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Control System Evolution on the ISIS Spallation Neutron Source

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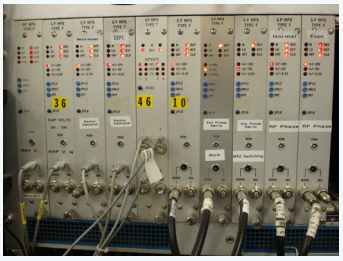
Hardware



The original GP MPX units. Timing (T) and analogue function generator (F) modules are shown here.

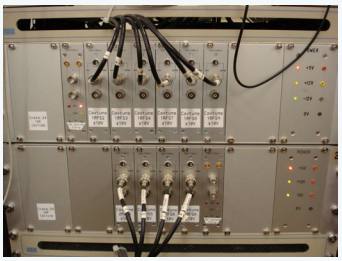
Control and monitoring are via CAMAC operations.

The modules shown form part of the fundamental RF system.

Second generation interface hardware, based on STEbus. These have an embedded 80188 processor with a single task, EPROM based system.

Control and monitoring are via raw Ethernet packets.

The modules shown are used for RF cavity tuning, on both the fundamental and second harmonic RF cavities.



Third generation interface hardware, based on CompactPCI. These use modern Intel processors, running Windows Embedded Standard 2009.

Control and monitoring is via an embedded web server.

The module shown is the Central Timing Distributor, which allows the repetition rates to the two targets to be varied independently.

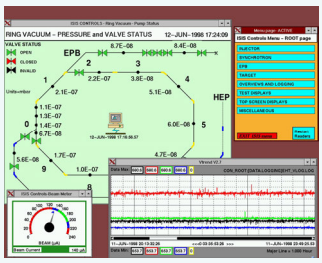
Software

The original ISIS Main Control Room in 1985, shortly after first neutron beam. The user interface was based on the CERN SPS system but was ported to GEC 4000 series computers.

The control screens used touchscreens and programmable hardware knobs to allow user input.

Vista Controls System Inc.'s Vsystem, currently used at ISIS. Vsystem is a commercially supported package, which can be enhanced with user code written in languages such as C and BASIC.

Vsystem was initially installed on the OpenVMS operating system using DEC Alpha processors. Currently it is run on the same OS on Intel Itaniums. In the near future it will be transitioning to Linux on x86-64.



Summary of Evolution

Proto-network (SNS/ISIS)	
Computer system	GEC 4000 series
Network	CAMAC based star network (internal only)
Operating system	GEC DOS 2.6 (modified in house)
User language	GRACES semi-compiled interpreter
Control object data	Data table
Control object method	Fixed Data Module (High level assembly language, BABBAGE)
Hardware I/O	CAMAC plus General Purpose Multiplex system (As CERN SPS)
HMI	CAMAC: Colour TV display controllers, touch screens, programmable knobs

Metamorphosis (Single target ISIS from 1985)		
Computer system	GEC 4000 series	DEC Workstations
Network	CAMAC based star network	Thick-wire Ethernet 10MB/s
Operating system	GEC DOS 2.6 (modified)	OpenVMS
User language	GRACES semi-compiled	BASIC, FORTRAN, C Interpreter
Control object data	Data table	Run time database
Control object method	Fixed Data Module (BABBAGE)	Parameterized handler (C)
Hardware I/O	CAMAC\MPX	CAMAC/MPX/STEbus/PLC
HMI	CAMAC Display/touch/knobs	X-windows, Programmable knobs

Maturity (Two target ISIS)	
Computer system	HP Itanium / Intel
Network	UTP flood-wired Ethernet sharing site network infrastructure >100MB/s
Operating system	OpenVMS / Windows 7
User language	BASIC, FORTRAN, C, C++
Control object data	Run time databases (~21000 channels)
Control object method	Parameterized handler (C)
Hardware I/O systems	CAMAC/MPX/STEbus/CompactPCI/PLC/LabVIEW
HMI	X-windows/Exceed

Experience

1. **Obsolete Equipment Lives On**. It's very hard to replace a working production system. The GEC systems lived on in phased replacement until 2009, there is still original MPX equipment installed.

2. **Design Rationales are Forgotten**. The design rationale for original systems may be lost due to inadequate documentation and loss of personnel. This may leave a situation in which it is known 'how' a system works but not 'why'. When such a system is replaced there is a risk that features that were once required but are now redundant will be duplicated, or that undocumented requirements will be lost.

3. **Lots of Standards, Lots of Customisation.** Flexibility to accommodate custom requirements while achieving standardisation across a large number of historical standards is difficult.