

MTF Legacy Computer Systems

Internal Status Report

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Batavia, June 10, 2016

Overview

The T&I Department operates at Magnet test Facility (MTF) a number of Sun Microsystems computers which are obsolete and, therefore, constitute a significant risk to our mission-critical magnet test programs. These obsolete systems form the foundation for cold testing systems at VMTF and Stand 3 and warm magnetic measurements at stands A, B, and C. All of these computer systems are at least 20 years old and consequently are very difficult to support. The software and tests systems on the obsolete hardware are far from trivial and will require significant resources to develop the replacements that will allow the decommissioning of the existing systems.

For years the Software Systems Group has been showing their increasing concern with the situation and strongly advocating the need for funding projects and supplementing manpower to develop replacement systems. As a result, the Magnetic Measurement Upgrade Committee was formed and the development of a new generation of measurement systems commenced. A similar design and development effort is still needed for the cold test systems, where the project proposal formulated by the Software Systems group (J. M. Nogiec, "Proposal for Replacement of MTF Superconducting Magnet Testing System", 2013) could be used as a starting point.

These upgrade projects, although vital to the T&I mission, have to compete for resources with other, frequently strategic for the laboratory, projects, such as Mu2e, LARP or LCLS II. The lack of adequate manpower in the T&I Software Systems group results in prolonged development times and exacerbates the risk of interruptions in the magnet testing programs for the various projects and R&D efforts.

In addition to the risks stemming from the aging hardware, several interoperability problems have recently emerged in connection with the obsolescence of the SunOS and Solaris operating system platforms, and their incompatibility with the operating systems available on the Fermi-supported Linux distributions.

Legacy Systems

The Sun-based legacy computer systems in use at MTF include:

- A cluster of servers and computers supporting testing of superconducting magnets at VMTF and Stand 3, including application servers, development servers, multi-screen operator stations, and VxWorks-based DAQ boards.
- A set of computers comprising a computing platform for CHISOX, a warm magnetic measurement system used on the stands A, B and C, including a database server, user operating stations, and SunOS-based DAQ boards.
- Portable measurement systems

Cold Testing System

The distributed monitoring and control system (DMCS) is dependent on obsolete computing platforms consisting of old Sun Microsystems workstations (purchased in 1995/96) and servers running outdated versions of operating systems (>18 years old). DMCS is fundamental to the operation of VMTF as it provides monitoring and control as well as quench protection and characterization functionality. The operation and data analysis user interfaces were developed

for SunOS systems. The same is true for the data storing capability: the in-house developed RFS (Remote File System) and CFS (Chunk Format Standard) systems.

The DAQ hardware layer with direct control and monitoring is implemented as a distributed system with multiple VME crates, each containing a VME single board computer running Wind River's VxWorks RTOS. The VME computers have two different architectures (PowerPC RISC and Motorola 68000 CISC processors) and their corresponding development toolchains. The VME computers are diskless and rely on the Sun-based servers for booting and operation. SunOs is also the platform for cross development of software for these targets. All parts of this system, both hardware and software, are over 15 years old.

CHISOX Measurement System

The CHISOX warm measurement system is a database-centric system. Its automation scripts (checklists) and measurement results are stored in the obsolete Sybase 10 database system. The measurement software running on the Force single board computers is highly coupled with the Sybase database and uses Sybase's proprietary API and stored procedures. The target boards run SunOS and require Sun computers to boot from.

Portable Measurement Systems

Portable measurement systems based on SunOS and Sun hardware are still in use, operated by the Magnet Systems Department magnetic measurement experts. These systems are planned to be replaced by new generation EMMA-based magnetic measurement systems, which requires not only replacement of their software, but also their measurement hardware, including instruments and DAQ boards.

Legacy Computers

Currently, measurement systems use three different flavors of obsolete operating systems: SunOs 4.1.3, Solaris 5.6, and VxWorks RTOS.

Obsolete hardware include Sun Sparc 5, Sun Sparc 20, Force 1e and 2e boards, PowerPC RISC and Motorola 68000 CISC processors.

In the table below, those computers with NFS dependency must be able to use NFS to connect to computer running modern Linux for one or all of: operating system files, data storage or access. The "Kerberized" column indicates the systems that are accessible from user's desktops, and are used for data analysis and access.

Computer	OS	Deployed	Dell Support	Core System	NFS Dependency	Kerberized
Cold Test System						
mdtf35	Solaris 5.6	1996	X	X	X	X
mdtf36	Solaris 5.6	1996	X		X	X

mdtf34	Solaris 5.6	1996	X	X	X	
mdtf19	Solaris 5.6	Pre-1996	X		X	
mdtf20	SunOS 4.1.3	Pre-1996	X	X	X	
mdtf29	SunOS 4.1.3	Pre-1996	X		X	
mdtf30	SunOS 4.1.3	Pre-1996	X		X	
mdtf31	SunOS 4.1.3	Pre-1996	X		X	
mdtf32	SunOS 4.1.3	Pre-1996	X		X	
1 x MVME147	VxWorks RTOS	Pre-1996				
2 x MVME167	VxWorks RTOS	Pre-1996				
6 x MVME2301	VxWorks RTOS	Pre-1996				
2 x MVME2604	VxWorks RTOS	Pre-1996				
5 x MVME1600	VxWorks RTOS	Pre-1996				
CHISOX Warm Magnetic Measurement System						
mdtf21	SunOS 4.1.3	Pre-1996	X	X	X	
mdtf25	SunOS 4.1.3	Pre-1996	X	X		
2 x Force 2	SunOS 4.1.3	Pre-1996				
Portable Magnetic Measurement Systems						
mdtf05	Solaris 5.6	1997	X	X		
mdtf17	Solaris 5.6	Pre-1996	X	X		

Hardware Support Agreement

The Sun computers are showing increased susceptibility to hardware failures, including disks and other parts. This is especially visible after restarting the systems following long-term power outages, when often several of our computers will experience hardware problems.

In addition, these computers are beginning to experience physical degradation, wherein the critical plastic supports of motherboards and hard drives inside the computer chassis are disintegrating.

Although our core Sun computer systems are under support agreement with Dell Services, Federal Government, due to the age of our computing resources and unavailability of old spare

parts, this agreement does not guarantee keeping our systems in operational status. The following information was obtained from queries to Dell Services and pertains only to our Sun systems:

1. Support will be for as long as parts are available.
2. The terms of support are for the length of the contract. The present contract ends March 11, 2017. Since a new contract has not yet been negotiated it is not certain what will happen after March 11. From our perspective we would hope that a similar contract is in place by then.
3. The response time is basically a next day response, between 8am and 5pm. This is to have someone come and diagnose the problem. Beyond that there is no specified guarantee of time to correct the issue. Correction time depends on how long it takes to find replacement parts.
4. If for some reason a part cannot be found, an attempt is made to find an alternative, and we would be informed. Dell Services typically alerts their clients approximately six months in advance if parts start to become scarce.

Software Obsolescence

Software obsolescence is visible in:

- Security obsolescence, and
- Interoperability problems.

Security Obsolescence

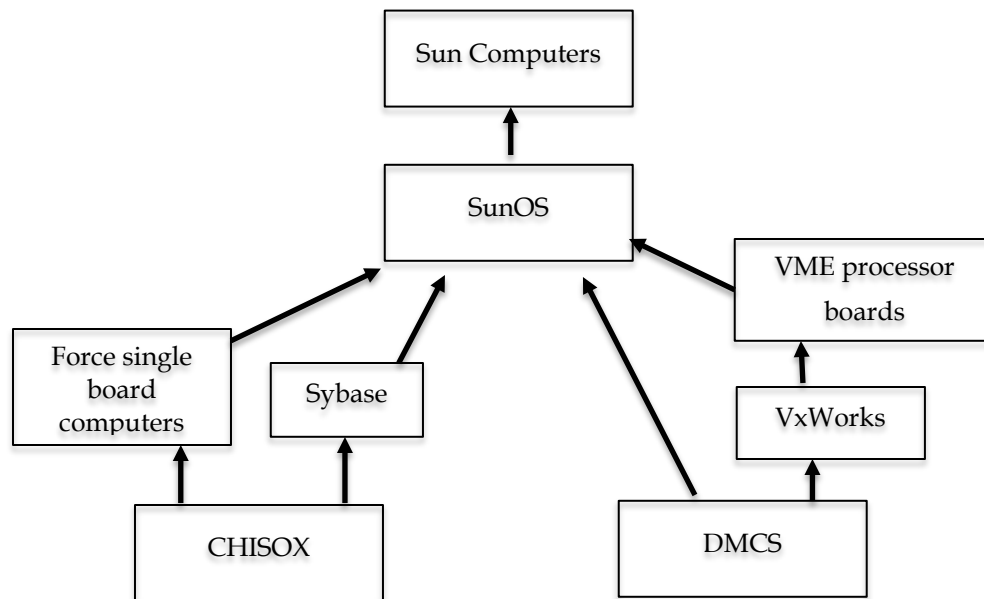
- All operating systems mentioned above have no security upgrades or maintenance patches, and have not had such for several years.
- Remote access to analysis machines via X windows (needed for some analysis programs) requires the use of obsolete X servers, which uses a protocol that cannot be made secure on the obsolete operating system on which it runs.

Interoperability Problems

To address the small capacity and high rate of failures in disks in the Sun computers, the software group deployed a Linux based storage service implemented via NFS. Unfortunately the security improvements in NFS resulted in versions of NFS that are not compatible with the NFS available on the SunOS systems. A temporary, interim solution is to continue using an older, unpatched version of a Linux system that is compatible.

Interoperability problems will continue to impact our ability to use current releases of Linux OS containing all security and functional patches, which in turn will result in isolation of some Linux servers and result in the need to support multiple versions of Linux servers. This is a short term solution, as the Computing Sector requires yearly application for exemptions for the use of obsolete systems.

The dependencies can be graphically expressed as follows:



Recommendations and Conclusions

Our reliance on already outdated test and measurement software, which in turn runs on obsolete SunOS and VxWorks operating systems, creates a precarious dependency on obsolete hardware, including Sun computers, and Force and Motorola single board computers.

Our Sun computing hardware is no longer officially supported, and Sun Microsystems as a company no longer exists. Additionally, it is increasingly difficult to obtain replacement parts, and those parts that are obtained are refurbished units of unknown reliability and remaining lifetime. Clearly, we are past the end of the useful lifetime of Sun computer systems.

Improvements in computer security severely impact our ability to access these old computing systems from other platforms and create interoperability problems with X Windows and NFS. These interoperability problems will impact our ability to use current releases of Linux with all their security and functional patches, which in turn will result in isolation of the outdated Linux servers.

In conclusion, the recent developments reinforce the need to intensify our effort to replace and decommission the systems running on obsolete hardware and software. Prolonging the status quo is increasing the risk of a serious disruption in our test and measurement programs.

Since the replacement effort requires both resources (financial and human) and the time to develop new solutions, planning for these strategic projects should commence as soon as possible, in order to make it feasible to finish the implementation in the next couple of years. A definitive timeline needs to be created now, because if this effort takes longer than two years, interim projects must be established to bolster the obsolete systems to allow them to continue to work throughout the timeline.