Analysis of the Innovative Subatomic Particle Demonstration Platform

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Analysis of the Innovative Subatomic Particle Demonstration Platform

Creating an interactive, multimedia method that allows engineers to quickly and conveniently learn the capabilities of advanced, easy-to-use software for designing and debugging embedded systems.

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1. Introduction

As the electronics market continues toward a commodity market, the cost associated with a design has shifted from hardware to software. With the reduction in cost of the hardware, more concern is being placed on the design and sustainability of the application. In many cases, the development time for the software component has exceeded 75 percent of the design cycle and, as such, the cost associated with the development of an application has rooted itself in software.

Knowing this, it's no wonder that most engineers consider the selection of development tools and the access to pre-developed code, such as drivers, middleware and sample projects, as a primary decision factor when selecting a processor vendor. Therefore, after suitable microcontrollers (MCUs) or microprocessors (MPUs) have been identified, the focus of attention shifts to the software tools, drivers, sample code, etc., all of which must be evaluated before the best device for the system can be selected. A project's success truly depends not only on the quality of the code produced for the embedded design, but also on the quality and usability of the software tools used by the engineers who develop that code.

To engineers, having access to information about the latest tools and software is obviously critical in making their embedded project successful. Historically, to do this, hardware companies sent an engineer to the customer's site to discuss and demonstrate the capabilities of devices and support products — a manpower intensive solution that has to be scheduled in advance, but works well. Now, there is an alterative method to enable engineers to get a great, self-guided interactive demo/tutorial, conveniently, whenever it was best for them to do so.

Analysis of the evaluation kits available on the market revealed that most of the development forethought had been placed on the hardware. If a user's guide was provided, it was either too simplistic or contained errors — or, worse, both. Moreover, a range of concerns were noted, any of which could result in a frustrated engineer and poor rating for the device being evaluated. In some cases, the experience was so bad that the kit was likely to be discarded before the evaluation was finished. Among the problems discovered were the following:

1. Installation procedures were often clumsy, and overly burdened with mouse clicks and erroneous user inputs.
2. Software tools failed to install correctly.

3. Hardware didn't operate correctly or required additional components, such as a power supply and cables.
4. Hardware and software components failed to operate with one another.
5. Large number of shunts and jumpers were required, which could be lost and or improperly positioned, thereby leading to future configuration problems.
6. Hardware that was overly simple, or unnecessarily complex, for assessing the target MCU or MPU.
7. Example code and projects (when supplied) often were remedial and provided little insight into device and tool performance and capabilities.
8. Setup and startup instructions were cumbersome, unclear, or incomplete.
9. There was no explanation of the IDE and/or toolchain — despite the fact that their operation wasn't nearly as intuitive as might be expected — creating delays and annoyance.
10. Often it was necessary to call the device manufacturer for help before getting the kit's system board to work.

In all likelihood, the root cause of bad user-experience problems is the limited resources allotted to the design of the kits, which have to sell at low prices or are free. The typical solution, a Quick Start Guide (QSG) generally helps somewhat, yet it typically has its own set of problems. First the term *"Quick"* emphatically states that no specific instructions will be given on ways to accomplish complicated procedures. Secondly, a QSG cannot provide in-depth explanations about tool operation without becoming too long. Clearly, a better alternative to contemporary evaluation kits was needed.

2. Checklist for Creating the Platform

When the development of the Renesas Subatomic Particle board began, the focus was placed equally on the hardware <u>and</u> software. Specifically, the following checklist was created to ensure a better solution that engineers could use to evaluate MCUs and MPUs and their associated support tools:

- Develop an interactive software tutorial to replace the Quick Start Guide.
- Write good software and test it.
- Make project code complete and useful.
- Make the installation process as easy as possible by minimizing user input and making the install software more intelligent.
- Minimize the "dead time" during the installation by providing users with an overview of Renesas and what they should expect from the new Demonstration Platform.
- Make the evaluation board in the Demonstration Platform a *"living item"* that can be updated with new code and interactive software to keep it current and extend its lifetime.
- Provide instructional videos covering both software tools AND hardware devices.
- Inform the user about third-party choices for development tools, IP, and more.
- Provide "Next Steps," such as device samples, ways to buy development systems, and improved methods for searching for specific part numbers.

3. Introducing the Subatomic Particle Board Demonstration Platform

The end result of the development efforts, which were guided by the preceding checklist, is the Renesas Subatomic Particle Board (SPB) demonstration platform, a new concept that obsoletes the previous norm in evaluation kits. While giving engineers a much more pleasant and productive experience, it is likely to enhance fair and unbiased evaluations of hardware devices and tools and increase the value of the kit to users.

The innovative SPB successfully marries several existing technologies in a manner not fully realized until now:

- MCU/MPU evaluation.
- Adobe® Flash technology.
- Windows® COM technology.

To facilitate the linkage between these core technologies, special, interface software was developed, utilizing a proprietary COM (Common Object Model) module, called "HEW Target Server," or "HTS" for short. Unique in its operation, HTS exposes the elements and functionality of the Renesas' HEW (High-performance Embedded Workbench) integrated development environment (IDE). Due to this exposure, engineers can use HTS to take control of the Renesas software tools. With HTS they can also reach through the Renesas software tools directly into the target MCU or MPU and manipulate memory, peripherals, and registers. This is accomplished over the target's existing debug channel, without the need for any additional physical means of communication (see Figure 1).

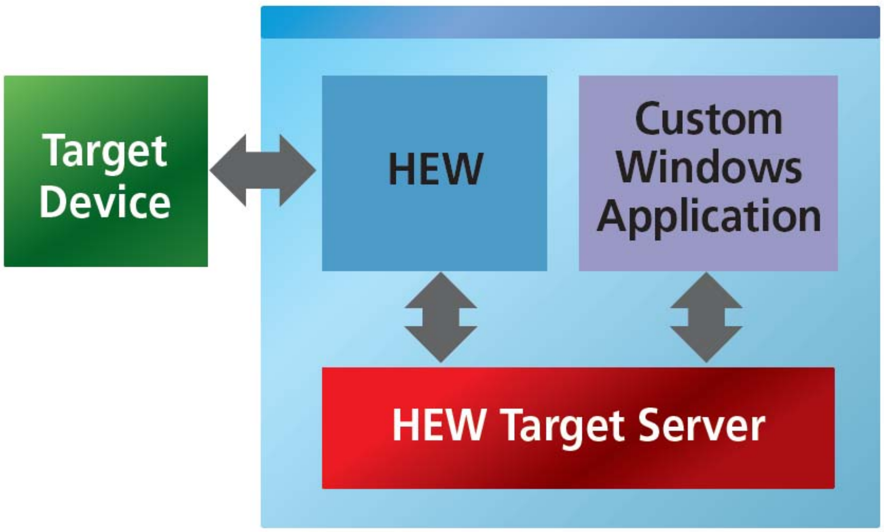

Fig. 1

The combination of the SPB's interface software and HTS gives engineers a truly interactive demonstration and learning environment. The software system informs users how and when to perform a given procedure, then monitors events and provides feedback when something has been done incorrectly (see Figure 2).

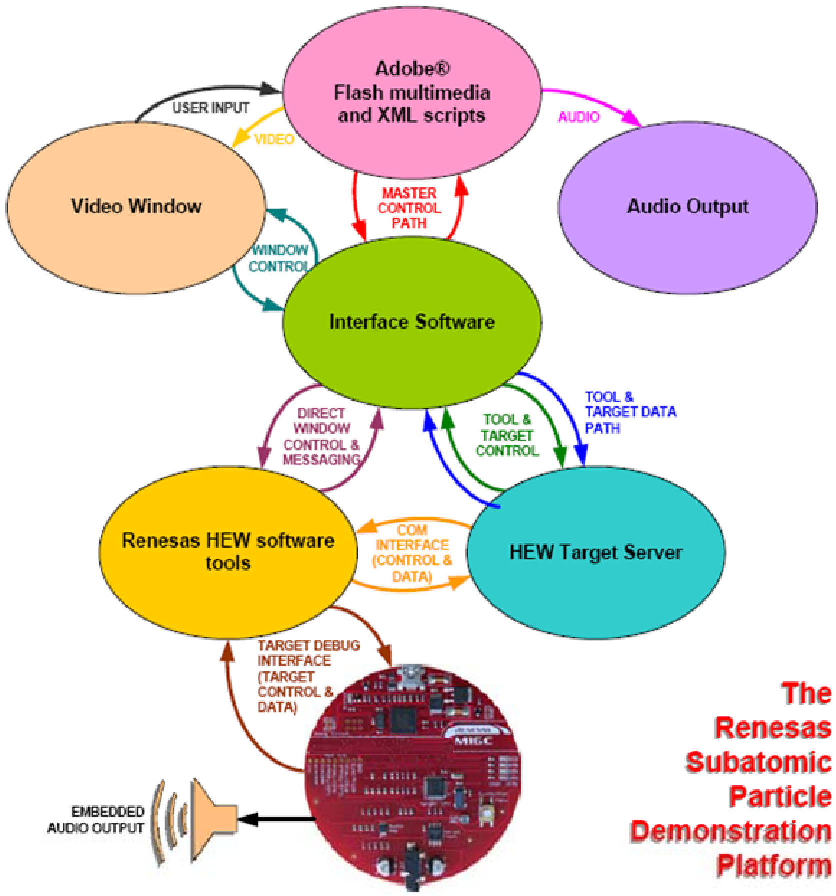

Fig. 2

This interactive capability, which is flash-video based, made it possible to eliminate the traditional QSG, replacing it with a series of highly functional scripts and tutorial files. Thus, resources are built into the SPB that not only ease the installation of the software tools, but can also guide users step by step through various processes. Engineers get clear, concise instructions based on their inputs and actions within the software tools.

It has been said that a picture is worth a thousand words. The SPB has shown that a well-executed flash video is worth much more — more than sufficient to justify the development cost involved.

2.2 The "Request then Monitor" Process Engages the User

An example of the creative interactivity implemented in the SPB is a tutorial script asking the user to fix some bugs that were intentionally placed in the code, causing errors that were detected during the build process. The tutorial then demonstrates the process of finding and correcting errors and asks the user to do the same. After the user has successfully done so, the tutorial script prompts the user to perform a new build of the project.

When the compiler completes that operation, HTS detects this and reports the completion of the build operation to the controlling Flash script. It responds by checking to see if a downloadable ".X30" file was created. The existence of a ".X30" file verifies that the build was completed without errors. If the compiler hasn't produced such a file, then the Flash script asks the user to go back and use the same procedure as before, to correct the errors in the code.

In summary, this interactive tutorial has been written in such a way that it can detect and respond to a myriad of user and development tool stimuli, just as if the exercise had been monitored by an application which guided the user through all the steps necessary to illustrate a successful problem detection and solution process.

It is the "Request then Monitor" process that makes the flash script a truly interactive experience and not just a standard instructional video. As with any scenario, some situations are outside the scope of the HTS/HEW link. When this occurs, the issue is usually remedied using an application called the "Interface Software," which is written in Windows .NET. This application detects when a window has opened, a .X30 File exists, or the SBP USB Driver is active. All of these events are reported in status variables back to the Flash Program, which controls the instruction based upon the variables.

The end result is that four software packages work together to enable this interactive environment: HEW, HTS, the Interface Software, and the flash tutorial. Obviously, therefore, in the context for the SPB, the term "interactive" designates a process — a capability — that's significantly more complex in the background, but much more effective in terms of the user experience, than a simple video guide.

2.3 The "Bullet Proof" Demonstration Board with Intentionally Inserted Bugs

Of course, the effectiveness of interactivity would be limited or nil if the SPB demonstration platform was in any way weak or faulty. Thus, users can be sure that a significant amount of time was spent developing and testing the tutorial scripts to ensure they are as close to being "bullet-proof" as possible.

Yet despite this fact, known bugs were inserted into to the code to implement an important part of the instruction. Yes, the bullet-proof code has bugs in it! But are intentionally placed bugs truly bugs at all? Bugs were placed intentionally in order to demonstrate the debugging process, an important part of the learning process to understand the software and tools. They are the key enablers of a capability, after all.

In developing the SPB, Renesas deliberately avoided producing a basic "Hello, World" type canned tutorial. Instead the implementation lets the user play stereo ".wav" files from the target board using simple instructions. The flexible design allows the user to change the sound files to whatever they like. This capability for the tutorial and benchmarking software is enabled by the resources built into the circuit board, such as 1Mbyte of SPI flash, an audio amplifier, a 2.5mm stereo jack, a pushbutton switch, four LEDs, and a light sensor. These on-board peripherals give the engineer various ways to exercise the MCU or MPU on the target board, so they can witness the power of the tight coupling between the software and the hardware.

3. Installer Enhancements

Activities aimed at smoothing out and accelerating the software installation experience have been ongoing at Renesas for years. This is no small task, as evidenced by the fact that typical evaluation kits now include as many as 6 individual installers. The SPB has installers for the HEW IDE (multiple versions, based on MPU/MCU family), the Flash Development Toolkit, AutoUpdater, etc. In reality, therefore, the main installer is really a wrapper for the other installers.

In general, the installer asks users to agree to an end user license agreement (ESLA), then asks what software is to be installed, and verifies those selections. Then the wrapper starts the required installers for the selected program elements and provides the inputs required by the installation program, allowing the user to simply wait while the installation is performed automatically. The SPB, however, adds an additional capability to simplify the installation process. To improve the process, a video has been added to guide users as the installation progresses.
By playing multimedia files during the installation, the SPB enables the engineer to learn interesting and useful pieces of information that can later be used during their evaluation of the platform. Time that might otherwise be wasted is put to good use.

The video is a short introduction that summarizes the corporate facts of the company, as a leading global system LSI supplier, provides an overview of what the Subatomic Particle Board is, and highlights what the user will experience. It also provides information on available support resources, which range from educational courses to the products and services offered by third-party suppliers. Viewing the video is both more pleasant and more beneficial than just watching a progress bar move across the screen, and has been well received as a result.

3.1 Extended Lifetime

The analysis of available evaluation kits revealed that too often they quickly become obsolete as technology advanced, and thus were abandoned to collect dust or fill the trash barrel. To give the SPB greater longevity, extended "staying power," it was given a link to the Renesas AutoUpdater utility. This utility allows users to not only download new versions of HEW and HTS, but also to download new interactive tutorials as they are produced.

Among the ideas under consideration for new instructional material are scripts on how to perform firmware coverage analysis, ways to make a project portable, methods for setting up interrupt service routines (ISRs), etc. The addition of new material would help keep the SPB in the roster of design tools that engineers keep at the ready.

4. Endless Education

Many engineers want to take advantage of any training offered by their favorite MCU/MPU supplier. To address this issue, the user can access interactive training courses from the "Activity Center" that the SPB supports. Those courses provide an accurate idea of the type of material they can access by navigating to the vast library of material at the Renesas Interactive website.

Furthermore, because many design engineers rely on third-party suppliers for everything from drivers to graphics files to software stacks, special tutorials from three technology partners have been created for the launch of the SPB, with more to come. Specifically, tutorials are included from IAR, Segger, and KPIT Cummins covering their tools, drivers or software.

4.1 Three Different System Boards

Three different versions of hardware are available for the SPB: the M16C family, the R8C family, and the H8 family. Each of the three system boards has been designed to showcase the features and capabilities of the MCUs in their respective product lines, so users can perform the careful analysis appropriate for the requirements of the application. Obviously, the boards implement cross-platform functionality and features in order to work in the SPB. To this end, each of the hardware designs contains a number of common features, as shown in Figure 3. They include the following:

- USB debug link
- On-board debugger circuitry
- 1 Mbyte SPI Flash
- Audio amplifier
- Pushbutton switch
- 3 User LEDs
- 1 Power LED
- Light sensor
- 2.5-mm stereo jack
- Expansion Header
- Power obtained via a USB port

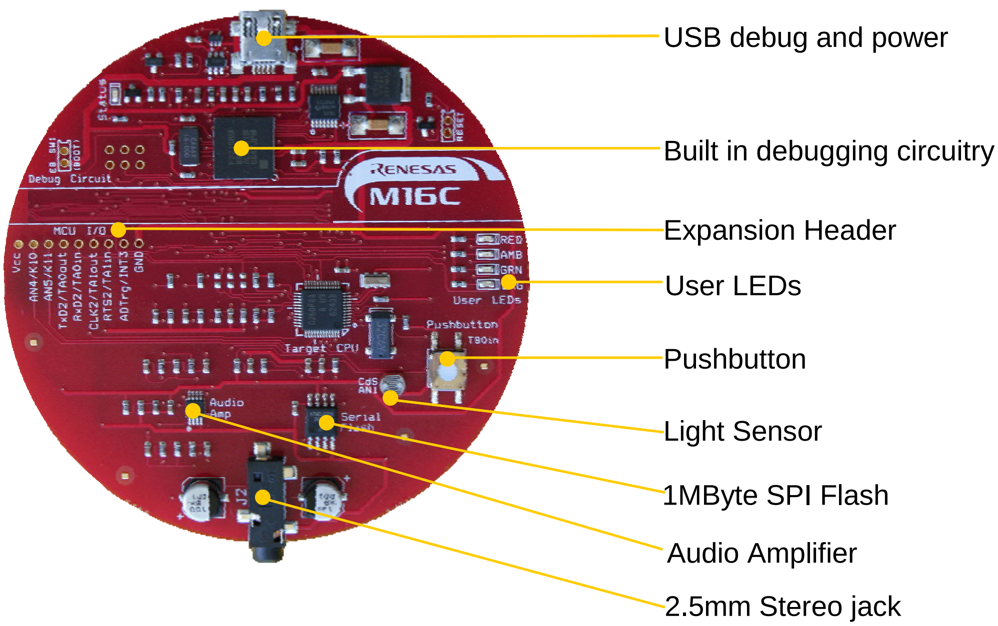

Fig. 3

4.2 A Toolkit Expansion

The SPB Demonstration Platform is a new addition to the support tools that Renesas provides. It does not replace any existing tool, and complements the various popular Renesas Starter Kits (RSKs). Rather, it is an innovative product for introducing new users to the values and benefits of the Renesas solutions for embedded systems. Figure 4 provides some perspective on the position the SPB holds relative to other support tools.

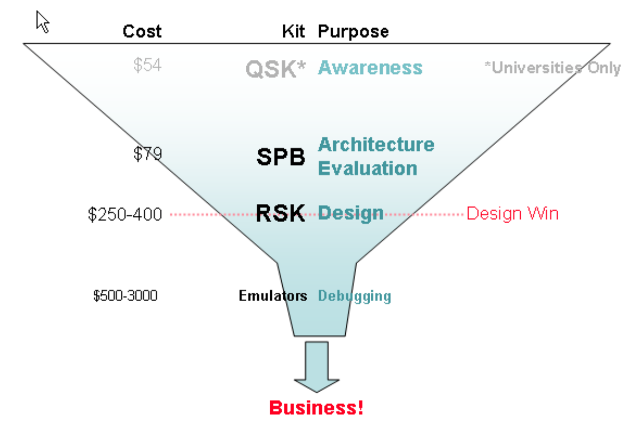

Fig. 4

5. Conclusion

The SPB offers much more functionality than that of an evaluation board, but doesn't have anywhere near as much cost and complexity as a development board. It's particularly effective because it both demonstrates software development tools to the user in an engaging way, and lets the user perform their own application-specific evaluation.

The Renesas SPB Demonstration Platform gives engineers a unique tool for software and hardware evaluation platform — a tool designed to deliver long-term value and benefits. Customers can use it now and then download new features as they become available to enhance their level of knowledge and understanding of various aspects of embedded system design and debug.

6. Additional Resources

For more information, please visit the following links:

http://www.America.Renesas.com/SPB

http://www.RenesasRulz.com/SPB

http://www.RenesasInteractive.com/SPB

Also, additional resources are available at these Renesas Eco System sites:

www.RenesasRulz.com

www.RenesasInteractive.com