NSTX

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Central Instrumentation and Control - WBS6

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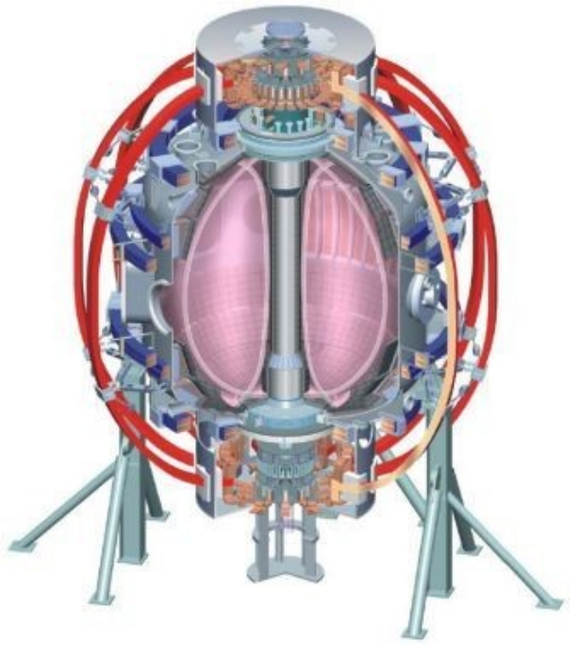
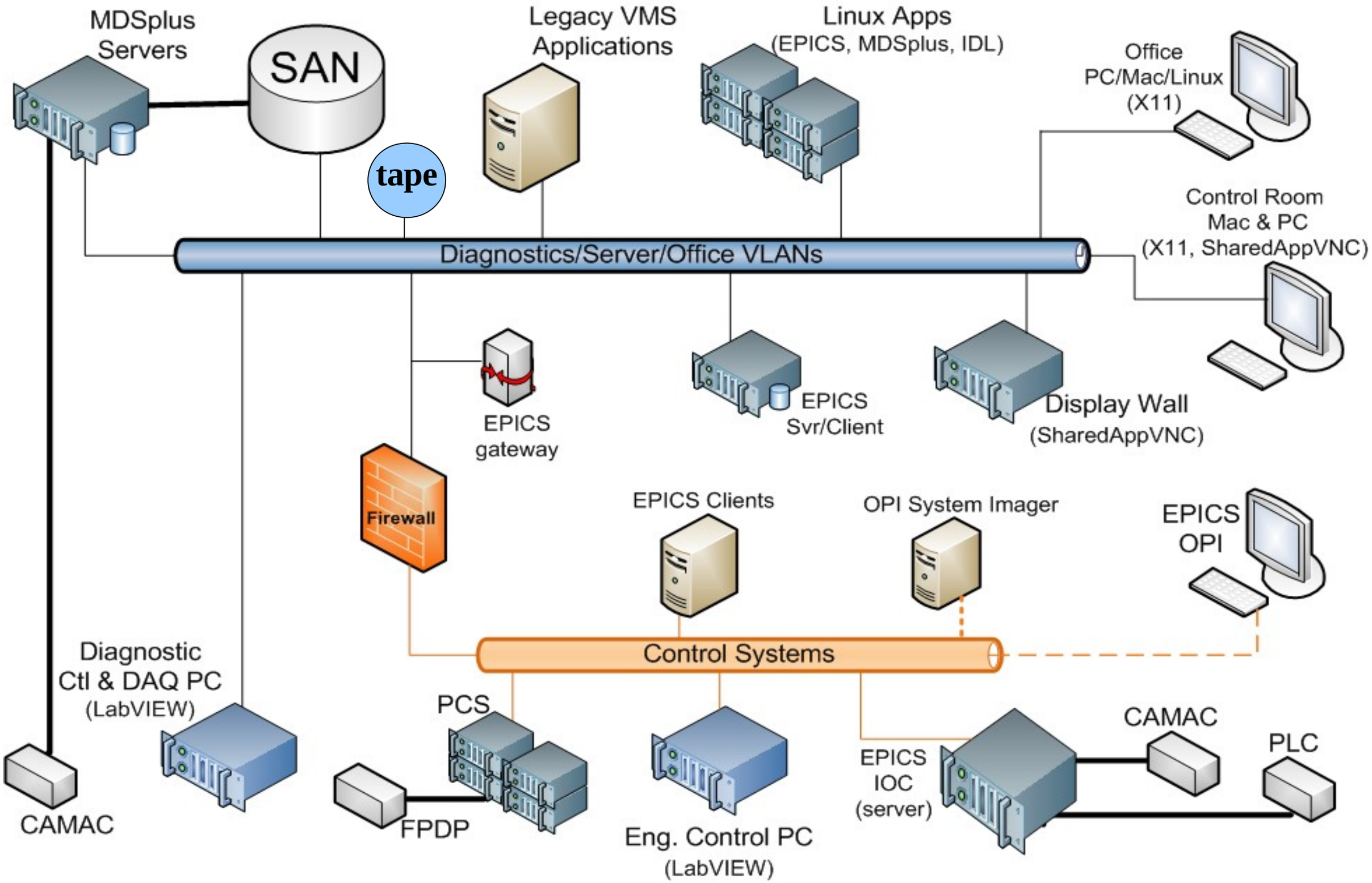
NSTX Centerstack Upgrade Peer Review
LSB, B318
April 29, 2010



NSTX Computing & Data Acquisition



Overarching Requirements

- Pulse Length: The pulse length drives real-time control, data acquisition, analysis, networking, and storage.
  - Currently, a 'long' plasma lasts ~1.8 seconds.
  - GRD Design Requirement: **6.5 second plasma**.

- Quality of Service: The *timeliness* of data acquisition, analysis, and visualization should not degrade from the pre-upgrade level.

Update since CDR

- GRD revised:
  - Emphasized the design point for Central I&C support for the pulse length
  - Better guidance for the extent of networking and CAMAC upgrades - inferred by the 'timeliness' statement
- Retired Risks
  - replace more CAMAC
  - upgrade the network to 10+ Gbit/sec
  - retract the assumption that the real-time computers would have been replaced prior to NSTX-U (by operations)
  - The risk registry included a cost-range: The cost for retiring these risks has not yet been determined and has not been added to this review's WBS6 Work Estimate.
- Remaining Risk: evaluate the tape backup capabilities and needs

Central Computing Tasks in support of longer plasma pulse

Real time plasma control	•New real-time computers, supporting additional memory and CPU/cores. •Additional algorithms and I/O.
CAMAC data acquisition	•~1500 chans •Migrate selected systems to newer technology. •Develop 1 MegaSample Memory board. •Improve CAMAC data acquisition performance.
Data acquisition and management (currently <10 GB/shot)	•Cameras: 30+ GB/shot •PC's/standalone: 15 GB •CAMAC: < 1 GB
NSTX networking	•One or more 10 Gbit/sec networks •evaluate tape backup capability
NTC vacuum rack relocation	•~80 signals •Final design pending cable length analysis.

Recommendation Log

200911-24	CDR Chit-24	Consider alternate solutions to the I&C system other than CAMAC. It is old and fraught with problems and difficult to debug failures. Now may be the time to replace	The GRD has been revised to specify that the post-shot data acquisition and analysis time should be the same as before the upgrade. The design presented at the PDR will consider this.
200911-32	CDR Rec NB-03	Consider replacing data acquisition and I&C CAMAC systems with something more modern and reliable.	See 200911-25

(post-CDR) Risk Registry

- These risks now retired - resources will be added to the cost & schedule.

6100a	Volume of data from diagnostic camera systems exceed capability of network, storage, and backup systems	Install 10 Gbit networks and enhance storage and backup systems	PDR	open	U	Engineering estimate	30 to 200
6100b	EPICS data acquisition takes too long	Include in the base job the upgrade of some data acquisition systems (CAMAC)	PDR	open	VL	Engineering estimate	10 to 100
6100c	Data Acquisition period exceeds GRD requirement	Upgrade additional CAMAC systems	PDR	open	U	Manager's estimate	15 to 150

Supplemental

Cost Basis

- Similar tasks previously executed
- Prior Experience
- Catalog prices
- Engineering Judgment

- Risk and Uncertainty table shows an estimate of uncertainty and risks that impact cost and schedule.

NSTX CAMAC Transient Digitizers

- Excerpt from the list of NSTX CAMAC digitizers is shown below.
- ~150 Transient Digitizers. ~90 H908 model. Others include H907, TR612, and 6810.
- CAMAC digitizers produce < 0.5 GB

Logical Name	Physical	Comment	Ch's	Mem (K)	Rate (Khz)	Dig_ Dur	TYPE
SBA_H908_01	GKC319:N13	Bolometer Array (SPaul)	16	128	5	1.64	908
SBE_H908_01	GKC149:N13	BEaP 3232	8	256	20	1.64	3232
SCH_H908_03 (aka spc_h908_03)	GKC261:N10	test digitizer das_b, crate 61	4	512	40	3.28	908

Real-time Control

Issue	Approach
Additional real-time control algorithms will exceed the capability of the present system.	Upgrade the current PCS computers and software to provide more CPU cores.
Longer real-time control period will exceed the (memory) capability of the present system.	Upgrade the current PCS computers and software to accommodate additional memory.

Central Process and Integrated Control

Issue	Approach
CAMAC Data Acquisition - The present method (client C-program) is not only complex, but too slow.	Develop and use EPICS MDSplus records, and replace the client/server model with a (IOC) server-based solution.
Computer - The present vxWorks/68060 CPU is relatively slow, and makes CAMAC data acquisition take too long.	Upgrade the VME computer and EPICS software.
CAMAC Memory - The CAMAC crates do not have room for more memory modules.	Develop a (high-density) 1 megasample CAMAC memory module
CAMAC bit-serial Highway - The throughput is too low	Reduce the amount of CAMAC data by migrating selected CAMAC-based systems to current technology-based data acquisition systems.

(Diagnostic) Data Acquisition, Data Storage and Management

Issue	Approach
CAMAC Memory - The CAMAC crates do not have room for more memory modules.	Develop a (high-density) 1 megasample CAMAC memory module
CAMAC byte-serial Highway - The throughput is too low.	Reduce the amount of CAMAC data by migrating selected CAMAC-based systems to current technology-based data acquisition systems.
Camera-based diagnostics' data acquisition and file transfer timeliness exceeds the present capability.	Upgrade the networking and computing capability of the present systems.
Post-shot data analysis and visualization timeliness exceeds the present capability.	Upgrade the networking and computing capability of the present systems.
Storage Area Network (SAN) cannot accommodate the additional data loads.	Enhance the SAN and explore more manageable storage file systems
Existing tape backup system cannot process additional NSTX data (load).	Analyze. and if necessary, add cost to expand tape backup system.

Networking

Issue	Approach
Throughput - The present 1 Gbit system will be too slow.	Engineer a network upgrade to provide at least 10 Gbit.

Timing & Synchronization

Issue	Approach
CAMAC crates and modules are required to provide Timing and Synchronization for data acquisition and control systems.	•Update the *Universal Networked Timer* (UNT) hardware design, fabricate, and install where needed. •Develop software to allow user's to configure their timing, from LabVIEW, MDSplus, EPICS.