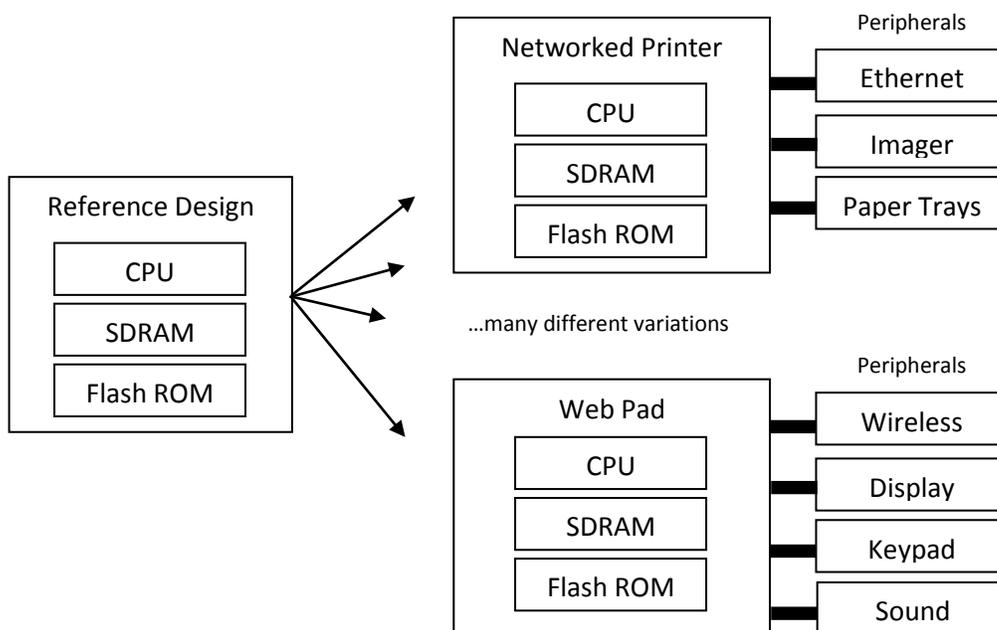


Minimum Requirements for a Windows CE Board Support Package

Kurt Kennett, Senior Software Design Engineer, Windows Embedded CE

Windows CE is an excellent choice for a small and feature rich OS that you can adapt for many different situations, from embedded components inside printers and elevators to user-interface driven products like kiosks and mobile phones.

Windows CE is easily portable to different systems and allows you to customize a reference design for your system to suit your particular purpose. For example, if your reference design circuit board has a specific CPU, SDRAM, and persistent memory you can build devices using the core components and peripherals that suit your needs.



If Windows CE is adapted to the reference design in a way that allows for easy extension and customization, then a great number of products can be created from that reference design. Any testing and development you perform on the reference design can be applied directly to the derived designs and strengthens the basic platform.

The board support package (BSP) for Windows CE is a collection of software components that adapts the generic parts of the OS kernel and peripheral management to a specific reference board with a specific set of peripherals. If your reference design includes a robust BSP, then the products you create using the reference design and any BSPs derived from the reference BSP will benefit.

The following are the minimum hardware components required for your BSP to have all the code and configuration files that you need to build your product. There are no required peripherals, power considerations, or I/O mechanisms.

- **CPU**
 - Windows CE-supported architecture (MIPS, X86, ARM, SH)
 - Memory management unit capable of 32-bit virtual memory (4GB)
 - 1MB of contiguous physical SDRAM
- **Synchronous dynamic RAM (SDRAM)**
 - Accessible on byte, word, or dword boundaries by using the appropriate instructions in the architecture instruction set
- **Persistent Storage (optional)**
 - This is optional because while it may be present on a board it is not required for a BSP to let a board function and be useful for development.

The minimum software components of a BSP can be categorized as three required entities:

- Boot loader
- Windows CE kernel OEM adaptation layer (OAL)
- Windows CE kernel independent transport layer support (KITL)

The following descriptions and requirements assume a significant knowledge of Windows CE low-level interfaces.

Boot loader

The system boot loader is software that takes the system from the initial power-on state to a state where the Windows CE operating system code for your CE OS image begins to execute. Your boot loader software must meet the following requirements:

- Turns on the board.
- Initializes any configurable chip pads and general purpose I/O (GPIO) to inhibit non-intentional peripheral use or activity.
- Initializes system CPU, peripherals, and any auxiliary oscillators or clocks to known default values. Summarizes this information into the bspspecs.txt standard ASCII text file document. There is a template for this file at the end of this paper.
- Initializes any configurable power regulators for CPU, SDRAM, persistent store (if supported), and KITL transport. Summarizes this information into the bspspecs.txt standard ASCII text file document. There is a template for this file at the end of this paper.
- Configures any battery-charging hardware or equipment so that no damage is possible to the board, to any board peripherals, or to any battery that is connected to the system while the boot loader is running.
- Initializes primary SDRAM so that there is at least one physically or virtually contiguous region of at least 1MB in size that is freely and directly accessible by the CPU.

- Optionally initializes access to primary persistent storage (NAND,NOR, Hard Drive, P-ROM) so that physical data blocks, pages, or sections can be read and written.
- Supplies a half or full duplex stream I/O 8-bit-wide channel that runs at a minimum of 38400 baud to a standard TTY data terminal which is physically separate from the board hardware. This can be an RS-232 or similar serial port. Must identify the physical connection point of this channel and any associated properties in the bspspecs.txt standard ASCII text file document. There is a template for this file at the end of this paper.
- Allows optional use of the above channel to configure the boot loader software to do the following:
 - Denote whether KITL should be enabled or disabled
 - Configure KITL transport
 - Select KITL mode (passive, active)
- Includes a fully functional, stable KITL transport.
- Downloads a standard Windows CE OS NK.BIN file image over a KITL transport to SDRAM.
- Passes arguments or persists a data area containing configuration of KITL that the OAL software can access when it starts up.
- Is able to relinquish complete control of the board by jumping to the physical SDRAM entry point address of the NK.BIN image.

OAL

The OAL is the adaptation layer that lets the Windows CE architecture-specific kernel work on the specific board of the board support package. It provides facilities the kernel needs to perform processes and threads and to use virtual memory. The OAL must meet the following requirements:

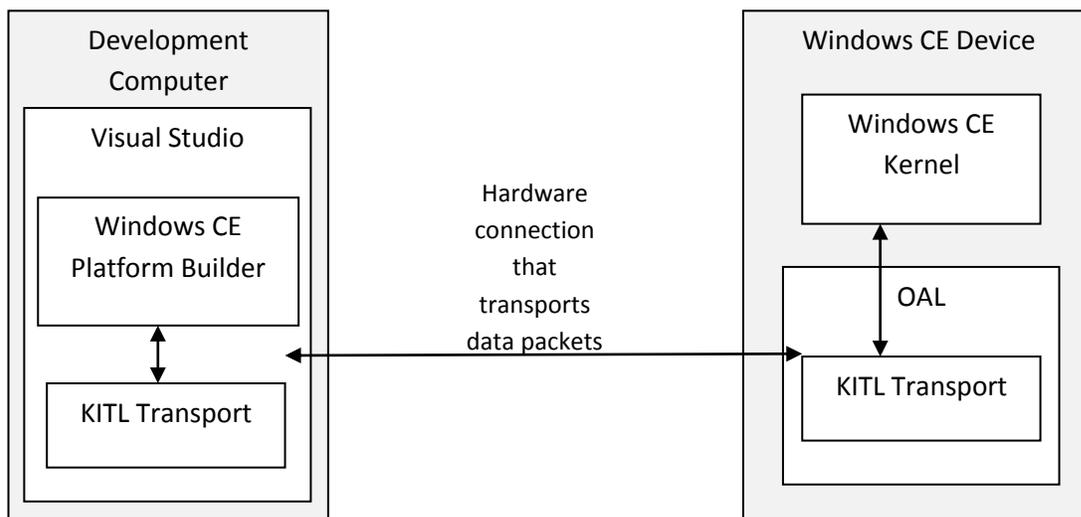
- Is able to read the KITL configuration information that the boot loader passes as an argument or stores in a persisted data area.
- Implements the system scheduling timer and handles its tick interrupt appropriately with no more than 10 microseconds between OS timer ticks.
- Implements or emulates the system real-time clock routines, including the real-time alarm. Responds appropriately to a real-time alarm set and activation via hardware or software interrupt assertion.
- Supply a half or full duplex stream I/O 8-bit-wide channel that runs at a minimum of 38400 baud to a standard TTY data terminal which is physically separate from the board hardware. This can be an RS-232 or similar serial port. Must identify the physical connection point of this channel and any associated properties in the bspspecs.txt standard ASCII text file document. There is a template for this file at the end of this paper. Support output of the argument passed to OEMWriteDebugByte() OAL function to this channel.
- Maintains any battery charging hardware or equipment so that no damage is possible to the board, to any board peripherals, or to any battery that is connected to the system while the OS image is running.
- Implements KITL support for kernel debugging. Ensure operation of the following:

- The same KITL transport used by the boot loader, usable without additional information or configuration apart from the KITL configuration information that the boot loader provides.
- A dynamically linked KITL transport configuration (including KITL.DLL being absent).
- Permits active or passive KITL initialization that the boot loader passes as an argument.
- Supports an OS design configuration that includes the `SYSGEN_SHELL` (CESH debugging shell) `SYSGEN` variable.

KITL Support

The kernel independent transport layer (KITL) is the connection between the OS kernel that runs on your board and the kernel debugger and diagnostic systems that run on your development computer. To support KITL, a data transport facility must be built into or dynamically augment the OAL software described above. For more information on understanding KITL, see this Microsoft Website: <http://go.microsoft.com/fwlink/?LinkId=153802>.

When the OAL is started and KITL is being used, the KITL transport can connect to your development computer. Once connected, the transport sends and receives opaque data packets.



A BSP can support more than one type of KITL transport, but only one transport can be active while the board is in use. Examples of KITL transports are USB remote network driver interface specification (NDIS) (network card emulation via USB), USB serial (serial port emulation via USB), Ethernet (802.3), and RS232 serial. Your BSP must meet the following minimum requirements to support KITL on Windows CE:

- Supports active KITL. (Passive is preferred.)
- Supports polling mode. (Interrupt mode preferred.)
- Transport must disable any associated hardware from being used in the OS by OS drivers.

Supplemental Requirements

- Supports any OS design configuration running on the board for 60 minutes without interruption.
- BSP source builds without warnings or errors.
- A reference guide for a board or an SoC should be provided by the manufacturer.

A BSP that conforms to the above requirements is a solid foundation from which a wide variety of products can be built.

BSPSPECS.TXT template

BSP: <name>
MAXIMUM CPU SPEED: <XXX> Mhz
MAXIMUM CPU BUS SPEED: <XXX> Mhz
DEFAULT SDRAM SIZE: <XXX> MB at physical address <YYY>
DEFAULT DEBUG OUTPUT CHANNEL: <XXX> at <XXX> Baud, parameters <XXX>

DEFAULT PIN CONFIGURATION:

Pin <XXX> as <YYY>
<show all configurable CPU pads/GPIO pins and what they are configured to by default>
...

DEFAULT CLOCK TREE:

<show tree from initial oscillator or crystal down to all peripheral clocks>
...

DEFAULT POWER CONFIGURATION:

RAIL: <XXX> set to Y.Z V DC
<show all distinct power rails and/or LDOs and what their default settings are>