**Porting Device Drivers for the Solaris**

**Tuesday, July 04, 2006**

**Solaris platform**

The capabilities of the Solaris platform continue to expand to meet customer needs. The Solaris 10 release is designed to fully support both 32-bit and 64-bit architectures. The Solaris OS supports machines based on both 32-bit and 64-bit SPARC processors as well as 32-bit and 64-bit x86 platforms.

The primary difference between the 32-bit and 64-bit development environments is that 32-bit applications are based on the ILP32 data model, while 64-bit applications are based on the LP64 model. The primary difference between applications for SPARC and x86-based systems, from the driver developer's point of view, is big-endian versus little-endian translation.

To write a common device driver for the Solaris OS, developers need to understand and consider these differences.

Note: This document addresses topics related to x86 platforms only. In this document, references to 64-bit operating systems refer to the Solaris OS on machines with AMD Opteron processors.

The Solaris OS runs in 64-bit mode on appropriate hardware, and provides a 64-bit kernel with a 64-bit address space for applications. The 64-bit kernel extends the capabilities of the 32-bit kernel by addressing more than 4 Gbyte of physical memory, by mapping up to 16 Tbyte of virtual address space for 64-bit application programs, and by allowing 32-bit and 64-bit applications to coexist on the same system.

This document discusses the differences between 32-bit and 64-bit data models, provides guidelines for cleaning 32-bit device drivers in preparation for the 64-bit Solaris OS kernel, and addresses driver-specific issues with the 64-bit Solaris OS kerne

**GLOBAL POSITIONING SYSTEM**

**Wednesday, July 26, 2006**

**The Global Positioning System, usually called GPS,**

The Global Positioning System, usually called GPS, is the only fully-functional satellite navigation system. A constellation of more than two dozen GPS satellites broadcasts precise timing signals by radio to GPS receivers, allowing them to accurately determine their location (longitude, latitude, and altitude) in any weather, day or night, anywhere on Earth.

United States Department of Defense developed the system, officially named NAVSTAR GPS (Navigation Signal Timing and Ranging GPS), and the satellite constellation is managed by the 50th Space Wing at Schriever Air Force Base. Although the cost of maintaining the system is approximately US$400 million per year, including the replacement of aging satellites, GPS is available for free use in civilian applications as a public good.

GPS has become a vital global utility, indispensable for modern navigation on land, sea, and air around the world, as well as an important tool for map-making, and land surveying. GPS also provides an extremely precise time reference, required for telecommunications and some scientific research, including the study of earthquakes.

In late 2005, the first in a series of next-generation GPS satellites was added to the constellation, offering several new capabilities, including a second civilian GPS signal called L2C for enhanced accuracy and reliability. In the coming years, additional next-generation satellites will increase coverage of L2C and add a third and fourth civilian signal to the system, as well as advanced military capabilities.

The Wide-Area Augmentation System (WAAS), available since August 2000, increases the accuracy of GPS signals to within 2 meters (6 ft) [1] for compatible receivers. GPS accuracy can be improved further, to about 1 cm (half an inch) over short distances, using techniques such as Differential GPS (DGPS).

Global Positioning System) A satellite-based radio navigation system run by the U.S. Department of Defense. It was designed so that signals from at least four satellites would be on the horizon at all times, which is sufficient to compute the current latitude, longitude and elevation of a GPS receiver anywhere on earth to within a few meters. The first GPS satellite was launched in 1978.

In six different orbits approximately 12,500 miles above the earth, the system's 24 MEO satellites circle the earth every 12 hours. The satellites do nothing more than constantly transmit their current time based on atomic clocks and current location. A monitoring network on the ground tracks the satellites and uplinks data for synchronization. The system uses four frequencies in the L-band from 1.2 to 1.6GHz .

Whether installed in vehicles or carried by hand, a GPS receiver calculates the distance to the satellites by comparing the times the transmitted signals were sent with the times they were received. By knowing the precise locations of the satellites at a given moment, the receiver uses triangulation, the navigation technique of ship captains for centuries, to pinpoint its own location.

**PLASMA DISPLAYS**

**Wednesday, July 26, 2006**

Up until the past couple of years, most televisions have been built around the same technology.

This technology is the cathode ray tube. In CRT televisions, a gun fires a beam of electrons into a large glass tube.

The electrons send phosphor atoms to an excited state that causes them to light up. They have good images, but they also have one big problem. They take up a lot of space and are very heavy.

Now scientists wanted to find a better way to fit a big television in a small room. They came up with the plasma flat panel display.

They still come in large sizes, but are only about six inches thick. Plasma televisions illuminate tiny colored fluorescent lights to form an image. Each pixel is made up of three fluorescent lights. A red, green, and blue light.

The plasma display varies the intensities of the different lights to produce a full range of colors like the CRT televisions. plasma displays, a small electric current stimulates an inert gas sandwiched between glass panels, including one coated with phosphors that emit light in various colors.
While just 8 cm (3 in) thick, plasma screens can be more than 150 cm (60 in) diagonally.

Introducing The Computer of 2010 Kip Crosby, 08.21.00

**F**or decades, silicon, with its talent for carrying electrons, has been the mainstay of computing. But for a variety of reasons (see "The Coming Light Years"), we're rapidly approaching the day when electrons will no longer cut it. Within 10 years, in fact, silicon will fall to the computer scientist's triple curse: "It's bulky, it's slow, and it runs too hot." At this point, computers will need a new architecture, one that depends less on electrons and more on... well...what else? Optics.

With the assistance of award-winning firm frogdesign (the geniuses behind the look of the early Apple and many of today's supercomputers and workstations), *Forbes ASAP* has designed and built (virtually, of course) the computer of 2010.

Whenever possible, our newly designed computer replaces stodgy old electrons with shiny, cool-running particles of light--photons. Electrons remain, doing everything they do best (switching), while photons do what they do best (traveling very, very fast). In other words, we've brought the speed and bandwidth of optical communications inside the computer itself. This mix is called optoelectronics, another buzzword we encourage you to start using immediately.

The result is a computer that is far more reliable, cheaper, and more compact--the entire thing, believe it or not, is about the size of a Frisbee--than the all-electronic solution. But above all, optoelectronic computing is faster than what's available today. How fast? In a decade, we believe, you will be able to buy at your local computer shop the equivalent of today's supercomputers.

How likely is it that this computer will be built? Some of its components are slightly pie-in-the-sky. But many others have already been developed or are being developed by some of the best scientific minds in the country. Sooner or later, and probably sooner, an optoelectronic computer will exist...and it will probably look a lot like ours.

Okay, so we've built a revolutionary new optical computer just in time for 2010. What do we do with it now?

Everything. Because it's small (about the size of a Frisbee) and because it has the power of today's supercomputer, the 2010 PC will become the repository of information covering every aspect of our daily life. Our computer, untethered and unfettered by wires and electrical outlets, becomes something of a key that unlocks the safety deposit box of our lives.

When we plug our 2010 PC into the wall of our home, our house will become smart, anticipating our every desire. At work, we'll plug it into our desk, which will become a gigantic interactive screen. When it communicates wirelessly with a small mobile device, we'll have a personal digital assistant--on steroids.

**SECURITY** The PC will be protected from theft, thanks to an advanced biometric scanner that can recognize your fingerprint.

**INTERFACE** You'll communicate with the PC primarily with your voice, putting it truly at your beck and call.

**The Desktop as Desk Top** In 2010, a "desktop" will be a desk top...in other words, by plugging our computer into an office desk, its top becomes a gigantic computer screen--an interactive photonic display. You won't need a keyboard because files can be opened and closed simply by touching and dragging with your finger. And for those throwbacks who must have a keyboard, we've supplied that as well.

A virtual keyboard can be momentarily created on the tabletop, only to disappear when no longer needed. Now you see it, now you don't.

**Your Digital Butler** What do we do with our 2010 computer when we arrive home after a long day's work? Plug it into the wall with a magnetic clamp and watch as our home comes to life. In essence, the computer becomes the operating system for our house, and our house, in turn, knows our habits and responds to our needs. ("Brew coffee at 7, play Beethoven the moment the front door opens, and tell me when I'm low on milk.")

**Your Home** The PC of 2010 plugs into your home so your house becomes a smart operating system.

**HARD DISK (STORES PROGRAMS AND FILES)**

To build our 2010 computer (see previous page) we first need to build the hard disk. The disk will be holographic and will somewhat resemble a CD-ROM or DVD. That is, it will be a spinning, transparent plastic platter with a writing laser on one side and reading laser on the other, and it will hold an astounding terabyte (1 trillion bytes) of data, just a tad more than we get today--1,000 times more, to be exact. With such capacity, you'll be able to store every ounce of information about your life. But beware. If your computer is stolen or destroyed, you might actually start wondering who you are.

**WHERE ARE WE?** A holographic disk might be the easiest component here to build since it exists in the lab today.

**WHO'S WORKING ON IT?** Stanford University, Lucent Technologies, and cutting-edge Silicon Valley optics company Siros Technologies.

**TIME OF COMPLETION? 2005,** for a commercial product.

**THE CENTRAL PROCESSING UNIT (CPU--THE COMPUTER'S BRAIN)**

Our 2010 CPU will operate on the same principle as today's PCs. But instead of electronic microprocessors providing the brains and brawn, our future CPU will have optoelectronic integrated circuits (chips that use silicon to switch but optics to communicate). This will give us huge increases in speed and efficiency. Why? Because the CPU of today spends far too much time waiting around for data to process. Instantaneous on-chip optical communication, and memory running as fast as the processor, will guarantee a continuous stream of data processing within the CPU. With communication between components no longer bottlenecked by electronic transmission, we can probably push the clock rate to 100 gigahertz, 100 times faster than what's available now.

Our universal appliance of tomorrow also has a hexagonal optoelectronic processor surrounded by a ring of fast cache, so that data for any part of the chip can be fetched from the closest part of the cache. The result will be computer performance--or, at any rate, delivery of computational results--comparable to today's supercomputers.

**WHERE ARE WE?** Optoelectronic integrated circuits do exist today, on a small scale and for specialized purposes. Getting from the current state of the art to a complete and superfast optoelectronic CPU will require tremendous effort and the accumulation of an entirely new body of intellectual property.

**WHO'S WORKING ON IT?** Scientific-Atlanta, Lucent, and Nortel. Advanced work in optical interconnection is now being done at Stanford. Intel, through its purchase of Danish optoelectronics company GIGA, intends to have the fast track out of the gate.

**TIME OF COMPLETION? 2010,** if we're really lucky.

**MEMORY (RAM)**

When we stir optical communication into the old-fashioned electronic computer, some of the greatest potential gains will involve your computer's short-term memory. In the long-gone days (1980) of the 80286, computers enjoyed a design advantage that we've never had since. The memory bus speed--that is, the speed at which data flowed between CPU and memory--was the same as the CPU's clock rate, or how fast it operates. (Of course, they were both 8 megahertz, but we said this was a long time ago.) Data reached the CPU as fast as the chip could process it, which kept the CPU from waiting around being bored.

We've never reached that pinnacle again, and since then, the situation has gotten steadily worse. A reasonably fast computer today has a CPU clock of 600 megahertz and a memory bus speed of 133 megahertz. Despite various clever technical feats, the CPU still spends half to two-thirds of its time just waiting around for data from memory.

Optoelectronics will knock this problem out of the park. With a properly designed optical memory bus, speed of fetch from memory can once again equal CPU clock rate.

Of course, this also will require that processing in RAM be very quick, so we'll need a faster RAM architecture, which luckily is--or will be--available. A large cache (see below) made of superfast, nonvolatile magnetic RAM will hold information that the CPU needs quickly and repeatedly. It will be backed up by a much larger area of holographic (pure optical) main RAM that will hold programs, files, images, etc., while you work with them.

**FAST MEMORY (CACHE)**

To build our new fast cache, we'll need to get rid of the inefficiencies of today's product, which requires the computer to constantly refresh it, just like short-term memory in humans needs to be constantly refreshed or it's forgotten. The inefficiencies in cache are so bad, in fact, that once you know the speed of your cache you can assume that its real-world performance will be about a third of that--the missing two-thirds being sacrificed to refresh cycles.

Enter 2010's semiconductor technology, which, instead of using today's silicon memory, will rely upon magnetic memory on a molecular scale. Because tiny elements will be magnetized to represent zeros, or demagnetized to represent ones, the information can be easily and quickly refreshed with just a quick electrical signal. The whole process will be much faster than today's silicon memory--which is a good thing, because satisfying the demands of a CPU running at 100 gigahertz will definitely mean no coffee breaks.

Let's install a gigabyte of fast cache--1,000 times as much as the megabyte that serves an Intel Pentium III today. And, to put the whole system in overdrive, we'll hitch it directly to the CPU with a multiplexed optical bridge. Get ready for warp speed!

**WHERE ARE WE?** Mostly in the experimental stage.

**WHO'S WORKING ON IT?** U.S. government laboratories and IBM, which probably knows more about magnetic memory than any other company.

**TIME OF COMPLETION? 2010,** with just a small leap of faith.

**MAIN MEMORY**

Our main RAM will be purely optical, in fact, holographic. Holographic memory is three-dimensional by nature, so we can stack up any number of memory planes into a rectangular solid to create 256 gigabytes of optical main memory, 1,000 times as much as a really powerful desktop computer today.

**WHERE ARE WE?** Holographic memory exists, but it is slow, bulky, extremely difficult to build in quantity, and has quality-control problems.

**WHO'S WORKING ON IT?** University laboratories.

**TIME OF COMPLETION? 2009,** or maybe a tad earlier.

**POWER SUPPLY**

One of the biggest advantages of photonic circuitry is an extremely low power requirement. A long, sticklike lithium battery, bent into a doughnut and installed in the periphery of the computer, will run it for a couple of weeks. But fresh power is as close as the charging cradle on the nearest wall, which resembles the one for today's cordless or cellular phones.

**WHERE ARE WE?** Pretty close. We've come a long way in battery development in the past few years.

**WHO'S WORKING ON IT?** Hewlett-Packard.

**TIME OF COMPLETION? 2007.**

**THE SCREEN**

Size does matter in our 2010 computer screen. It will either be very large, literally the desk top of your desktop, or very small, a monocle you hold up to your eye. For the bigger version, our computer screen will depend on some kind of photonically excited liquid crystal, with power requirements significantly lower than today's monitors. Colors will be vivid and images precise (think plasma displays). In fact, today's concept of "resolution" will be largely obsolete. Get ready for pay-per-view Webcasts.

**WHERE ARE WE?** This design, if fully realized, depends on a technology that doesn't exist today. Optical excitement of a liquid crystal is the stuff of research papers. More likely is that our computer will end up with a less ambitious display, one like our current PCs possess but much, much better. We've got 10 fruitful years to develop it, after all.