating as expected.

Simulators allow you to test and debug your software before the hardware is ready, and allow you to do time measurement of routines to help you evaluate and optimize your code.
In-circuit emulators are hardware instruments that replace the microcontroller in your target system with a probe that functions exactly like the microcontroller. It allows you to halt program execution, inspect internal registers, and single step through your code. In-Circuit emulators can time code execution, halt on complex series of events to help you find subtle bugs, and can trace the execution of code as it executes your application at full speed.

In-circuit emulators include MPLAB ICE 2000
…and MPLAB ICE 4000. These powerful hardware tools offer trace analyzers, time stamping, virtually unlimited breakpoints, and offer the ultimate control over your application during development.
Programmers are the last link in the chain.

Programmers are used to embed the finished code into the PICmicro or dsPIC device so that the target application can run on its own. At that point, the development system tools have finished their work, and you can begin evaluating your application as it operates in its final form, completely separated from the development environment.

Programmers include MPLAB PM3, our newest addition,
PRO MATE® II, and
PICSTART® Plus, our most popular programmer. PICSTART® Plus is intended as an engineer’s desktop prototype programmer, and PRO MATE II and MPLAB PM3 are intended to robustly program the parts according to minimum and maximum operating conditions.
Finally, there is MPLAB ICD 2, the in-circuit debugger, which spans the categories of Emulators and Programmers. It can be used as a cost effective emulator and can be used as a device programmer.

An in-circuit debugger connects up to your application and debugs it much like an emulator. Unlike an emulator, however, the in-circuit debugger does not replace the microcontroller, but communicates with it through some specialized circuitry on selected devices. The in-circuit debugger can program the chip and can then run your application at full speed. You can set breakpoints, single step through code, and inspect and change variables.
Besides these core tools, Microchip provides other resources for application development.
Other Tools Available

❖ Demonstration/ Learning/ Proof of Concept

A wide range of Demonstration, Learning, and Proof-of-Concept PC boards are available to jumpstart an application built around standard hardware. These systems come complete with firmware, source code, schematics, and reference designs that can be used as models for your design, and as a starting point for exploring development with Microchip devices.

These systems usually provide breadboard areas, so known, functional embedded systems PC boards can be extended with prototype circuits, and reprogrammed by the MPLAB programmers with your custom code.
Other Tools Available

❖ Demonstration/
    Learning/ Proof of
    Concept
❖ Third-Party Tools

We have over 120 Third Party vendors who also provide development tools, some of which can be integrated into MPLAB IDE. Check our website for a directory of these manufacturers of software and hardware tools.
Additionally, Microchip provides a number of avenues of training and support. Regional seminars are held worldwide. Check our website for upcoming events in your local area. Web conferences provide public technical support by design engineers and Microchip staff. Our Technical support staff is here for difficult problems that require immediate assistance.

A change notification system provides informational announcements on tool upgrades and broadcasts emails on issues that may affect the use of tools.
Let’s take a quick look at MPLAB IDE.
The MPLAB desktop looks like many other Windows applications.
Pull-down menus at the top allow access to all the features of MPLAB IDE.
The debug section of the toolbar allows running, stopping, single-stepping and resetting the processor with a simple click of the mouse.
Floating the cursor over any icon will bring up a text to describe the icon’s function.
At the bottom of the MPLAB desktop, the status bar provides current information on the debug tool, the processor supported, as well as debug information such as the Program Counter and processor flags.
In a typical debugging session, you have immediate view of all the information on your project set up. You have instant access to all source files in order to edit your code. Breakpoints and single stepping can be done in source code windows, in machine code views, and in mixed C and assembly views.

Trace buffers track and analyze your code so you can view and measure actual program flow. Data and Watch windows allow you to see variables, arrays, and structures from your source code, as well as current I/O, memory and registers on the microcontroller.

The color keyed editor make source code debugging easier, you can set breakpoints with the click of a mouse in your source code, hover the cursor over the name of a variable to see its value, and customize your watch windows to view and modify registers and memory locations.
MPLAB IDE contains many built-in features to help you get started.
Template files allow projects to be constructed with standard “cookbook-type” files. Template files are simple source files that can be built upon to form the starting point of your application.
Wizards are handy for guiding you through complex set ups, and,
Extensive On-Line Help is available for all features of MPLAB IDE and its components. These are among the many facilities to assist you in getting started with MPLAB IDE and its components so you can get your design completed quickly.
On-Line Help

The MPLAB Help system provides detailed information on all its features and components. The help system is an on-line reference for all your questions on MPLAB IDE. Help is organized to allow you to quickly get familiar with the basic operation of MPLAB IDE and to provide instant tips on the various features and tools.

Help is organized by content, has an index, allows searches, and provides a glossary of MPLAB IDE terms.

In addition, the on-line help has “walk-throughs” to guide you through the many features of MPLAB IDE. It also has getting started sections, troubleshooting sections, and extensive reference sections allowing you to get your work done without searching through manuals.
The features of the MPLAB debugger vary a little depending upon which tool is being used.

Software breakpoints can be set on program locations in the target microcontroller, on labels in your program, or upon selected lines or line numbers in your source code.

The simulator, the in-circuit emulator, and the In-Circuit debugger can set breakpoints on complex conditions, such as access to registers, the values of variables, or after a particular routine executes a specified number of times.

Hardware tools such as the in-circuit emulator allow breakpoints based upon signal levels or interaction with other hardware devices.
Complex watch points allow you to examine arrays, structures and variables in their natural formats, as defined in your source code.
Trace buffers allow you to watch and measure the execution of code and help track down complex problems, and to ask questions like:

- How long is the routine taking to execute?
- How often is this routine being called?
- Is all my code being executed?

Breakpoints are useful for getting a static snapshot of your code and the state of the design, but the trace gives you a dynamic view of code execution and often can find a problem quicker than setting breakpoints and single-stepping through many lines of code.
The simulator has complex stimulus capabilities to test how your application will perform when subjected to signals applied to pins or registers.
MPLAB® IDE DEBUG

Breakpoints
  ◦ Address/Label/Line Number
  ◦ Complex condition

Complex Watch Points
  ◦ Arrays
  ◦ Structures
  ◦ Source Data Number Formats

Execution Trace
  ◦ Software (simulator)
  ◦ Hardware (ICE)

Simulator Stimulus
Simulator Output Log

It also can export data to a log file for analysis,
MPLAB® IDE DEBUG

Breakpoints
  - Address/Label/Line Number
  - Complex condition
Complex Watch Points
  - Arrays
  - Structures
  - Source Data Number Formats
Execution Trace
  - Software (simulator)
  - Hardware (ICE)
Simulator Stimulus
Simulator Output Log
Import/Export Data

And you can import and export blocks of data for algorithm development and performance measurement.
MPLAB® Hardware Components

MPLAB supports these Microchip hardware development systems:

- MPLAB ICD 2
- PICSTART® Plus
- PRO MATE® II
- MPLAB PM3
- MPLAB ICE 2000
- MPLAB ICE 4000

We've briefly discussed the Project Manager, Programmer’s Editor, Language Tools and Simulator as the major software components of MPLAB IDE. This section will introduce the hardware components including MPLAB ICD 2, the in-circuit debugger; PICSTART Plus, PRO MATE II, and MPLAB PM3 device programmers; and MPLAB ICE 2000 and MPLAB ICE 4000, the in-circuit emulators.
While the simulator is handy and free with MPLAB IDE, when an application gets programmed into a device, there may be subtle interactions with real-time signals that the simulator can not easily predict. While the simulator can tell you if sections of code are functioning correctly, it is difficult to anticipate all the interactions that will occur when the target hardware is operational. When you are trying to figure out why something is happening or not happening in your application, you often need a hardware debugger.

With an oscilloscope or logic analyzer you can probe the circuits on your design to see if external signals are present on the input pins of the microcontroller, and you can attach to output pins to see activity there. But to efficiently debug your application at this stage, you need to see what happens on these pins when particular sections of code execute. For this you need a hardware debugger. Microchip provides two types of hardware debuggers, MPLAB ICE and MPLAB ICD 2. In this section we'll look at MPLAB ICD 2, the in-circuit debugger.

In this photo, MPLAB ICD 2 is the round red and blue module.

It connects to the target application in order to program and debug the target microcontroller.

It connects with a USB or RS-232 cable to the PC for control by MPLAB IDE.

In this picture, the MPLAB ICD 2 is shown with a Microchip demo board, which will be discussed later.
MPLAB ICD 2 can be a cost-effective solution for debugging. While it does not have the level of complexity of an in-circuit emulator, it does allow your target application to run in real time, and can be used to help debug the firmware while it runs in your prototype or actual finished PC board.

There are a few trade-offs when using MPLAB ICD 2, however.
MPLAB® ICD 2 Resources

- 2 Stack locations

Two stack locations are used by the in-circuit “monitor,” so if a portion of your application uses all the stack, MPLAB ICD 2 will not be able to set breakpoints there.
MPLAB® ICD 2 Resources

- 2 Stack locations
- Some RAM and ROM locations

It also uses some program memory for its “monitor” program and uses some RAM locations while debugging. Your program must not use all of memory while using the MPLAB ICD 2 debugger.
Two I/O pins are required to be dedicated to MPLAB ICD 2 use and
MPLAB® ICD 2 Resources

- 2 Stack locations
- Some RAM and ROM locations
- Exclusive use of 2 I/O pins
- Shared control of Reset pin

...the Reset pin must be able to be quickly toggled by MPLAB ICD 2.

When using the MPLAB ICD 2 as a programmer, none of these restrictions apply. The reset pin and 2 I/O pins are used to program the device, but after programming, MPLAB ICD 2 can be completely removed from your application.
PICSTART Plus is a low cost device programmer for Microchip microcontrollers. It connects to a PC via an RS-232 cable, and programs most parts that are offered in DIP packages, as well as a few others using an adapter. This latest version of PICSTART Plus allows automatic firmware uploading with new versions of MPLAB IDE to support new devices as they are released.

It also comes with a free PICC Lite™ C compiler. The PICSTART Plus programs all memory areas and provides a simple desktop programmer for prototyping.
PRO MATE II and MPLAB PM3 are device programmers that can operate either from the PC or standalone. They can be used for production programming, using min/max programming voltages to ensure that parts are programmed exactly according to Microchip specifications.
MPLAB ICE 2000 is a full featured in-circuit emulator. It differs from the in-circuit debugger in that it has additional features, and does not require the resources from the target. The Device Adapter plugs into the socket on your target application. MPLAB ICE 2000 allows unlimited breakpoints, complex tracing logic, and code coverage verification.
MPLAB ICE 4000 is a high speed emulator, allowing up to 2 Mb of program memory overlay. It has a stopwatch and 48-bit time stamp with its 64K deep 136 bit wide trace analyzer. It also provides code coverage information, and connects to the PC via a Parallel or USB interface.
Beyond these components, Microchip also offers an array of demonstration and evaluation boards. These can be used for prototyping your applications, getting up to speed with Microchip devices, and for understanding specific applications using PICmicro and dsPIC microcontrollers. Kits are available for other Microchip products, as well, such as analog parts and CAN controllers.
The PICDEM 2 Plus Demonstration board is a great way to start off learning about the Flash PIC microcontrollers. It can be used with a number of different PICmicro devices. It has an LCD display and sample code, a Piezo speaker, temperature sensor, LEDs, potentiometers and an RS-232 interface, just to name a few of its features. As shown, it easily connects up to the MPLAB ICD 2 for debugging and programming.
The PICkit™ 1 Flash Starter kit interfaces with MPLAB IDE and programs 8-pin and 14-pin Flash parts. It includes a copy of Hi-Tech’s PICC Lite C compiler, a booklet of Tips and Tricks, and 7 tutorials in assembly and C code to guide you through an understanding of these small PIC microcontrollers.
The PICDEM.net demonstration board is a great way to get bootstrapped into connecting your embedded design to the internet. It includes a large prototyping area for your custom circuits, Free TCP/IP software and can easily be used as an HTML web server. It comes with a copy of the textbook named “TCP/IP Lean: Web Servers for Embedded Systems”
PICDEM™ 4 Demo Board

- Supports 8/14/18-pin devices
- LCD Display
- Prototyping Area
- SuperCapacitor Circuit
- Areas for LIN and motor control circuits

PICDEM 4 is one of our newest demonstration boards, and supports a variety of 8-, 14-, and 18-pin DIP microcontrollers. Next to a prototyping area, there is an LCD display, an RS-232 connector, a connector for MPLAB ICD 2 debugging and programming, push button switches, LEDs, and a SuperCapacitor circuit. A LIN transceiver and a motor driver IC can be directly soldered into unpopulated DIP circuits on the PC.
The PIC18FXX20 Demo board provides a convenient circuit for exploring some of our larger memory devices. It contains an interface for MPLAB ICD 2 debugging and programming, a prototyping area, temperature sensor, potentiometer and LEDs for quick experimentation, and has connector pinouts for external connection to any of the pins on the PIC18FXX20 parts.
The dsPICDEM™ board uses the dsPIC30F digital signal controller, allowing you to experiment with digital audio, among other things. This full-featured board includes a connector for MPLAB ICD 2 hook up for programming and debugging, an RS232 connector, connector for RS485 and RS422 communication, a CAN communication channel, a voice based CODEC circuit, thermal sensor, digital potentiometer, large LCD, LEDs, pushbuttons, and a large prototyping area.
Other free tools are available that work in conjunction with MPLAB IDE. These are available for download from our web site. Digital filter design is made easy with our Filter Design package for the dsPIC30F devices.

The Visual Device Initializer helps you set up initializing code for dsPIC30F and PIC18 devices. No need to rummage through a data sheet to find register configuration values and enable bits. It’s all done quickly with a graphical tool showing you the pins used, and quickly identifying resource conflicts.

A TCP/IP stack is available for connectivity applications.

The dsPICworks™ visual algorithm analyzer provides a variety of 32-bit floating point or 16-bit fractional signal generators, has powerful arithmetic and digital signal processing tools, such as FFT, convolution and correlation, sample rate conversion, and digital filtering. It can display data in a variety of formats, as charts, graphs and with 3 dimensional plots. Files can be imported and exported to the MPLAB IDE.

A host of software libraries exist for C and assembly language programming. And more software is coming. Check our website for the latest free downloads.
So, in summary we’d like to answer the question, “Why Microchip Tools?” Microchip has long been noted as having a strong commitment to Development Tools. Without good tools, embedded systems design can be frustrating. Our tools have these advantages:
The Microchip Development Systems group is dedicated to high quality. Our processes are certified to ISO 9000 and are audited yearly to ensure that our quality improvement process is helping us produce and maintain robust tools.
We have quick delivery. Order tools through your local distributor, via the internet, or buy on our web site.
Microchip has free technical support. No credit card fees are required for support. Our staff of corporate application engineers has years of experience with embedded systems designs. We also maintain web conferences where users can post questions and get help from their peers as well as Development systems engineers.
Summary: Why Microchip Tools?

- High Quality: ISO 9000
- Quick delivery
- Free technical support
- SAR “no hassle” replacement

If a tool develops problems, we have a quick turn around service authorization request program. Our goal is 48 hour turn around.
Because Microchip makes the tools for our silicon, you are assured that there will be no “finger pointing” when and if there are problems. The buck stops here and we’re dedicated to solve your problems and assist you in getting your design out the door.
Summary: Why Microchip Tools?

❖ High Quality: ISO 9000
❖ Quick delivery
❖ Free technical support
❖ SAR “no hassle” replacement
❖ Our Tools, Our Silicon, Our Issues
❖ World Class - Reasonably Priced Tools

Last, our tools are world class, yet still reasonably priced.
Summary: Why Microchip Tools?

❖ High Quality: ISO 9000
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❖ Our Tools, Our Silicon, Our Issues
❖ World Class - Reasonably Priced Tools

Quality * Availability * Support * Service * Value

For quality, availability, support, service, and value, Microchip Development Systems provide a cost effective solution for your embedded design projects.
If you haven't already done it, now is the time to get started with MPLAB IDE. Simply go to our web site or contact your local Microchip Sales Office for the latest MPLAB CDROM.

That is the end of our presentation. Thank you for your time.