NEW DEVELOPMENTS ON EPICS DRIVERS, CLIENTS AND TOOLS AT SESAME

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P.O. Box 7, Allan 19252, Jordan
www.sesame.org.jo

I. Saleh, Y.S. Dabain, A. Ismail, SESAME, Allan, Jordan

Abstract

SESAME is a 2.5 GeV synchrotron light source under construction in Allan, Jordan. The control system of SESAME is based on EPICS and CSS.

Various developments in EPICS drivers, clients, software tools and hardware have been done. This paper will present some of the main achievements: new linux-x86 EPICS drivers and soft IOCS developed for the Micro-Research Finland event timing system replacing the VME/VxWorks-based drivers; new EPICS drivers and clients developed for the Basler GigE cameras; an IOC deployment and management driver developed to monitor the numerous virtual machines running the soft IOCs, and to ease deployment of updates to these IOCs; an automated EPICS checking tool developed to aid in the review, validation and application of the in-house rules for all record databases; a new EPICS record type (mbbi2) developed to provide alarm features missing from the multibit binary records found in the base distribution of EPICS; a test of feasibility for replacing serial terminal servers with low-cost computers.

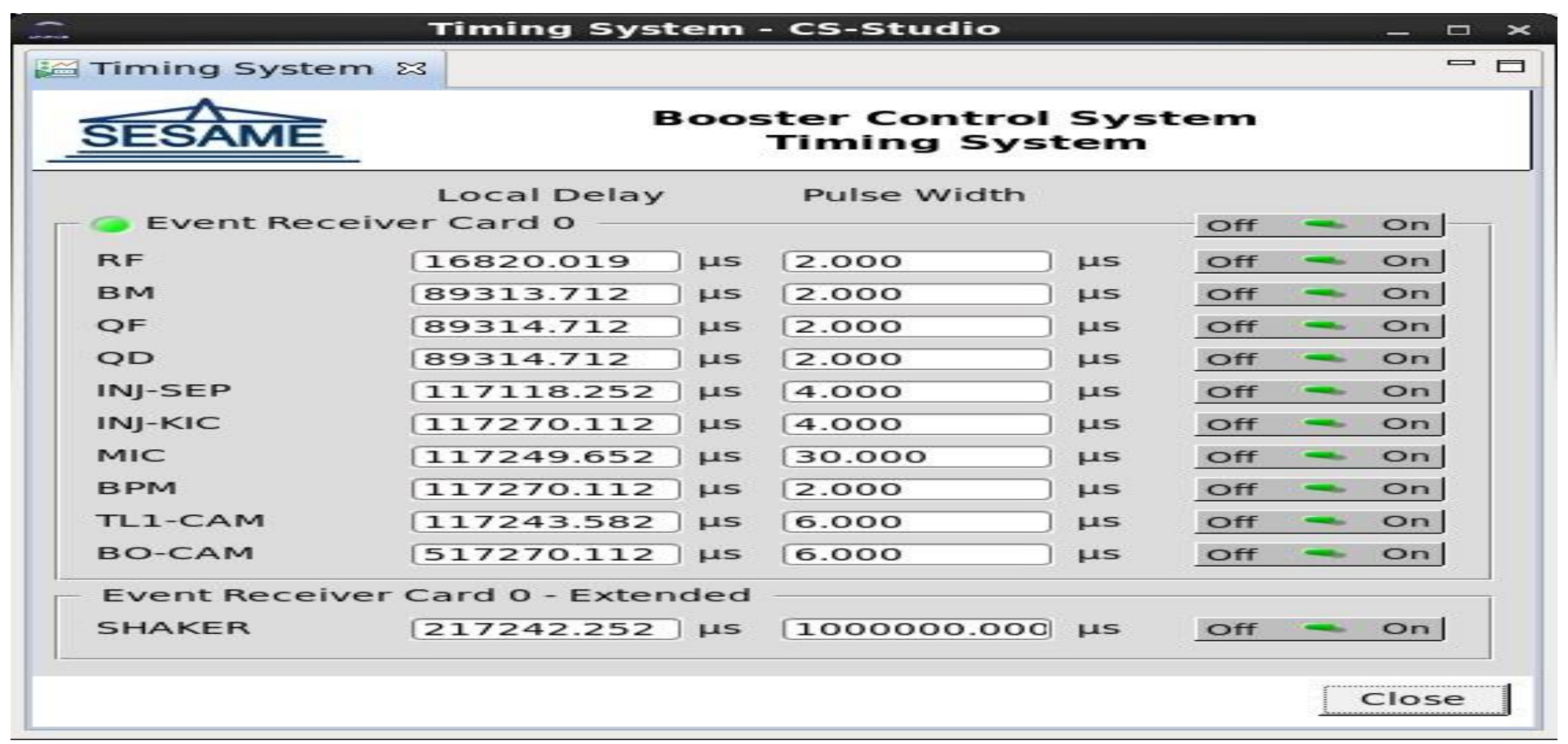
TIMING SYSTEM DRIVER

Figure 1: VME-EVG230

Figure 2: VME-EVR230

- New Linux-x86 EPICS drivers were developed for the VME-EVG230 and VME-EVR230 timing modules from Micro-Research Finland.
- Building an EPICS over Ethernet instead of the VME bus has the following benefits:

- Drops the dead weight: The VME CPU card, the RTOS that runs on the CPU card along with any required licenses.
- Lowers the cost of implementation.
- Confines the required development skills to Linux/x86 platforms



Timing System - CS-Studio

Timing System

Booster Control System
Timing System

Event Receiver Card 0 — Off / On

	Local Delay		Pulse Width		
RF	16820.019	µs	2.000	µs	Off On
BM	89313.712	µs	2.000	µs	Off On
QF	89314.712	µs	2.000	µs	Off On
QD	89314.712	µs	2.000	µs	Off On
INJ-SEP	117118.252	µs	4.000	µs	Off On
INJ-KIC	117270.112	µs	4.000	µs	Off On
MIC	117249.652	µs	30.000	µs	Off On
BPM	117270.112	µs	2.000	µs	Off On
TL1-CAM	117243.582	µs	6.000	µs	Off On
BO-CAM	517270.112	µs	6.000	µs	Off On

Event Receiver Card 0 - Extended

SHAKER	217242.252	µs	1000000.000	µs	Off On

Figure 3: CSS Timing OPI

BASLER GIGE CAMERA DRIVER & CLIENT

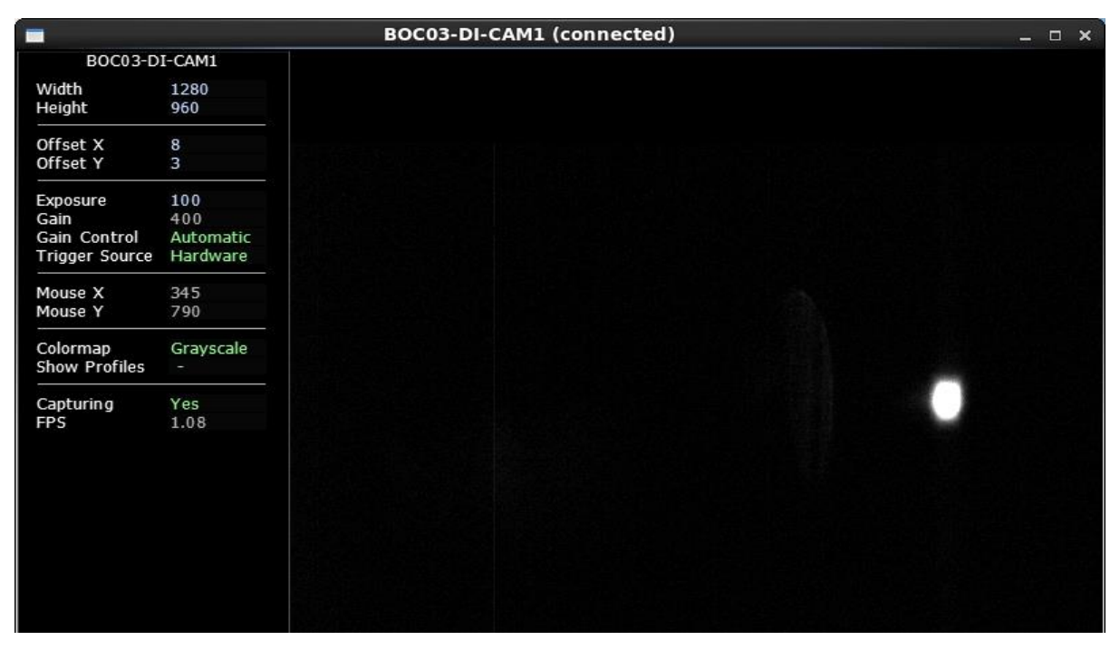
Basler GIGE Camera Driver

- Purpose: Speed up scientific analysis, system integration, needed image, gain, exposure, ROI, and trigger control
- Record types: bi, bo, longin, longout, waveform
- Device support: Asynchronous processing (I/O thread)
- Driver support: One thread per device, message passing
- Device driver: Shared C++ libraries from Basler

Basler GIGE Camera Client

- Uses EPICS client framework
- Built using C, OpenGL, SDL , AntTweakBar and EPICS channel access libraries
- Provides an interface to control basler camera parameters such as: image size, offset, gain, ROI, exposure and trigger source
- Provides different color maps

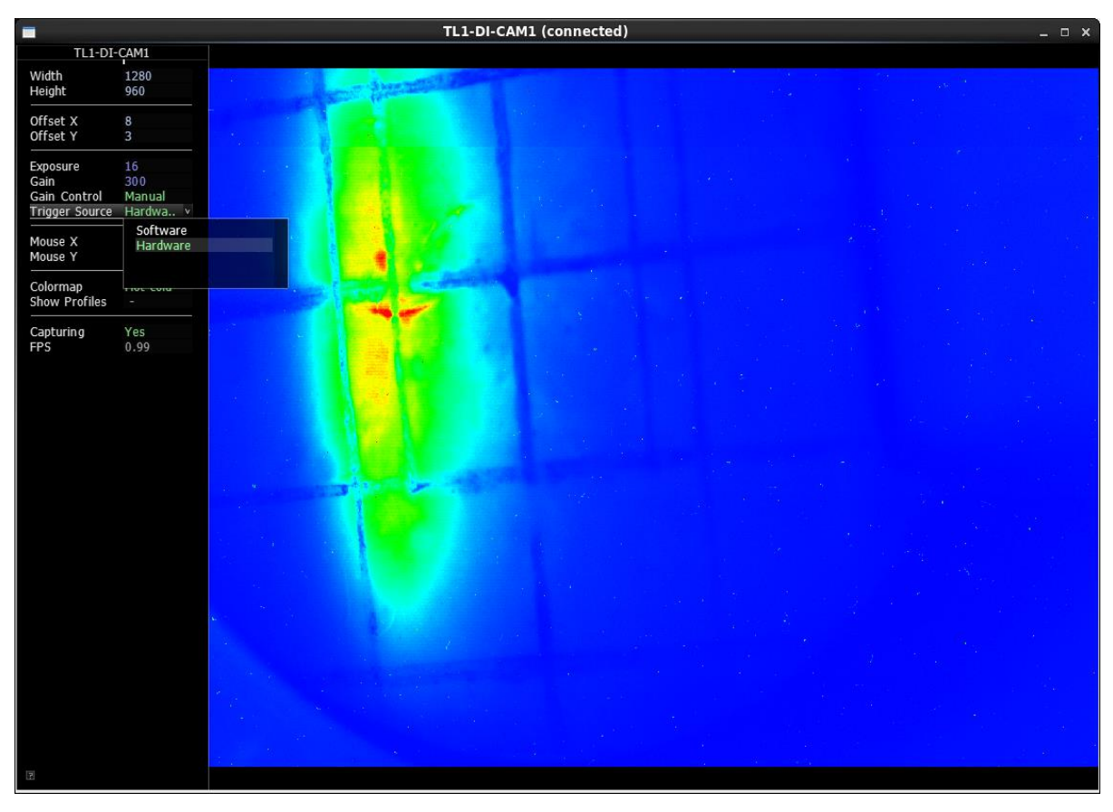
Figure 4: Ace acA1300-30gm GigE camera



BOC03-DI-CAM1 (connected)

```
BOC03-DI-CAM1
Width           1280
Height          960
Offset X        8
Offset Y        3
Exposure        100
Gain            400
Gain Control    Automatic
Trigger Source  Hardware
Mouse X         345
Mouse Y         790
Colormap        Grayscale
Show Profiles   -
Capturing       Yes
FPS             1.08
```

Figure 5: Basler GigE camera client



TL1-DI-CAM1 (connected)

```
TL1-DI-CAM1
Width           1280
Height          960
Offset X        8
Offset Y        3
Exposure        16
Gain            300
Gain Control    Manual
Trigger Source  Hardwa..
Mouse X
Mouse Y
Colormap
Show Profiles   -
Capturing       Yes
FPS             0.99
```

Figure 6: Camera client colours mapping

TERMINAL SERVER

- Terminal server is an experiment to provide simple serial to Ethernet converters using low cost computers.
- The software is running under minimal x86 or x64 Linux systems using libevent2 for asynchronous non-blocking communication.
- The software reads a configuration file and connects to a serial device and starts listening for clients on a TCP port.

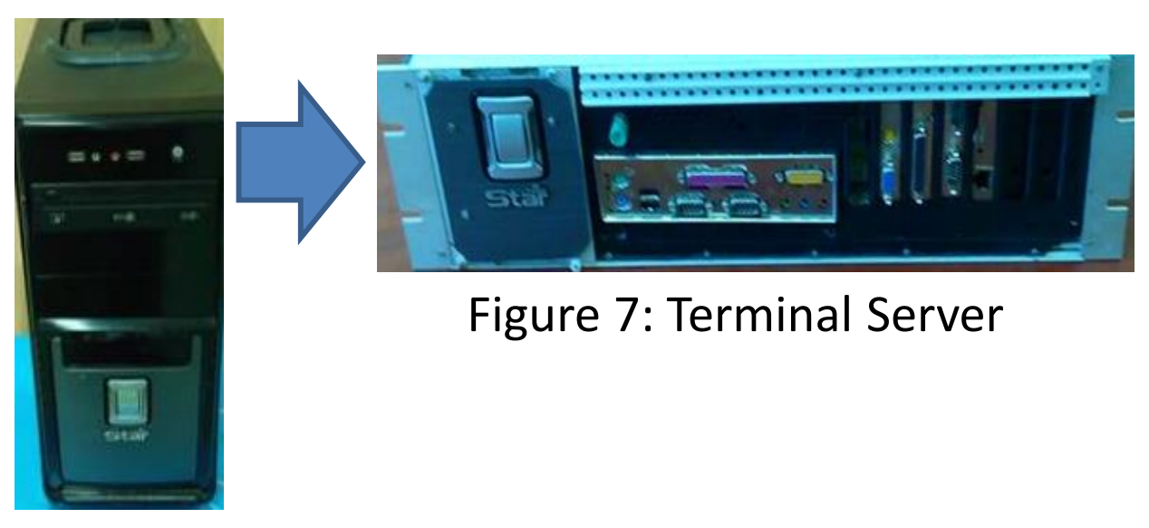
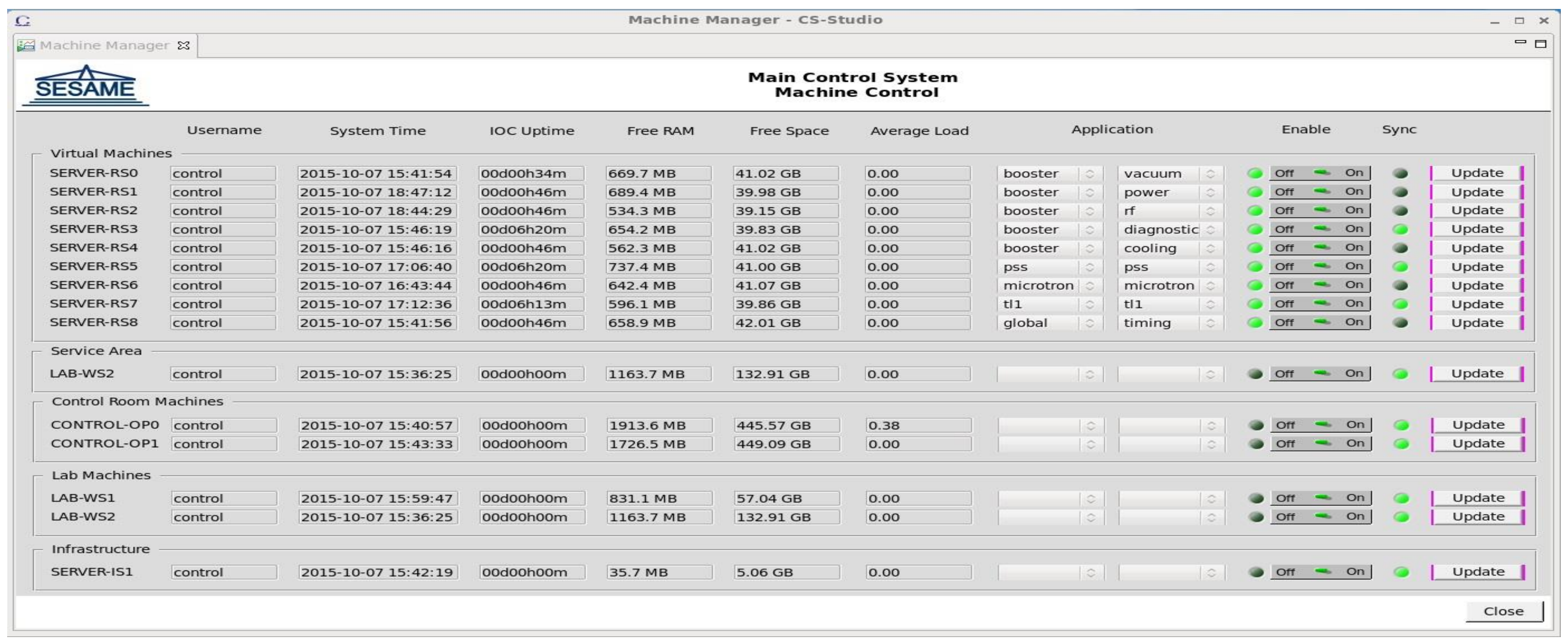


Figure 7: Terminal Server

IOC MANAGER

- The control infrastructure at SESAME uses 12 virtual machines to run the different IOC's and 8 physical machines to run the clients and for development purposes.
- The IOC manager is a Linux/x86 EPICS driver developed for the purpose of managing all the machines that are part of the control infrastructure at SESAME.
- The IOC manager provides the following services:

- Hostname and user of the IOC
- Date, time, and uptime of the IOC
- Drive, memory, and CPU utilization
- Control over which IOC's to run
- Enabling/disabling of the IOC's
- Build system which synchronizes the IOC with the main Git repository



Machine Manager - CS-Studio

Machine Manager

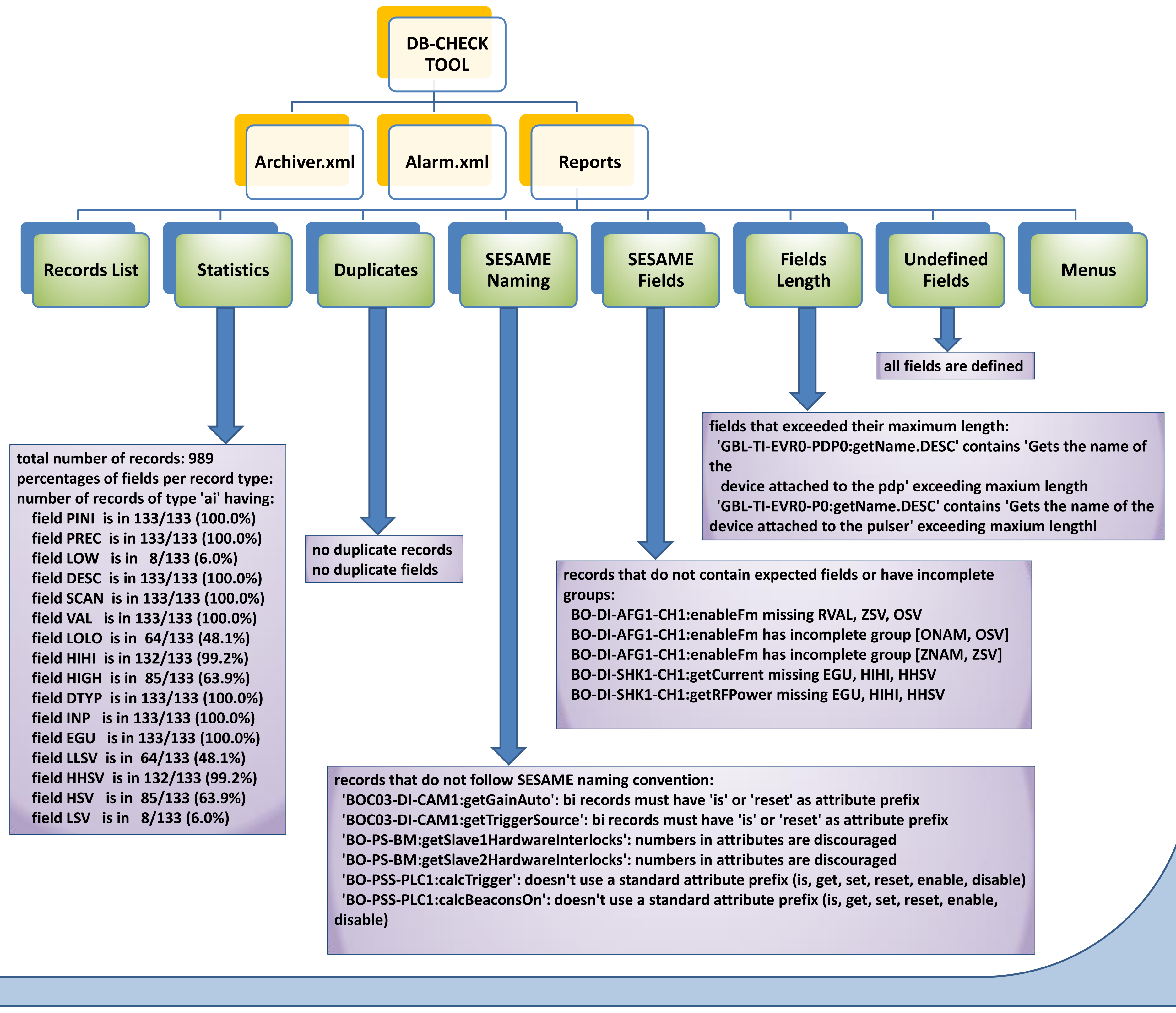
Main Control System
Machine Control

	Username	System Time	IOC Uptime	Free RAM	Free Space	Average Load	Application		Enable	Sync	
Virtual Machines											
SERVER-RS0	control	2015-10-07 15:41:54	00d00h34m	669.7 MB	41.02 GB	0.00	booster	vacuum	Off On		Update
SERVER-RS1	control	2015-10-07 18:47:12	00d00h46m	689.4 MB	39.98 GB	0.00	booster	power	Off On		Update
SERVER-RS2	control	2015-10-07 18:44:29	00d00h46m	534.3 MB	39.15 GB	0.00	booster	rf	Off On		Update
SERVER-RS3	control	2015-10-07 15:46:19	00d06h20m	654.2 MB	39.83 GB	0.00	booster	diagnostic	Off On		Update
SERVER-RS4	control	2015-10-07 15:46:16	00d00h46m	562.3 MB	41.02 GB	0.00	booster	cooling	Off On		Update
SERVER-RS5	control	2015-10-07 17:06:40	00d06h20m	737.4 MB	41.00 GB	0.00	pss	pss	Off On		Update
SERVER-RS6	control	2015-10-07 16:43:44	00d00h46m	642.4 MB	41.07 GB	0.00	microtron	microtron	Off On		Update
SERVER-RS7	control	2015-10-07 17:12:36	00d06h13m	596.1 MB	39.86 GB	0.00	tl1	tl1	Off On		Update
SERVER-RS8	control	2015-10-07 15:41:56	00d00h46m	658.9 MB	42.01 GB	0.00	global	timing	Off On		Update
Service Area											
LAB-WS2	control	2015-10-07 15:36:25	00d00h00m	1163.7 MB	132.91 GB	0.00			Off On		Update
Control Room Machines											
CONTROL-OP0	control	2015-10-07 15:40:57	00d00h00m	1913.6 MB	445.57 GB	0.38			Off On		Update
CONTROL-OP1	control	2015-10-07 15:43:33	00d00h00m	1726.5 MB	449.09 GB	0.00			Off On		Update
Lab Machines											
LAB-WS1	control	2015-10-07 15:59:47	00d00h00m	831.1 MB	57.04 GB	0.00			Off On		Update
LAB-WS2	control	2015-10-07 15:36:25	00d00h00m	1163.7 MB	132.91 GB	0.00			Off On		Update
Infrastructure											
SERVER-IS1	control	2015-10-07 15:42:19	00d00h00m	35.7 MB	5.06 GB	0.00			Off On		Update

Figure 8: CSS IOC Manager OPI

EPICS DATABASE CHECK TOOL (DB-CHECK)

- **A command line tool built to help in reviewing, unifying and maintaining the numerous EPICS databases at SESAME.**
- **The way the db-check works is by parsing the DB and DBD files using a PEG grammar. The tool is built in D programming language and using pegged library for the parser.**



```
total number of records: 989
percentages of fields per record type:
number of records of type 'ai' having:
   field PINI  is in 133/133 (100.0%)
   field PREC  is in 133/133 (100.0%)
   field LOW   is in   8/133 (6.0%)
   field DESC  is in 133/133 (100.0%)
   field SCAN  is in 133/133 (100.0%)
   field VAL   is in 133/133 (100.0%)
   field LOLO  is in  64/133 (48.1%)
   field HIHI  is in 132/133 (99.2%)
   field HIGH  is in  85/133 (63.9%)
   field DTYP  is in 133/133 (100.0%)
   field INP   is in 133/133 (100.0%)
   field EGU   is in 133/133 (100.0%)
   field LLSV  is in  64/133 (48.1%)
   field HHSV  is in 132/133 (99.2%)
   field HSV   is in  85/133 (63.9%)
   field LSV   is in   8/133 (6.0%)
```

```
no duplicate records
no duplicate fields
```

```
fields that exceeded their maximum length:
  'GBL-TI-EVR0-PDP0:getName.DESC' contains 'Gets the name of the
   device attached to the pdp' exceeding maxium length
  'GBL-TI-EVR0-P0:getName.DESC' contains 'Gets the name of the device attached to the pulser' exceeding maxium lengthl
```

```
records that do not contain expected fields or have incomplete groups:
  BO-DI-AFG1-CH1:enableFm missing RVAL, ZSV, OSV
  BO-DI-AFG1-CH1:enableFm has incomplete group [ONAM, OSV]
  BO-DI-AFG1-CH1:enableFm has incomplete group [ZNAM, ZSV]
  BO-DI-SHK1-CH1:getCurrent missing EGU, HIHI, HHSV
  BO-DI-SHK1-CH1:getRFPower missing EGU, HIHI, HHSV
```

```
records that do not follow SESAME naming convention:
  'BOC03-DI-CAM1:getGainAuto': bi records must have 'is' or 'reset' as attribute prefix
  'BOC03-DI-CAM1:getTriggerSource': bi records must have 'is' or 'reset' as attribute prefix
  'BO-PS-BM:getSlave1HardwareInterlocks': numbers in attributes are discouraged
  'BO-PS-BM:getSlave2HardwareInterlocks': numbers in attributes are discouraged
  'BO-PSS-PLC1:calcTrigger': doesn't use a standard attribute prefix (is, get, set, reset, enable, disable)
  'BO-PSS-PLC1:calcBeaconsOn': doesn't use a standard attribute prefix (is, get, set, reset, enable, disable)
```

MBBI2 RECORD

- mbbi2 record is the same as an mbbiDirect record except for its ability to specify alarm states for individual bits.
- mbbi2 is used for devices which provide read access to status registers where different bits hold on/off status, others hold warnings and others hold interlock status.

```
record(mbbi2, "BO-PS-$(DEVICE):getMasterHardwareInterlocks")
{
   field(DESC, "Reads master hardware interlocks")
   field(SCAN, "5 second")
   field(DTYP, "stream")
   field(INP, "@bruker.proto getRelayInterlocks $(DEVICE)")
   field(VAL, " 0")
   field(PINI, " YES ")
   field(B0ST, "Fan")             field(B0ZSV, "NO_ALARM")   field(B0OSV, "MAJOR")
   field(B1ST, "Door open")       field(B1ZSV, "NO_ALARM")   field(B1OSV, "MAJOR")
   field(B2ST, "Phase")           field(B2ZSV, "NO_ALARM")   field(B2OSV, "MAJOR")
   field(B3ST, "DC On")           field(B3ZSV, "NO_ALARM")   field(B3OSV, "MAJOR")
   field(B4ST, "Temperature") field(B4ZSV, "NO_ALARM")   field(B4OSV, "MAJOR")
}
```