Embedded Operating Systems in a Point of Sale Environment

White Paper

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Embedded Operating Systems in a POS Environment

Overview

Fortunately today there are a number of very good Operating Systems (OS) options available that work well for Point of Sale computers. This has not always been the case but things have progressed. This document will briefly try to list the different operating systems available and explain their benefits and limitations.

POS Operating Systems

On the next page is a list of the operating systems widely used for POS systems. There are others available but these are the ones J2 would recommend for new systems. The older OS that are still used, like Windows 2000 and Windows 98 are now running into (delete -a lot of) support and update issues and are not supported on newer POS hardware.

In addition to the Microsoft Windows platforms and Linux systems, other options are available such as a number of RTOS (Real Time OS) and older legacy OS (such as DOS and Free DOS). Although these systems can be extremely stable platforms there are development costs, a lack of tools plus some support issues which could preclude the use of the OS's; however for some customers they still make sense. J2 currently still provides drivers for network and touch for DOS on 580 and 650 POS systems, but this is normally only used for OS image loading.

Microsoft's web site has a lot of good information on their Embedded OS platforms, here is a link: http://www.microsoft.com/windowsembedded/en-us/default.mspx

Operating Systems Availability

Operating System	Availability from 2008	Recommended CPU Speed[4]	Recommended Memory	OS Size	HDD, SSD	Auto Update	CF	RAID 650	650	580
Windows Embedded Enterprise, Vista Business	2018	Dual Core 2 GHz +	2GB	40GB	Yes	Yes	No	Yes	Yes	No
Windows Embedded Enterprise, XP Pro	2014	Celeron 1 GHz +	1GB	2GB	Yes	Yes	No	Yes	Yes	Yes
Windows XP Embedded, XPE	2012	Celeron 1 GHz +	512KB	1GB	Yes	No	Yes	Yes	Yes	Yes
Windows Embedded Standard	2018	Celeron 1 GHz +	512KB	1GB	Yes	Yes	Yes	Yes	Yes	Yes
Windows Embedded for Point of Service, WEPOS	2017	Celeron 1 GHz +	1GB	2GB	Yes	Yes	No[1]	Yes	Yes	Yes
Windows CE 6.0	2017	600 MHz Celeron +	512KB[3]	64MB[2]	NA	No	Yes	No	Yes	Yes
Linux	NA	600 MHz Celeron +	512KB	1GB	Yes	No	Some	No	Yes	Yes

Notes:

1: Some POS vendors ship WEPOS on CF cards; however J2 does not recommend this unless a High Speed Industrially rated CF card with wear leveling is used; at which point a SATA Solid State Drive (SSD) would be a better choice.

2: CE 6.0 only requires <64MB of storage. J2 normally ships a unit with a 1GB CF card and this extra storage is available to the user.

3: The maximum memory supported by CE 6.0 is 512MB. Extra memory can be in the system, but CE cannot access it.

4: For acceptable performance when SQL is used, J2 recommends at least a 1.5 GHz Celeron and at least 1GB of main memory.

5: The Operating Systems *(above)* shaded in green are recommended by J2 for the POS environment.

Operating Systems Overview

Windows Vista Business for Embedded Systems

Microsoft offers Vista Business as an embedded operating system. There is no difference between Embedded Vista Business and normal retail Vista Business except for long term support. All normal Vista updates will apply. If high end graphics and multimedia functions are required this is the way to go. The J2 650 unit with its minimum of a 2.0 GHz dual core Pentium processor with 2 GB of memory is recommended for Vista.

Windows Embedded Enterprise, XP Pro

This version of XP Professional is the same that has been available for the retail computer market for years. It now has been moved to Microsoft's Embedded Marketing group and is available until 2016.

Windows XP Embedded, XPE

This is the first version of XP embedded released by Microsoft in 2002. This is also the current version of XP embedded that J2 ships, which has recently been upgraded to XP service pack 3. XP embedded can run on a hard drive, a solid state drive, or a Compact Flash card. This is a very good operating system for the POS environment. Windows XPE is currently being replaced by a slightly upgraded version of XPE called Windows Embedded Standard. XPE will be available till 2012. XPE is 100% binary compatible with XP Pro and will run software written for Windows XP.

Windows Embedded Standard

This is the latest version of XP embedded and has all the same features as XPE, but also has a few additional features not present in XPE. This OS is recommended by J2 for any new installs. The cost is the same as XPE.

Windows Embedded for Point of Service, WEPOS

WEPOS was released by Microsoft specifically to target the Point of Service (Sale) market. WEPOS does have a few features added specific to the POS market, like extra drivers, but is basically a slightly stripped down version of XP Pro. Almost all customers

using XP Pro could move to WEPOS with no changes to their software or installation procedures. Like XPE, WEPOS is 100% binary compatible with XP Pro and will run software written for Windows XP. One feature that WEPOS has that XPE does not is automatic updates. It depends how this feature is used as to whether this is a good or bad feature on a POS system.

Windows CE 6.0

Windows CE 6.0 is the latest release of Microsoft's lowest cost OS. Windows CE is a surprisingly capable operating system and is more than able to support high end POS applications. Windows applications need to be rewritten to work on CE but sometimes this only requires the changing of a few lines of code and recompiling. Applications that only require a web browser to run are perfect for CE since no change is required to run on CE. One big advantage of CE it is very immune to computer viruses.

Linux

The best thing about Linux is the price, free. If Linux expertises are available this may be a good way to go. Support is always an issue with Linux and J2 only supplies a minimum level of support as we are limited by the driver support we get from Intel and other chip suppliers. A list of Linux versions that run on J2 hardware platforms is available on the J2 web site.

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Technical Considerations

Storage Media

When using an embedded operating system the correct choice of the storage media is very important. J2 highly recommends the use of SSD drives when using XP Pro, WEPOS or Linux. For Windows CE a CF card is the logical choice. For XP Embedded when using the EWF a CF card is also appropriate, otherwise a SSD or HDD make sense.

Hard Disk Drive (HDD) still makes sense in a cost sensitive environment or for when large amounts or storage are required; however J2 sees the SSD as the primary player in the future for POS.

Solid State Drives

Although available for some time now, solid state drivers (SSD) are finally coming into the main stream. A solid state drive uses NAND flash to store data and has no moving parts. Newer SSD drives use the SATA interface and 2.5 inch hard disk physical format; they are a drop-in replacement for a 2.5 inch SATA hard drive. Costs are coming down fast, a high speed 32GB SSD is now only about 1.4X the cost of a 2.5 inch HDD and projected to be on par by next year.

The big advantage of a SSD is twofold - reliability and speed. The MTBF for a SSD is normally between 1,000,000 and 2,000,000 hours, or 114 and 228 years! Because there are no moving parts the shock rating is normally 1,500G. Most SSD are also very fast, faster than rotating hard drives with normal transfer ratings of 150MB/s for reads, 00MB/s for writes.

SSD memory blocks have a limit as to the number of erase/write cycles they can perform. The number of erases/write cycles to a MLC NAND block is 10,000 and is about 100,000 to a SLC NAND. SSDs typically have a very sophisticated wear leveling scheme to insure that the writes to the SSD are spread out, insuring that the SSD will not wear out. Intel stated that their SSD can handle 100GB of data written to the drive per day and be guaranteed to last 5 years.

The bottom line is that a SSD makes a great drop-in replacement for a HDD where extreme reliability is required.

Compact Flash

Although SSDs are similar to Compact Flash cards in many ways, there are some major differences. Not all CF cards have wear leveling, which means that if too many writes are done to the card they will wear out. In addition, the CF card interface uses the older PATA (IDE) interface and cannot read or write as fast as a SSD and so are typically a lot slower than a hard disk drive or an SSD. Like the SSD, the CF card when used correctly, is extremely reliable.

A CF is perfect when all it has to do is to boot the system. When using Windows CE or XP Embedded with the EWF, this is the case. The operating systems in these cases are run almost entirely out of RAM once the system is booted, so the CF cards slow speed and limited writes are not a factor.

WEPOS

WEPOS is very straight forward, if you know XP Pro, you know WEPOS. It installs and works the same as XP only it misses some unneeded functions. WEPOS costs less than XP Pro and has a more restrictive license than XP Pro. Any application written for XP should run on WEPOS without any problems. WEPOS has the same remote update feature as XP, so if you enable the system you will always have the latest patches installed.

Only one thing comes up with WEPOS, that is does not have the MS DOS Windows icon under the accessories menu. To run the command prompt, run *cmd.exe* from the run command.

XP Embedded / Windows Embedded Standard

XP Embedded (XPe) and Windows Embedded Standard are basically the same operating systems with Windows Embedded Standard being the newer version of the two. Windows Embedded Standard has a few additional features XPe does not. Please see Microsoft's web site for the details: http://www.microsoft.com/windowsembedded/en-us/products/wexpe/default.mspx   In this section the comments that apply to XPe also apply to Windows Embedded Standard.

XPe is a componentized version of XP Pro. XPe is not installed like XP Pro, it is built similar to compiling a program from a number module. XPe can contain as many as 12,000 components. When XPe is built the needed components are selected to be included in the build, this way only the functions that are needed are included in the final

OS image. This not only makes an OS image smaller but simpler, which can mean more reliablity.

 J2 has built two generic XPe images, one to run on a CF card with the EWF, and one to run on a HDD or SSD. The normal procedure is for the POS software vendor to work with J2 to customize the XPe image to their requirements. The generic image provides a starting point to work from. In alot of cases the generic image does not need any changes to work with the customer application. Any application written for XP should work with XPe as long as the components required by the application are included in the XPe build.

After an XPe image is created drivers and programs can still be added to the OS. This is done exactly the same as on XP. XP drivers work on XPe without change and can be installed exactly the same way as on XP. In fact, if you are adding a driver to an existing XPe OS image you must use an XP driver, not an XP embedded driver because the XP embedded drivers are an XPe component, not an installable driver. This is specifically for times when XPe OS is built.

When used with a HDD or SSD drive XPe acts and behaves just like XP Pro, since it is XP Pro stripped down. XPe can be thought of just as a lower cost version of XP. When used with its EWF - which is unique to XPe – it has a very useful feature which is covered in the next section. XP Embedded does require a little more time and effort on the front end to deploy than WEPOS or XP Pro, but there are a number of long term savings, one of which is the cost of the OS itself.

EWF with XP Embedded / Windows Embedded Standard

When using XP Embedded on a CF card the Enhanced Write Filter (EWF) is used to do two things. One is to limit the number of writes to the CF card. All CF cards can only handle a limited number of writes to any sector before the sector is worn out. On most commercial CF cards this number is 300,000. Newer CF cards use "wear leveling" to reduce this issue but it still a major consideration when using CF cards.
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The other thing is the CF cards can be very slow writing. To solve this problem Microsoft developed the EWF. The EWF gets around the limitation of CF cards by buffering all writes to CF cards. When XPe writes to the CF card the write is only posted to a buffer in RAM. The EWF does not actually write the data to the HDD until told to do so, this is done with the EWF "commit" command. By buffering the writes the EWF gets around the CF write limitations.

The problem is that the EWF causes the OS to act differently than what is seen with XP Pro. One example is that if the EWF is not committed to the CF before shut down, and changes have been made to the OS, like adding a program or driver, they will not be on the system when it reboots because they were not written to the CF card.

Depending how the system is to be used, a script can be run at shutdown to commit the EWF. In most cases this makes XPe with the EWF work just like XP Pro. If a program or driver is loaded it will be present after the system is rebooted as expected. This is how the generic version of XPe that J2 ships is configured. It should be noted that if the system is shut down improperly (AC power failure) then all data in the EWF will be lost.

There are some <u>very good reasons</u> why you may not wish to commit writes to the CF card every time the system is rebooted. If all transaction data is written to a server and no data is stored locally you may wish not to commit HDD writes to the CF card. The advantage of this is it is very hard for a systems disk image to become corrupted. The CF card is only read during boot up and never written too. Every time the system reboots the system is guaranteed to be the same as when first installed. If a Windows virus infected the system it would be cleared when the system is rebooted, since no writes were done to the CF card. System updates can still be made but would require the EWF to be committed to the CF manually.

Using the EWF without committing the writes has many advantages when used for a POS client computer. In this configuration the system works like a ROM based system, which anyone in the POS business for a long time will remember how reliable ROM based systems were. Unlike a ROM based system though, XPe can still be updated remotely if required. In conclusion XP Embedded on a CF card using the EWF can make for an extremely reliable POS system.

Windows CE 6.0

Windows CE 6.0 is the latest release of Microsoft's lowest cost OS at less than USD $20. CE is not an installable OS, it has to be built for the target hardware platform. Like XP embedded the features it supports are selected at build time. Windows applications need to be rewritten to work on CE but sometimes this only requires the changing of a few lines of code and recompiling.

J2 has a generic version of CE built for the J2 580 and 650 POS computers. This version works for most applications but J2 can customize the CE build, based on the POS software vendor's requirements.

CE is booted from a CF card and the OS is loaded and run out of RAM memory. Storage is provided on the CF for local data, but in most cases transaction data is stored remotely. CE does contain an Explorer WEB browser and most WEB browser applications work.

CE is almost immune to computer viruses for a few reasons. One reason is that there is no common way to add code to CE. A virus written, say for a PDA, will not be able in almost all cases, to infect a CE on the POS because the file structure is totally different. Also, when the CE system is rebooted the OS is reloaded from a write protected area that cannot be infected.

CE is a very cost effective and reliable OS for a POS system. Although development costs may be higher on the front end, the long term cost can be much lower than with WEPOS or XPe. It is not uncommon to have a mix of CE and XP based systems in the same install as well, there is no problem mixing the two.

Conclusion

There are some very good operating system options available for POS systems, each with its strengths and weaknesses. The selection of operating systems is much better than it has been in the past, when a retail computer OS was all that was available. With the advent of embedded operating systems with long term availability and support, many of the concerns of the POS markets have been addressed.

We believe J2 to be attuned to your specific client needs with embedded operating systems. Please contact your J2 salesperson for additional information.