Topics in System Administration

The Year 2000 Problem

The Problem

- Year kept in 2 digit format in old COBOL programs
- Time also uses 2 digit year in many embedded systems
  - If they use time at all, they assume it moves forward
  - Embedded systems are everywhere, the wild card of Y2k compliance
    - → Power plants
    - → Factories manufacturing facilities
    - → Transportation: trains, planes, cars
    - → Military weapons systems
- Jan 1, 2000 is an inflexible deadline
  - Occurs in winter in much of the world
  - Starts in New Zealand
- www.sibal.com/sandeep/mil_bug.gif

Important Dates

- April 9, 1999:
  - 99th day of 1999, 9999 on the Julian Calendar
  - 9999 denotes "end of input" in many COBOL programs
  - Also the date which data operations staff have traditionally used to indicate when data may be scratched, or discarded and overwritten
- August 22, 1999: GPS rollover
- Sept. 9, 1999: 9999 on the Gregorian Calendar
  - Same problems as above

Important Dates, cont.

- Dec. 31, 1999: Last day in 1999 year
- Jan. 1, 2000: Beginning of the year 2000
- Jan. 3, 2000: First business day in the year 2000
- Jan. 10, 2000: First date to require a 7 digit date field (1/10/2000)
- Feb. 29, 2000: Leap year
- Oct. 10, 2000: First date to require an 8 digit date field (10/10/2000)
- Dec. 31, 2000: Check that year has 366 days
- Dec. 31, 2001: Check that year has 365 days

Costs

- Estimated to cost 300-600 billion dollars
- Some estimates are in trillions
- Many organizations spending about half their computing budget on y2k
- IRS spending 850 million to 1 billion
  - Started with 3 people, now 800
- Old COBOL programmers suddenly very employable

Costs, cont.

- Cost estimates per line of code
  - If fixed in 1996: $1.25
  - If fixed in 1997: $2.00
  - If fixed in 1998: $3.00
  - If fixed in 1999: $4.25
  - If fixed in 2000: $6.75
  - If fixed in 2001: $6.50
- Zillions of lines of code

GPS Rollover

- Navstar/GPS satellite transmits time in 2 binary integers
  - The number of seconds in the week
  - And the number of weeks since midnight Jan 6, 1980 in 10 bit field
    - → Rolls over at midnight August 22, 1999
- Converted to regular time and date by GPS receiver.

GPS Rollover, cont.

- GPS receivers depending on the model:
  - May be ok, fix built in
  - May need firmware upgrade
  - May need hardware modifications
    - → May be field upgradable
    - → May need to be returned to factory or thrown away
  - May need new antenna (Acutime antenna/receiver) before 1997
  - May be impossible to correct
  - Some vendors fixing for free if under warranty,
- Military uses GPSs a lot
  - Validating solutions this fall
  - Will implement them by the end of 1998

US Government Organizations

- By January 1998, only agency that was Y2k compliant was the Bureau of Cemeteries and Graves
- Social security still has 30 million lines of code for disability benefits to fix.
- IRS Started late, just recently realized the size of the problem
  - 44% compliant at the end of Sept, 1998
  - Year 2000 refunds may be a long time in arriving
  - Y2k compliance costs to businesses are deductible
    - → Can be amortized, details fuzzy

Stock Market

- SEC requiring companies to say if they are Y2k compliant
- Companies reluctant to admit their status
- Good Samaritan Act says that companies Y2k statements cannot be used in evidence in millennium litigation
  - Already have settled a few Y2k cases
    - → Grocer got $250,000 for credit card scanner that crashed on 00 expiration dates
  - Act changes rules of evidence, likely to be challenged
- Stock market also plans to change prices from dollars and fractions of a dollar to dollars and cents
- Change in European Community to the Euro currency likely to disrupt things too

Power Plants

- Power grid infrastructure essential to world economy and to survival
- Test in Great Britain scary
  - Set clocks ahead in one plant to test
  - 20 seconds after midnight generator failed with high temperature
  - Control valve integrated over time
    - → Change from 99 -> 00 made integration interval infinite
    - → Allowed generator to overheat
- Meter readers hand-held devices failed

Power Plants, cont.

- Power plants distributed control systems have thousands of embedded processors associated with them
  - Substation control
    - → If failure, would require personnel to open/close breakers
  - Routing control
    - → Failure could cause lines to overvoltage
    - → Then sag
    - → Then snap and catch fire
  - Energy management systems also control efficiency
    - → Would cost millions in fuel and wasted power to go back to manual control
- Some systems use VMS with Rockwell software, vintage 1981
  - Many fixes required

Nuclear Power Plants

- Hard to test compliance
- Being required (in the US) to shutdown if they cannot prove compliance
- Embedded microprocessors the problem
- Date sensitive software predicts load and demand based on time of day, day of the year, etc.

Fossil Fuel Power Plants

- Often have computer controlled emissions monitoring
- Computer controlled conveyor belts deliver fuel
- Lots of smart valves, turbine controls, etc.
- 1 to 3 weeks supply of fuel onsite
  - □ Transportation usually rail, especially for coal fired plants
    - → Rail car movement tracked by computers
    - → Switches operated by embedded controllers

Testing War Stories

- Food plant told workers to throw out all the food as it was outdated (1900)
- Chrysler's security system shutdown the plant, locked everyone in/out.
  - □ Time clocks didn't work for employees to punch in/out
- GM after getting all their financial and accounting functions Y2k compliant decided to test a manufacturing plant
  - □ Plant totally failed, shutdown
    - → Took several days to get it back online
  - □ Hindsight showed 500,000 computerized factory floor devices companywide that could crash
  - □ And 40,000 suppliers who also need to be Y2k compliant to keep the assembly line running

Testing, cont.

- Funny situations, in simulated tests
  - □ Towns water purification plant released huge amounts of chemicals into the water supply, making it toxic to drink
  - □ Bank vaults flew open
  - □ Credit cards with 00 as the expiration date don't work in many scanners
  - □ ICBM missiles launch controls will fail
    - → Unlaunchable (fail safe)

The Airlines

- 16,000 control chips in a Boeing 747
  - Boeing says only 4 have Y2k problems
  - Only 1 related to safety, Boeing will fix it
- Air traffic control and flow control systems less clear
  - Many embedded systems
  - Expect delays
  - Don't fly New Years Eve :-)

No Power

- Recently tested in the midwest during a snowstorm
- Without power for 4 days, but had natural gas for heat
- Many who thought they were prepared were totally unprepared
  - 10 house breakins/hour during blackout
  - Generators stolen if left outside
  - People hurt (carbon monoxide poisoning) if generators locked in closed garage

No Power, cont.

- Panic runs on stores for bread, canned food, candles
  - Cash registers electric, many stores prices are only there
  - Doors often electric, resist opening without power
  - Money machines are electric
  - Gas pumps are electric
- Need about two weeks supply of essentials
  - Food that doesn't need to be cooked or refrigerated
  - Gasoline in your car
  - Candles, flashlight batteries, matches, lamp oil, etc.
  - Cash, with some small bills
  - A way to keep warm

Embedded Systems

- Machine tools now mostly computer controlled
- Computerized valves used everywhere
  - Process control systems in manufacturing plants
    - → Chemical plants scary
- Medical industry has many embedded systems
  - Life support machines
  - Kidney machines
  - Hospital scheduling software, for operations, staff, etc. perceptions scarier than reality

Bottom Line

- Huge problem, but
  - Perceptions scarier than reality
  - Doomsday folks hype worse than the real thing will be
- Has some good sides, many companies are modernizing their systems to become compliant
- Bigger problem -- everyone panicing
  - Withdrawing all their $$ from the banks
  - Selling all their stocks and mutual funds
  - Hoarding food at the last minute
    - → Buying out the supplies of bread, canned food, etc. the last week
    - → Candles, batteries, too

Hacks to Help

- Map year 2000 back to 1972 as a program starts, map back again as it ends
- PCfix2000 patches PC's bios and OS to fix real time clock
- HP's softbench year 2000 tool
  - Shows date related code in COBOL and C/C++ programs
- SGI's scanning software: http://www.sgi.com/tech/year2000/images/year20
  - Good discussion at: http://www.sgi.com/tech/year2000/headstart.h
- XOpen standardized a form for a 2 year date to postpone the problem
  - 69-99 = 1969-1999
  - 00-68 = 2000-2068

UNIX Systems

- UNIX sort of shines with its date algorithm
  - At least until 3:14:07 on January 19, 2038, when a 32 bit int will go negative
  - struct tm is broken though
    - → Years field is not real years, but years since 1900
  - String format includes a few troublesome %'s
    - → %C -- century number (year/100 truncated to an integer, 00-99)
    - → %D -- date as %m/%d/%y
    - → %y -- year within century (00-99)
    - → %Y -- year as ccyy (eg. 1986)
  - Library functions that use the %y form: srtftime, ascftime, cftime, getdate

HP-UX Compliance

- www.hp.com/year2000/
- Most hardware systems are compliant
  - All workstations
  - Newer servers in the 800 and letter classes
  - Netservers too
  - Some need real time clock reset manually
  - Most laptops OK too

HP-UX Compliance, cont.

- Software systems compliant with patches
  - HP-UX 9.x not compliant and won't be made compliant
    - → Web site lists known problems
    - → Not with UNIX OS underneath, with struct tm and programs like accounting
  - HP-UX 10.x OK with patches
  - HP-UX 11.x OK with patches
- Changed the C library functions getdate and strptime so applications should be OK
  - Must recompile or use shared libraries (10.30 and 11.0)
  -
- HP is charging for Y2k patches
  - Free to support customers

Solaris Compliance

- www.sun.com/y2000
  - Defines Y2k compliance codes and then maps products to them
    - → 0 -- no date related content
    - → 1 -- compliant at time of release
    - → 2 -- requires modifications to be Y2k compliant
    - → 3 -- under review
    - → 4 -- not compliant, upgrade or migrate to another product
    - → 5 -- source code that you can fix yourself

Solaris Compliance, cont.

- Solaris 2.6 is compliant
- Solaris 2.5 has long list of patches
  - Free to all support customers or warranty folks
  - Others must pay (may hurt Universities)
- No mention of SunOS on their web pages

IRIX Compliance

- www.sgi.com/tech/year2000
- IRIX 6.5 compliant
- Patches for 5.3 and 6.2, 6.3, 6.4
- Has scanning tools to assist in finding problems
- Long list of hardware that is compliant

BSD/OS Compliance

- www.bsdi.com/info/year2000.mhtml
- Releases since 3.0 are totally compliant
  - Support 64 timezones
  - Even have leap seconds done right

FreeBSD Compliance

- www.freebsd.org/y2kbug.html
- Totally compliant
- Problems that were fixed
  - Hardcoded 19%d responses for the year in yacc, ftpd, make
  - Sed script that add the kernel ID line to the motd
  - Nameserver make-localhost script that generates DNS serial number with 2 digit year
  - Groff tmac macros with hardcoded 19 for generating dates
  - TkDesk uses hardcoded 19 in file listing window.

Linux Compliance

- Fully compliant

AIX Compliance

- www.software.ibm.com/year2000/papers/aixy2
- Some RS6000 firmware has problems
- AIX 4.3.2 is compliant
- AIX 4.3.x, 4.2.x, 4.1.x, and 3.2.5 require patches
- AIX 3.1, 2 and 1 are not compliant, you need to upgrade
- Fixes are free to everyone -- YEAH

Microsoft Compliance

- Makes you register to search their web site for Y2k stuff
  - Got to Y2k page and it said: "THIS PRODUCT ENTRY IS CURRENTLY UNDER REVISION. PLEASE TRY AGAIN LATER"
- Many PC bios's must be patched
- NT requires Y2k fixes
  - Problem with leapyear in the user manager that cannot expire accounts on Feb 29
  - Word documents date format must be fixed
  - Find file entry fields must be fixed

A Piece of History, from VMS

D I G I T A L

SPR ANSWER FORM

SPR NO. 11-60903

SYSTEM	VERSION	PRODUCT	VERSION	COMPONENT
SOFTWARE: VAX/VMS	V3.2	VAX/VMS	V3.2	Run-Time Library

PROBLEM:

The LIB$DAY Run-Time Library service "incorrectly" assumes the year 2000 is a leap year.

RESPONSE:

Thank you for your forward-looking SPR.

Various system services, such as SYS$ASCTIM assume that the year 2000 will be a leap year. Although one can never be sure of what will happen at some future time, there is strong historical precedent for presuming that the present Gregorian calendar will still be in effect by the year 2000. Since we also hope that VMS will still be around by then, we have chosen to adhere to these precedents.

The purpose of a calendar is to reckon time in advance, to show how many days have to elapse until a certain event takes place in the future, such as the harvest or the release of VMS V4. The earliest calendars, naturally, were crude and tended to be based upon the seasons or the lunar cycle.

The calendar of the Assyrians, for example, was based upon the phases of the moon. They knew that a lunation (the time from one full moon to the next) was 29 1/2 days long, so their lunar year had a duration of 354 days. This fell short of the solar year by about 11 days. (The exact time for the solar year is approximately 365 days, 5 hours, 48 minutes, and 46 seconds.) After 3 years, such a lunar calendar would be off by a whole month, so the Assyrians added an extra month >from time to time to keep their calendar in synchronization with the seasons.

The best approximation that was possible in antiquity was a 19-year period, with 7 of these 19 years having 13 months (leap months). This scheme was adopted as the basis for the religious calendar used by the Jews. (The Arabs also used this calendar until Mohammed forbade shifting from 12 months to 13 months.)

When Rome emerged as a world power, the difficulties of making a calendar were well known, but the Romans complicated their lives because of their superstition that even numbers were unlucky. Hence their months were 29 or 31 days long, with the exception of February, which had 28 days. Every second year, the Roman calendar included an extra month called Mercedonius of 22 or 23 days to keep up with the solar year.

Even this algorithm was very poor, so that in 45 BC, Caesar, advised by the astronomer Sosigenes, ordered a sweeping reform. By imperial decree, one year was made 445 days long to bring the calendar back in step with the seasons. The new calendar, similar to the one we now use was called the Julian calendar (named after Julius Caesar). Its months were 30 or 31 days in length and every fourth year was made a leap year (having 366 days). Caesar also decreed that the year would start with the first of January, not the vernal equinox in late March.

Caesar's year was 11 1/2 minutes short of the calculations recommended by Sosigenes and eventually the date of the vernal equinox began to drift. Roger Bacon became alarmed and sent a note to Pope Clement IV, who apparently was not impressed. Pope Sixtus IV later became convinced that another reform was needed and called the German astronomer, Regiomontanus, to Rome to advise him. Unfortunately, Regiomontanus died of the plague shortly thereafter and the plans died as well.

In 1545, the Council of Trent authorized Pope Gregory XIII to reform the calendar once more. Most of the mathematical work was done by Father Christopher Clavius, S.J. The immediate correction that was adopted was that Thursday, October 4, 1582 was to be the last day of the Julian calendar. The next day was Friday, with the date of October 15. For long range accuracy, a formula suggested by the Vatican librarian Aloysius Giglio was adopted. It said that every fourth year is a leap year except for century years that are not divisible by 400. Thus 1700, 1800 and 1900 would not be leap years, but 2000 would be a leap year since 2000 is divisible by 400. This rule eliminates 3 leap years every 4 centuries, making the calendar sufficiently correct for most ordinary purposes. This calendar is known as the Gregorian calendar and is the one that we now use today. (It is interesting to note that in 1582, all the Protestant princes ignored the papal decree and so many countries continued to use the Julian calendar until either 1698 or 1752. In Russia, it needed the revolution to introduce the Gregorian calendar in 1918.)

This explains why VMS chooses to treat the year 2000 as a leap year.

Despite the great accuracy of the Gregorian calendar, it still falls behind very slightly every few years. If you are very concerned about this problem, we suggest that you tune in short wave radio station WWV, which broadcasts official time signals for use in the United States. About once every 3 years, they declare a leap second at which time you should be careful to adjust your system clock. If you have trouble picking up their signals, we suggest you purchase an atomic clock (not manufactured by Digital and not a VAX option at this time).

END OF SPR

