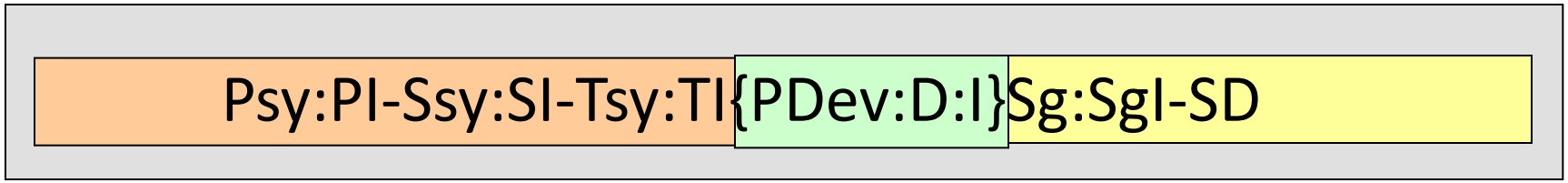
Device Definition and Composite Device Views on Top of the Flat EPICS Namespace

LingyunYang
Ralph Lange
Kunal Shroff
Bob Dalesio

A Naming Standard Can Group Signals for a Single Device



SR:C23-MG{PS:CL1A} Magnet PS CL1A in Cell 23 of the Storage Ring -

Analog setpoint:

SR:C23-MG{PS:CL1A}I:Sp1-SP --> Setpoint for H plane, in unit of Amp
SR:C23-MG{PS:CL1A}I:Sp2-SP --> Setpoint for V plane, in unit of Amp
SR:C23-MG{PS:CL1A}Rate:Rmp1-SP --> Ramp rate for H plane, in unit of Amp/sec.
SR:C23-MG{PS:CL1A}Rate:Rmp2-SP --> Ramp rate for V plane, in unit of Amp/sec.

Analog readbacks:

SR:C23-MG{PS:CL1A}I:Ps1DAC-I --> H plane DAC loopback readback, in unit of Amp
SR:C23-MG{PS:CL1A}I:Ps1DCCT1-I --> H plane DCCT1 loopback readback, in unit of Amp
SR:C23-MG{PS:CL1A}I:Ps1DCCT2-I --> H plane DCCT2 loopback readback, in unit of Amp
SR:C23-MG{PS:CL1A}Ps1Gnd-I --> H Plane ground current, in unit of Amp
SR:C23-MG{PS:CL1A}Ps1Err-I --> H Plane regulator loop error, in unit of Volt
SR:C23-MG{PS:CL1A}Ps1Ctrl-I --> H Plane regulator control voltage, in unit of Volt
SR:C23-MG{PS:CL1A}Ps1Volt --> H Plane power converter raw voltage, in unit of Volt

SR:C23-MG{PS:CL1A}I:Ps2DAC-I --> V plane DAC loopback readback, in unit of Amp
SR:C23-MG{PS:CL1A}I:Ps2DCCT1-I --> V plane DCCT1 loopback readback, in unit of Amp
SR:C23-MG{PS:CL1A}I:Ps2DCCT2-I --> V plane DCCT2 loopback readback, in unit of Amp
SR:C23-MG{PS:CL1A}Ps2Gnd-I --> V Plane ground current, in unit of Amp
SR:C23-MG{PS:CL1A}Ps2Err-I --> V Plane regulator loop error, in unit of Volt
SR:C23-MG{PS:CL1A}Ps2Ctrl-I --> V Plane regulator control voltage, in unit of Volt
SR:C23-MG{PS:CL1A}Ps2Volt --> V Plane power converter raw voltage, in unit of Volt

Digital commands:

SR:C23-MG{PS:CL1A}DoutMode-Sel -->Digital command mode: pulse or static
SR:C23-MG{PS:CL1A}CtctOff-Cmd --> Power convert contact off
SR:C23-MG{PS:CL1A}CtctOn-Cmd --> Power convert contact on
SR:C23-MG{PS:CL1A}RstFlt-Cmd --> Reset fault
SR:C23-MG{PS:CL1A}ParkOn1-Cmd --> H plane regulator park on (open loop)
SR:C23-MG{PS:CL1A}ParkOff1-Cmd --> H plane regulator park off (close loop)
SR:C23-MG{PS:CL1A}ParkOn2-Cmd --> V plane regulator park on (open loop)
SR:C23-MG{PS:CL1A}ParkOff2-Cmd --> V plane regulator park off (close loop)

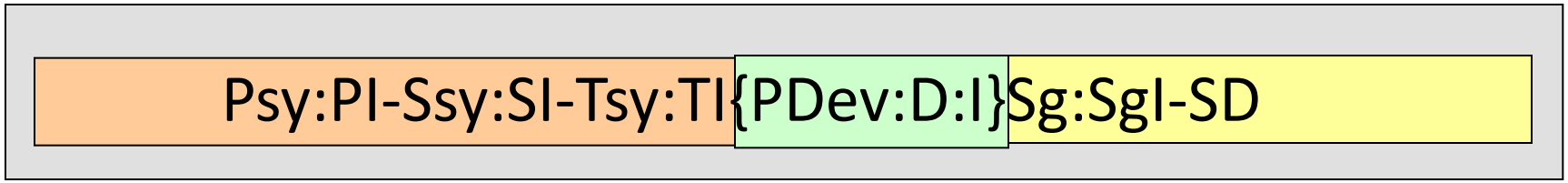
Digital status:

SR:C23-MG{PS:CL1A}CtctON-Sts --> Power converter contact on
SR:C23-MG{PS:CL1A}Ps1Park-Sts --> H plane regulator park status
SR:C23-MG{PS:CL1A}Ps1-I-Sts --> H plane regulator over current fault
SR:C23-MG{PS:CL1A}Ps1DCCT1-Sts --> H plane DCCT1 fault
SR:C23-MG{PS:CL1A}Ps1DCCT2-Sts --> H plane DCCT2 fault
SR:C23-MG{PS:CL1A}Ps1KLIX1-Sts --> H plane Klixon fault (magnet temperature too high)
SR:C23-MG{PS:CL1A}Ps1Gnd-Sts --> H plane ground current fault
SR:C23-MG{PS:CL1A}Ps2Park-Sts --> V plane regulator park status
SR:C23-MG{PS:CL1A}Ps2-I-Sts --> V plane regulator over current fault
SR:C23-MG{PS:CL1A}Ps2DCCT1-Sts --> V plane DCCT1 fault
SR:C23-MG{PS:CL1A}Ps2DCCT2-Sts --> V plane DCCT2 fault
SR:C23-MG{PS:CL1A}Ps2KLIX1-Sts --> V plane Klixon fault (magnet temperature too high)
SR:C23-MG{PS:CL1A}Ps2Gnd-Sts --> V plane ground current fault

ETC…….

Approximately 300 records each for 1000 power supplies – 300,000 records

A Naming Standard Can Group Signals for a Single Device BPM



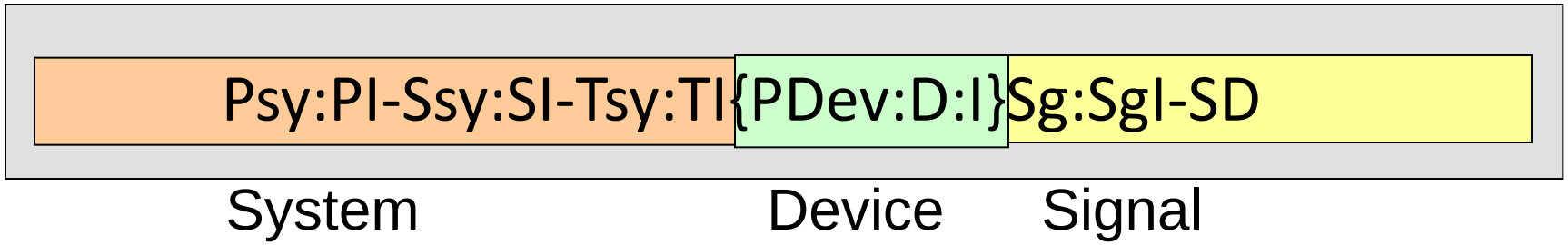
LN-BI{BPM:1 Beam Position Monitor 1 in the LINAC portion of Injection ---- 486 records

LI-CS{IOC:LI-BPM1}:CA_CLNT_CNT
LI-CS{IOC:LI-BPM1}:CA_CONN_CNT
LI-CS{IOC:LI-BPM1}:CPU_CNT
LI-CS{IOC:LI-BPM1}:FD_CNT
LI-CS{IOC:LI-BPM1}:FD_MAX
LI-CS{IOC:LI-BPM1}:IOC_CPU_LOAD
LI-CS{IOC:LI-BPM1}:LOAD
LI-CS{IOC:LI-BPM1}:MEM_FREE
LI-CS{IOC:LI-BPM1}:MEM_MAX
LI-CS{IOC:LI-BPM1}:MEM_USED
LI-CS{IOC:LI-BPM1}:RECORD_CNT
LI-CS{IOC:LI-BPM1}:SUSP_TASK_CNT
LI-CS{IOC:LI-BPM1}:SYS_CPU_LOAD
LN-BI{BPM:1}Ampl:ASA-I
LN-BI{BPM:1}Ampl:BSA-I
LN-BI{BPM:1}Ampl:CSA-I
LN-BI{BPM:1}Ampl:DSA-I
LN-BI{BPM:1}Ampl:PtASA-I
LN-BI{BPM:1}Ampl:PtBSA-I
LN-BI{BPM:1}Ampl:PtCSA-I
LN-BI{BPM:1}Ampl:PtDSA-I
LN-BI{BPM:1}Ampl:RawAMax-I
LN-BI{BPM:1}Ampl:RawAMin-I
LN-BI{BPM:1}Ampl:RawAPeekAddr-I
LN-BI{BPM:1}Ampl:RawBMax-I
LN-BI{BPM:1}Ampl:RawBMin-I
LN-BI{BPM:1}Ampl:RawBPeakAddr-I
LN-BI{BPM:1}Ampl:RawCMax-I
LN-BI{BPM:1}Ampl:RawCMin-I
LN-BI{BPM:1}Ampl:RawCPeakAddr-I
LN-BI{BPM:1}Ampl:RawDPeakAddr-I
LN-BI{BPM:1}Ampl:RawSMax-I
LN-BI{BPM:1}Ampl:RawSMin-I
LN-BI{BPM:1}Ampl:Sum-I
LN-BI{BPM:1}Bunch-SUM
LN-BI{BPM:1}Bunch-X
LN-BI{BPM:1}Bunch-Y
LN-BI{BPM:1}Button:APwr-I
LN-BI{BPM:1}Button:BPwr-I
LN-BI{BPM:1}Button:CPwr-I
LN-BI{BPM:1}Button:DPwr-I
LN-BI{BPM:1}Cnt:TrigPrev-I_
LN-BI{BPM:1}Dfe:Vcc5V-I
LN-BI{BPM:1}EE:FirmVer-I
LN-BI{BPM:1}FA-rmsA
LN-BI{BPM:1}FA-rmsB
LN-BI{BPM:1}FA-rmsC
LN-BI{BPM:1}FA-rmsD
LN-BI{BPM:1}FA-rmsQ
LN-BI{BPM:1}FA-rmsS
LN-BI{BPM:1}FA-rmsX
LN-BI{BPM:1}FFT:IF2-I
LN-BI{BPM:1}FFT:IF3-I
LN-BI{BPM:1}FFT:Mag0-I
LN-BI{BPM:1}FFT:Mag1-I
LN-BI{BPM:1}FFT:Mag2-I
LN-BI{BPM:1}FFT:Mag3-I
LN-BI{BPM:1}Fpga:FwVer-I
LN-BI{BPM:1}Fpga:VccAux-I
LN-BI{BPM:1}Fpga:VccInt-I
LN-BI{BPM:1}LTB:MbAvgA-I
LN-BI{BPM:1}LTB:MbAvgB-I
LN-BI{BPM:1}LTB:MbAvgC-I
LN-BI{BPM:1}LTB:MbAvgD-I
LN-BI{BPM:1}LTB:MbAvgS-I
LN-BI{BPM:1}LTB:MbAvgX-I
LN-BI{BPM:1}LTB:MbAvgY-I
LN-BI{BPM:1}LTB:MbStdA-I
LN-BI{BPM:1}LTB:MbStdB-I
LN-BI{BPM:1}LTB:MbStdC-I
LN-BI{BPM:1}LTB:MbStdD-I
LN-BI{BPM:1}LTB:MbStdS-I
LN-BI{BPM:1}Pos:UsrYoffset-I
LN-BI{BPM:1}Pos:Vref-I
LN-BI{BPM:1}Pos:X-I
LN-BI{BPM:1}Pos:Y-I
LN-BI{BPM:1}Sys:Frev-I
LN-BI{BPM:1}Sys:GainAdc0-I
LN-BI{BPM:1}Sys:GainAdc1-I
LN-BI{BPM:1}Sys:GainAdc2-I
LN-BI{BPM:1}Sys:GainAdc3-I
LN-BI{BPM:1}Sys:Hnum-I
LN-BI{BPM:1}Sys:IF-I
LN-BI{BPM:1}Sys:Rf-I
LN-BI{BPM:1}Sys:S21Adc0-I
LN-BI{BPM:1}Sys:S21Adc1-I
LN-BI{BPM:1}Sys:S21Adc2-I
LN-BI{BPM:1}Sys:S21Adc3-I
LN-BI{BPM:1}Sys:TbtDec-I
LN-BI{BPM:1}Sys:Vcxo-I
LN-BI{BPM:1}TBT-rmsA
LN-BI{BPM:1}TBT-rmsB
LN-BI{BPM:1}TBT-rmsC
LN-BI{BPM:1}TBT-rmsD
LN-BI{BPM:1}TBT-rmsQ
LN-BI{BPM:1}TBT-rmsS
LN-BI{BPM:1}TBT-rmsX
LN-BI{BPM:1}TBT-rmsY
LN-BI{BPM:1}TBT:AMax-I
LN-BI{BPM:1}TBT:AMin-I
LN-BI{BPM:1}TBT:BMax-I
LN-BI{BPM:1}TBT:DMax-I
LN-BI{BPM:1}TBT:DMin-I
LN-BI{BPM:1}TBT:QMax-I
LN-BI{BPM:1}TBT:QMin-I
LN-BI{BPM:1}TBT:SMax-I
LN-BI{BPM:1}TBT:SMin-I
LN-BI{BPM:1}TBT:XMax-I
LN-BI{BPM:1}TBT:XMin-I
LN-BI{BPM:1}TBT:YMax-I
LN-BI{BPM:1}TBT:YMin-I
LN-BI{BPM:1}Temp:AfeSense0-I
LN-BI{BPM:1}Temp:AfeSense1-I
LN-BI{BPM:1}Temp:DfeSense0-I
LN-BI{BPM:1}Temp:DfeSense1-I
LN-BI{BPM:1}Temp:DfeSense2-I
LN-BI{BPM:1}Temp:DfeSense3-I
LN-BI{BPM:1}Temp:FpgaDie-I
LI-CS{IOC:LI-BPM1}:CA_UPD_TIME
LI-CS{IOC:LI-BPM1}:FD_UPD_TIME
LI-CS{IOC:LI-BPM1}:LOAD_UPD_TIME
LI-CS{IOC:LI-BPM1}:MEM_UPD_TIME
LN-BI{BPM:1}Beam:Gain-SP
LN-BI{BPM:1}Beam:Off-SP
LN-BI{BPM:1}DDR_WFM-PollDly
LN-BI{BPM:1}DDS-freq
LN-BI{BPM:1}Ee:AdcGain0-SP
LN-BI{BPM:1}Ee:BbaOffQ-SP
LN-BI{BPM:1}Ee:BbaOffX-SP
LN-BI{BPM:1}Ee:BbaOffY-SP

Etc…….

Approximately 500 records each for 300 BPMs– 150,000 records

Names Are Not Adequate for Devices



These names are given by equipment engineers and reflect how a device is installed
One could easily see all of the PVs that make up one device
But ….. if the power supply is the device, how are the magnet readings identified?

One could find all of correctors or BPMs in the storage ring
But …. How does one determine which read back is the appropriate one – fast, fft, waveform?

One can ask for all of the devices in a given portion of the machine
But …. How does one express that devices can be in more than lattice?

And… How does one compose a subset of these Process Variables to create arbitrary groups for for a cross system device, such as experimental end station?

Physicists and Operators Have Different Views Than Equipment Engineers

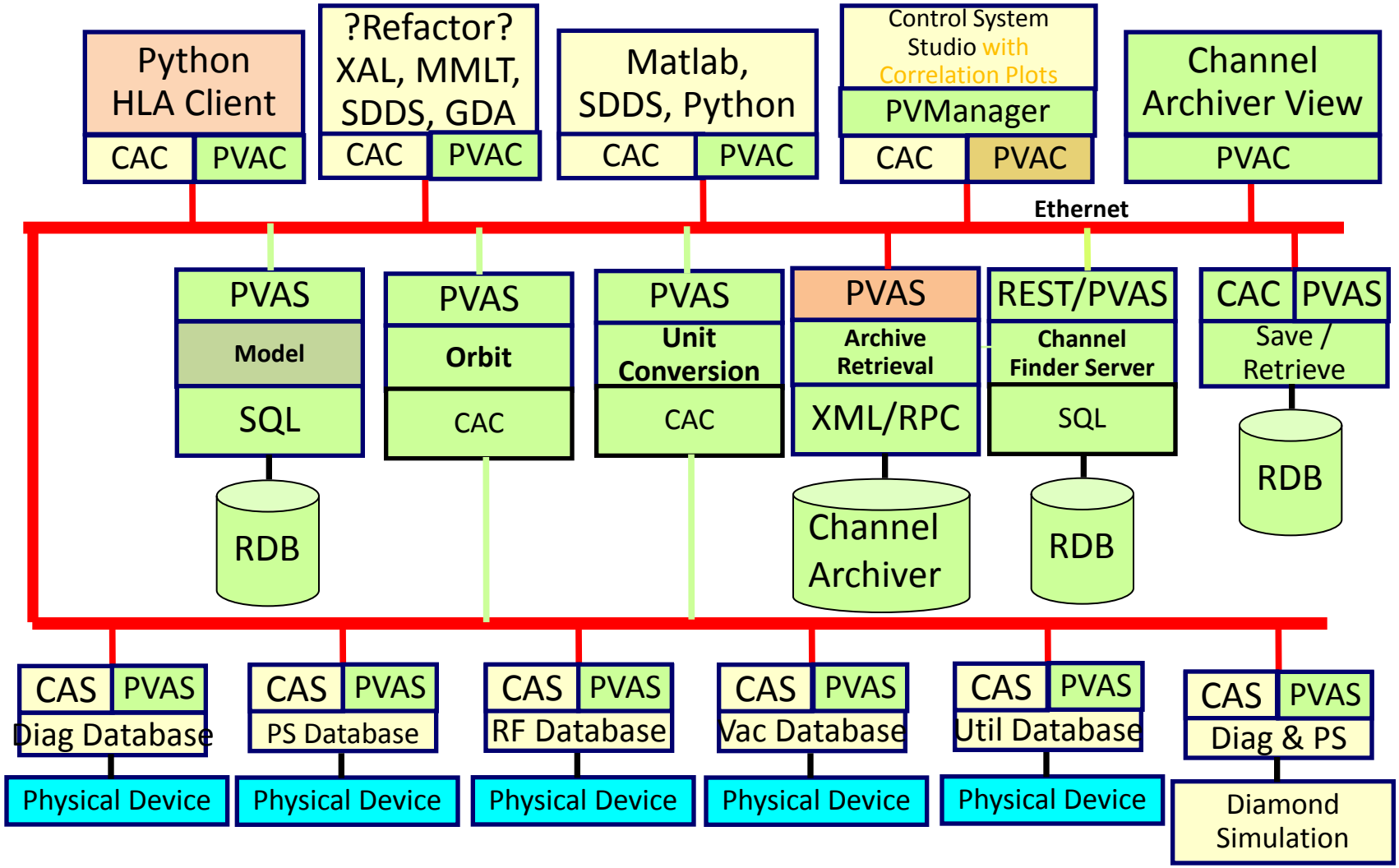
```
Lattice header and description for lattice (id: 4)
-------------------------------------------------------------------------------
       lattice format:                    txt
         lattice type:                  plain
         lattice name: CD3-Oct3-12-30Cell-addID-par-plain
      lattice version:                 20121003
      lattice version:                   design
initially created by:                  Weiming
initially created on:   2013-07-12T12:58:48
          description: This is a design lattice released on Oct 3rd, 2012 with plain format

Lattice data for lattice CD3-Oct3-12-30Cell-addID-par.txt
-------------------------------------------------------------------------------
 ElementName   ElementType       L          s          K1          K2       Angle
                               m          m        1/m2        1/m3         rad
-------------------------------------------------------------------------------
 _BEG_         MARK              0          0           0           0           0
 DH05G1C30A    DRIF        4.29379    4.29379           0           0           0
 FH2G1C30A     FTRIM         0.044    4.33779           0           0           0
 DH1G1A        DRIF        0.31221       4.65           0           0           0
 GEG1C30A      MARK              0       4.65           0           0           0
 GSG2C30A      MARK              0       4.65           0           0           0
 SH1G2C30A     SEXT            0.2       4.85           0     24.1977           0
 DH1AG2A       DRIF          0.085      4.935           0           0           0
 PH1G2C30A     BPM               0      4.935           0           0           0
 DBPM01        DRIF         0.0775     5.0125           0           0           0
 QH1G2C30A     QUAD          0.275     5.2875   -0.633004           0           0
 DH2AG2A       DRIF          0.145     5.4325           0           0           0
 SQHHG2C30A    QUAD            0.1     5.5325           0           0           0
 CH1G2C30A     SQ_TRIM           0     5.5325           0           0           0
 SQHHG2C30A    QUAD            0.1     5.6325           0           0           0
 DH2BG2A       DRIF         0.4595      6.092           0           0           0
 QH2G2C30A     QUAD          0.448       6.54     1.47765           0           0
 DH3AG2A       DRIF           0.19       6.73           0           0           0
 SH3G2C30A     SEXT            0.2       6.93           0     -4.1557           0
 DH3BG2A       DRIF         0.1825     7.1125           0           0           0
 QH3G2C30A     QUAD          0.275     7.3875    -1.70755           0           0
 DH4AG2A       DRIF        0.07252    7.46002           0           0           0
 PH2G2C30A     BPM               0    7.46002           0           0           0
 DBPM02        DRIF        0.08998       7.55           0           0           0
 SH4G2C30A     SEXT            0.2       7.75           0    -20.4869           0
 DH4BG2A       DRIF         0.2485     7.9985           0           0           0
 CH2G2C30A     TRIMD           0.3     8.2985           0           0           0
 GEG2C30A      MARK              0     8.2985           0           0           0
 DH4CG3A       DRIF         0.0315       8.33           0           0           0
 GSG3C30A      MARK              0       8.33           0           0           0
 B1G3C30A      DIPOLE         2.62      10.95           0           0     0.10472
 GEG3C30A      MARK              0      10.95           0           0           0
 GSG4C30A      MARK              0      10.95           0           0           0
 DM1AG4A       DRIF          0.501     11.451           0           0           0
 CM1G4C30A     TRIMD           0.2     11.651           0           0           0
 DM1BG4A       DRIF          0.274     11.925           0           0           0
 QM1G4C30A     QUAD           0.25     12.175   -0.803148           0           0
 DM2AG4A       DRIF            0.2     12.375           0           0           0
 SM1G4C30A     SEXT            0.2     12.575           0    -24.131           0
 DFT1          DRIF         0.2332     12.808           0           0           0
 FM1G4C30A     FTRIM         0.044     12.852           0           0           0
 DM2BG4A       DRIF         0.2924     13.144           0           0           0
 PM1G4C30A     BPM               0     13.144           0           0           0
 DBPM03        DRIF         0.0839     13.228           0           0           0
 QM2G4C30A     QUAD          0.283     13.511      1.2223           0           0
:
```

Views Can Be Created By Associating Attributes Using Tags and Properties

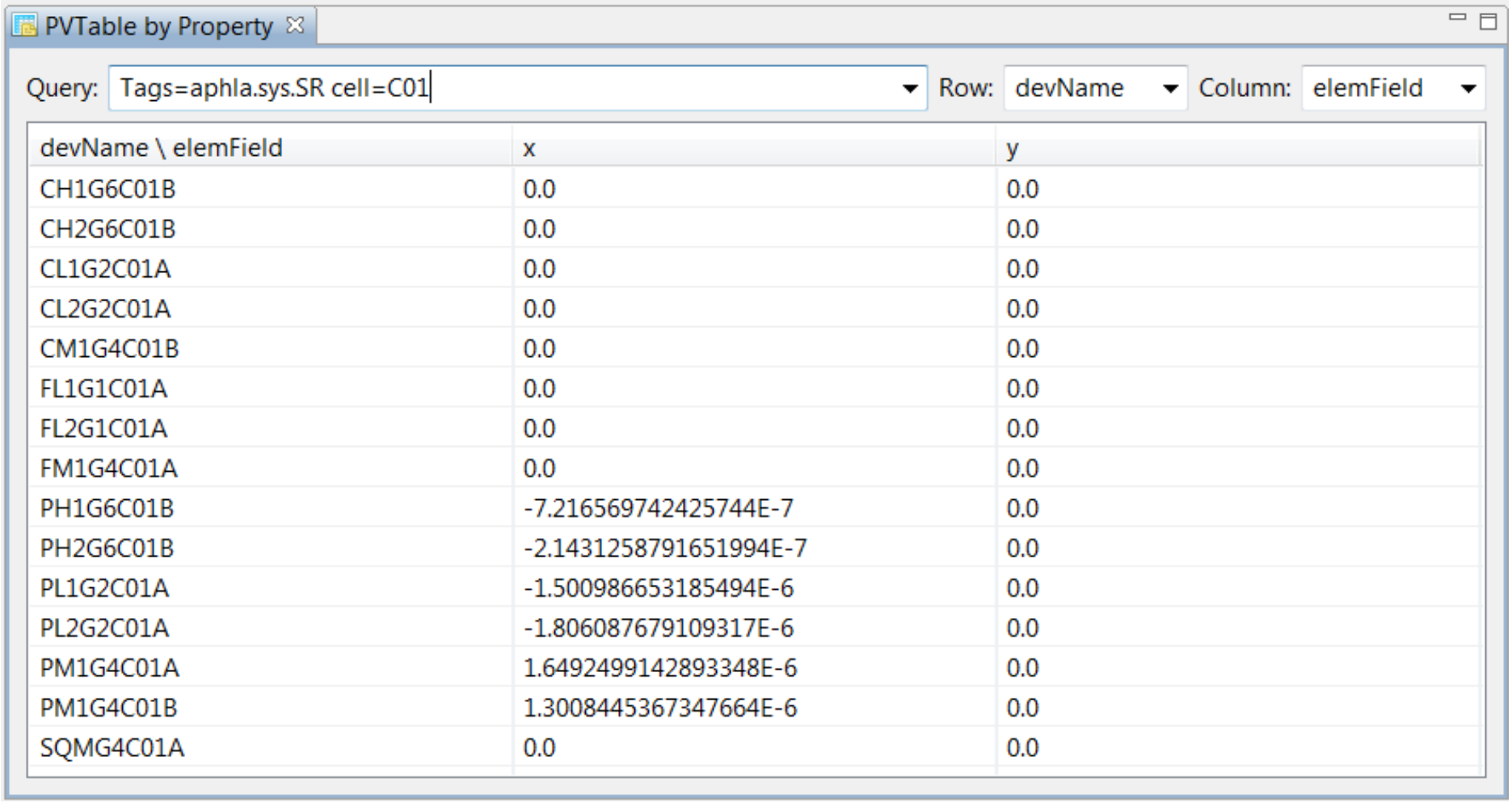
device FM1G4C02A

Channel Name	SR:C02-MG:G04A{HFCor:FM1}		SR:C02-MG:G04A{VFCor:FM1}	
	Fld-I	Fld-SP	Fld-I	Fld-SP
handle	READBACK	SETPOINT	READBACK	SETPOINT
elemName	FXM1G4C02A		FYM1G4C02A	
elemType	HFCOR		VFCOR	
elemField	x		y	
devName	FM1G4C02A			
sEnd	65.5222			
cell	C02			
girder	G4			
symmetry	A			
length	0.044			
ordinal	263		264	
tags	eget	eput	eget	eput
	x		y	
	sys.SR			

Channel Finder Service Enables Other Services to Use These Views

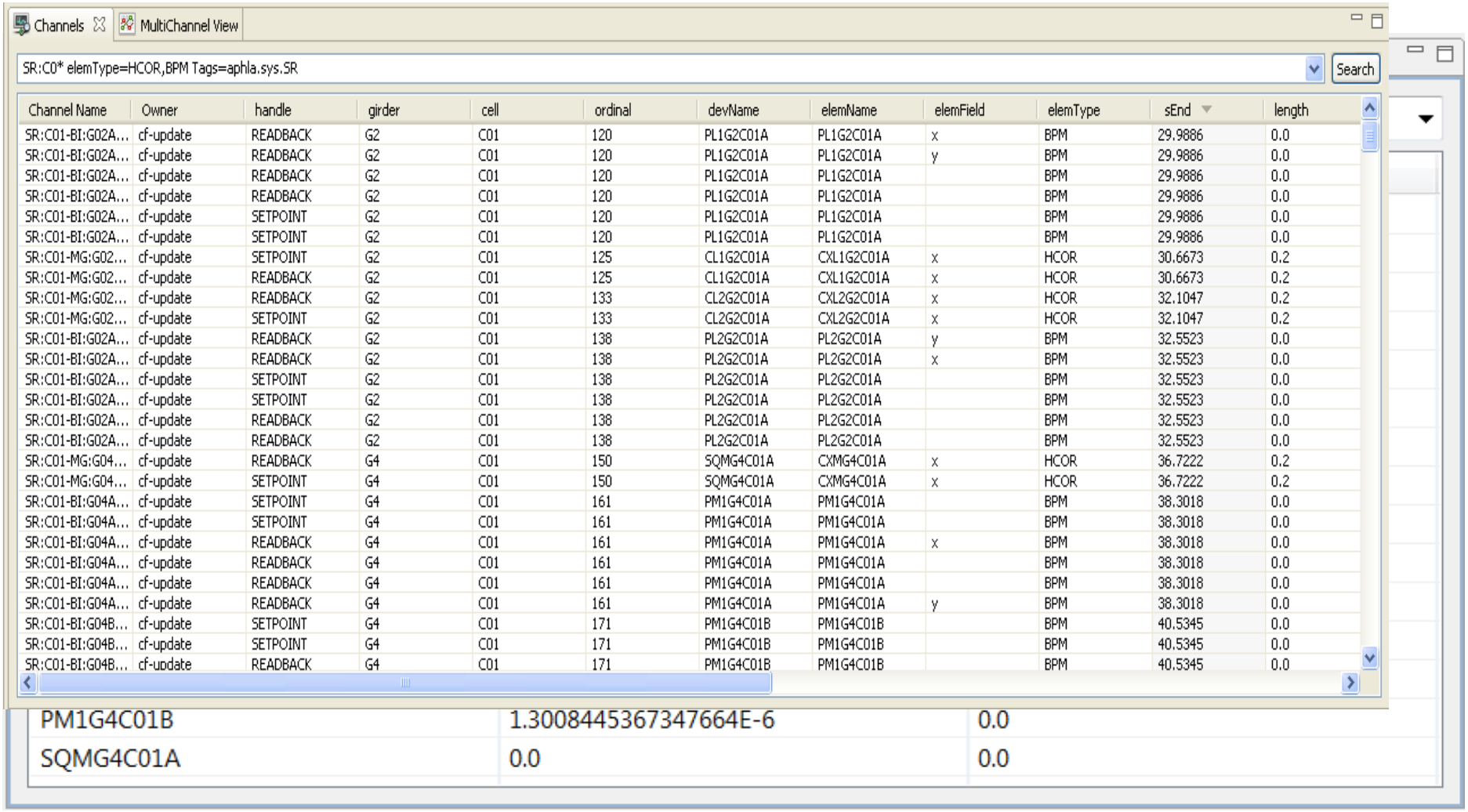


CS-Studio Uses Channel Finder Service

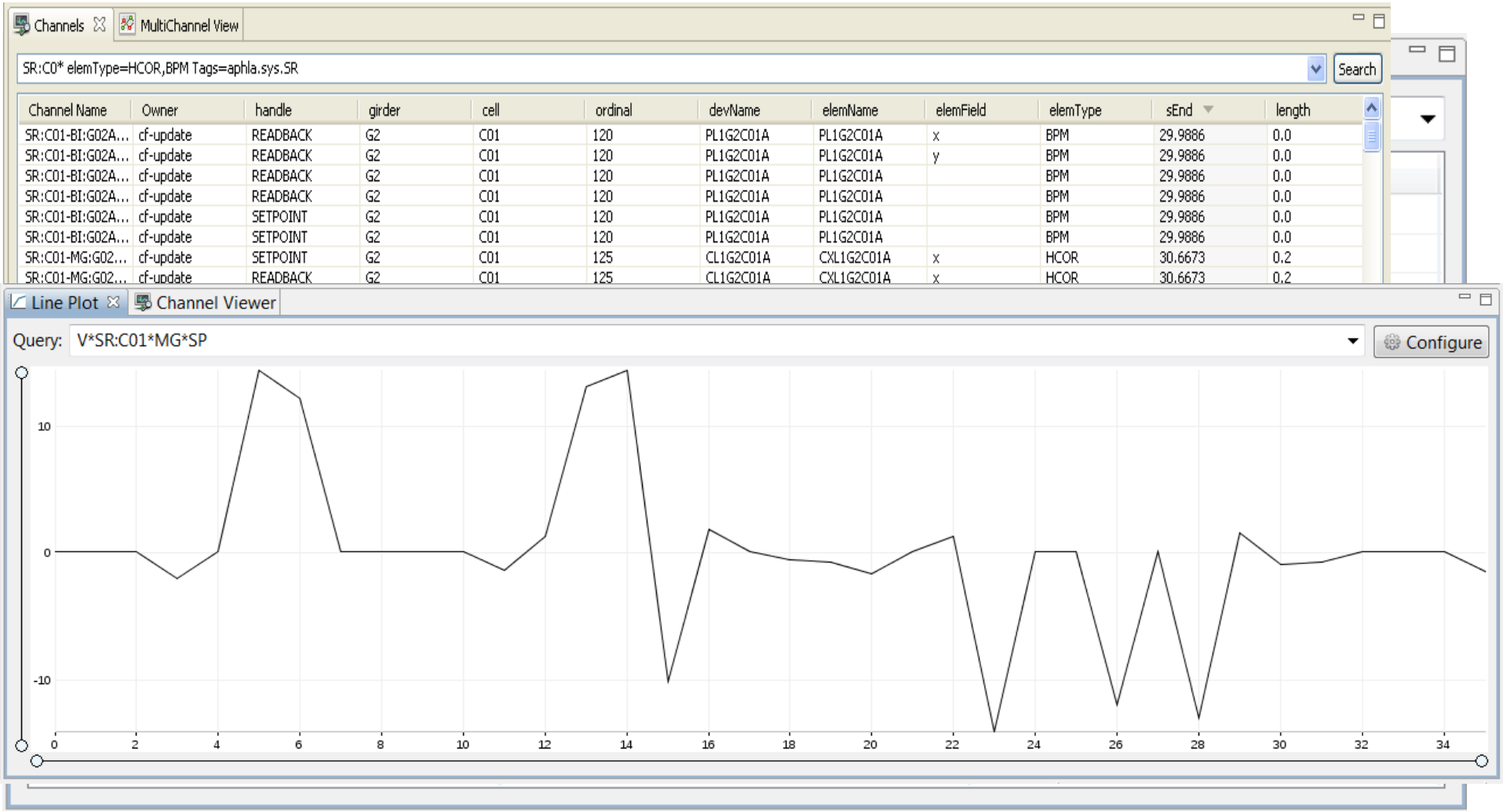


devName \ elemField	x	y
CH1G6C01B	0.0	0.0
CH2G6C01B	0.0	0.0
CL1G2C01A	0.0	0.0
CL2G2C01A	0.0	0.0
CM1G4C01B	0.0	0.0
FL1G1C01A	0.0	0.0
FL2G1C01A	0.0	0.0
FM1G4C01A	0.0	0.0
PH1G6C01B	-7.216569742425744E-7	0.0
PH2G6C01B	-2.1431258791651994E-7	0.0
PL1G2C01A	-1.500986653185494E-6	0.0
PL2G2C01A	-1.806087679109317E-6	0.0
PM1G4C01A	1.6492499142893348E-6	0.0
PM1G4C01B	1.3008445367347664E-6	0.0
SQMG4C01A	0.0	0.0

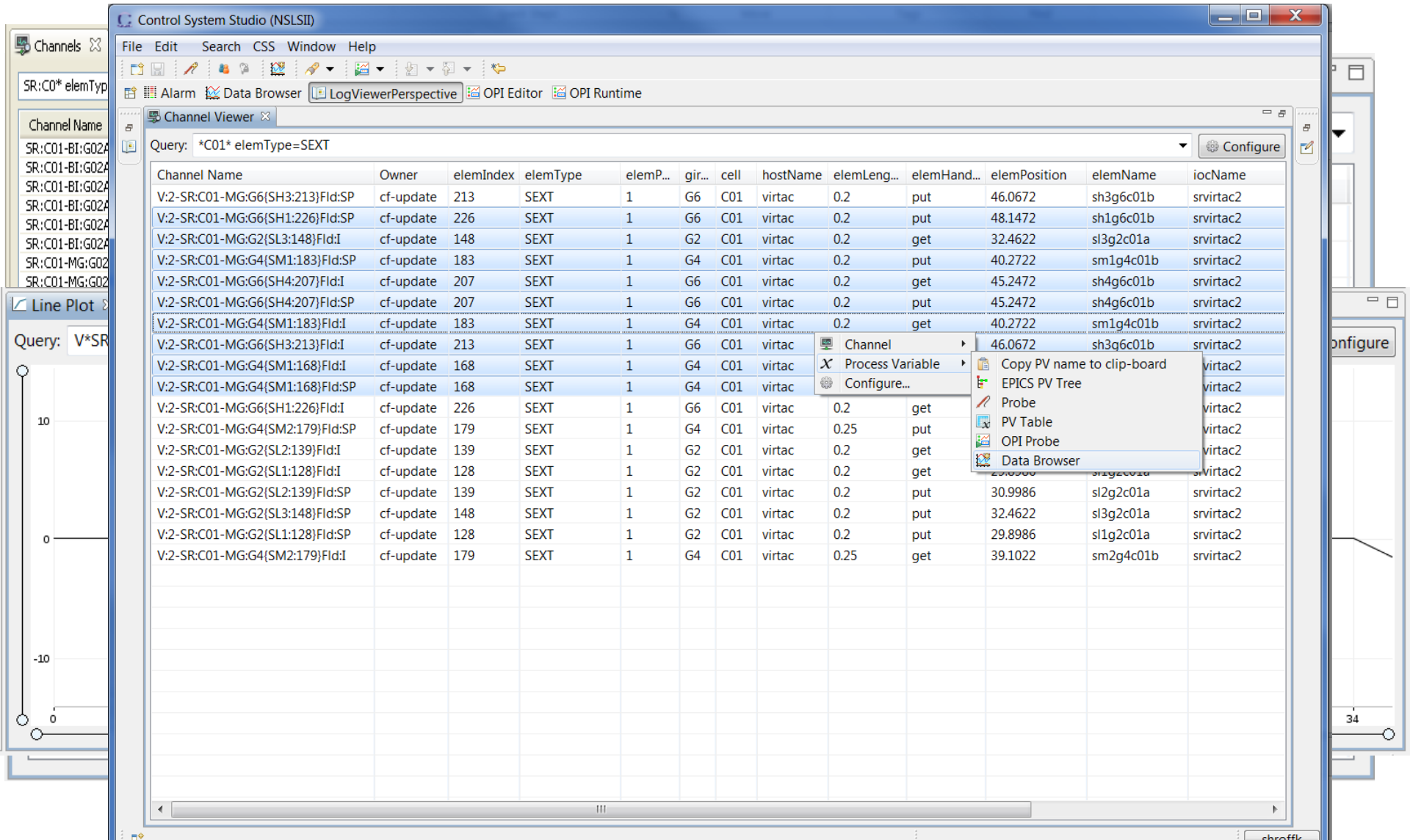
CS-Studio Uses Channel Finder Service



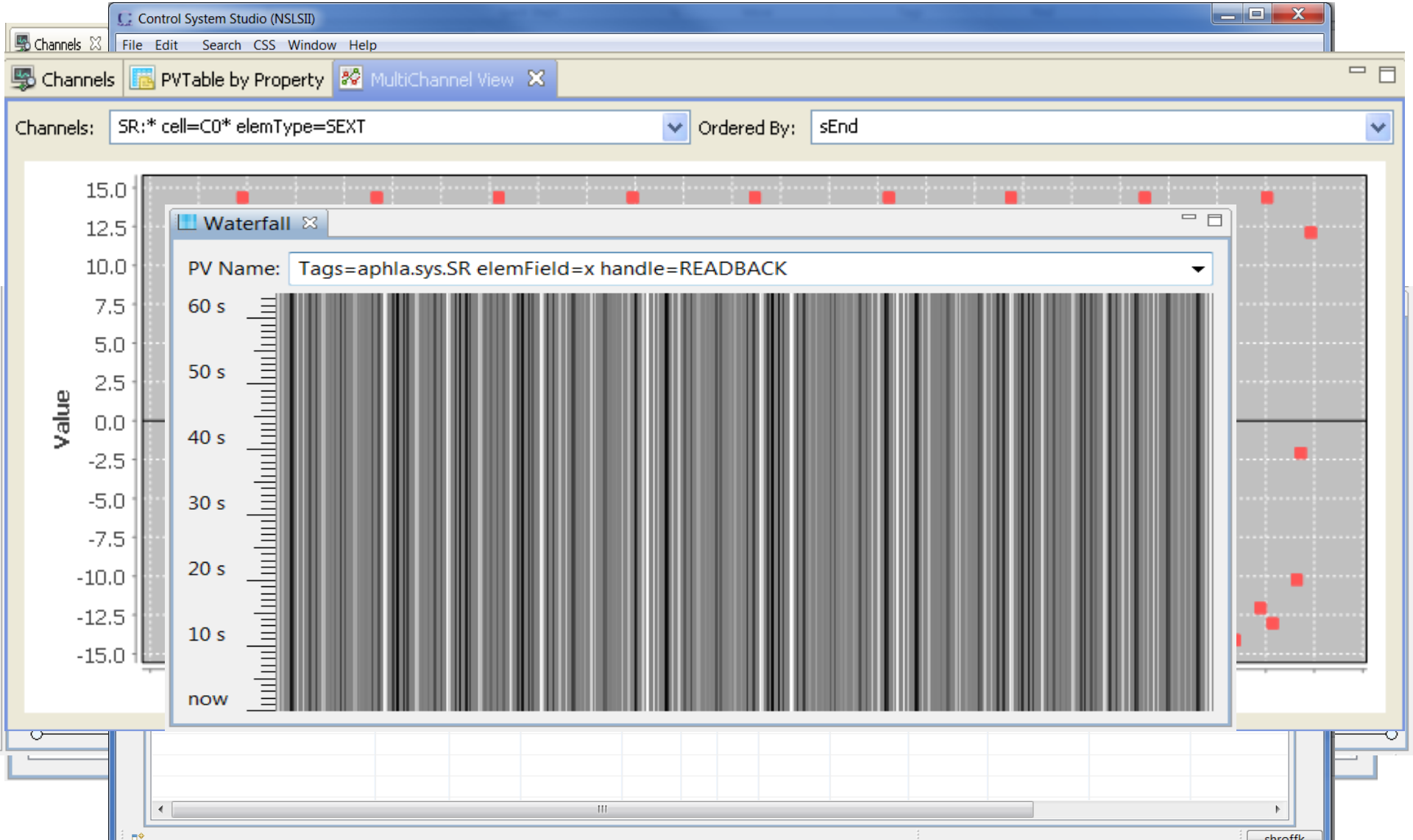
CS-Studio Uses Channel Finder Service



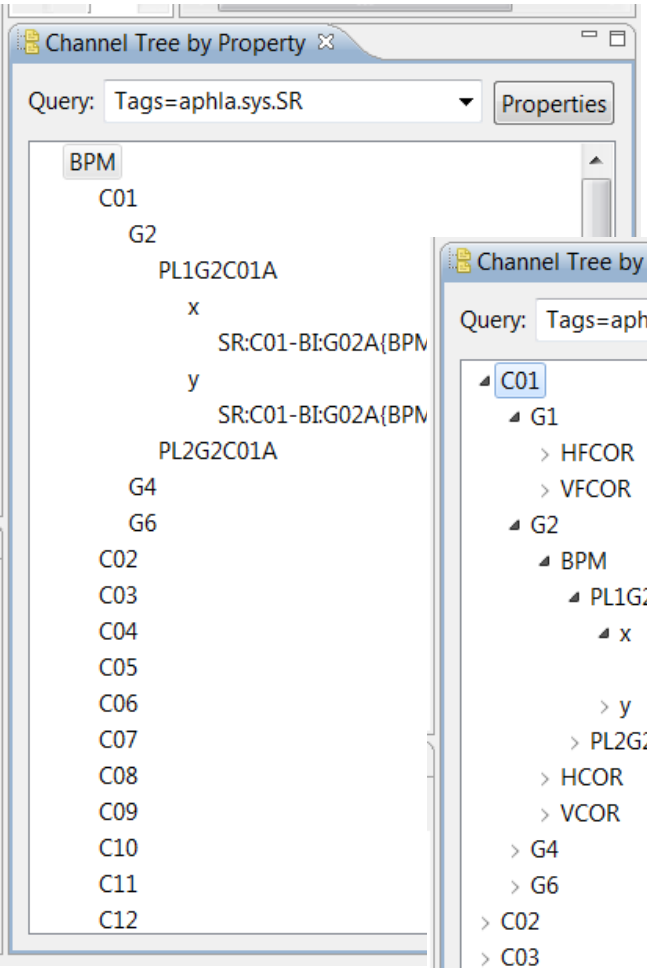
CS-Studio Uses Channel Finder Service

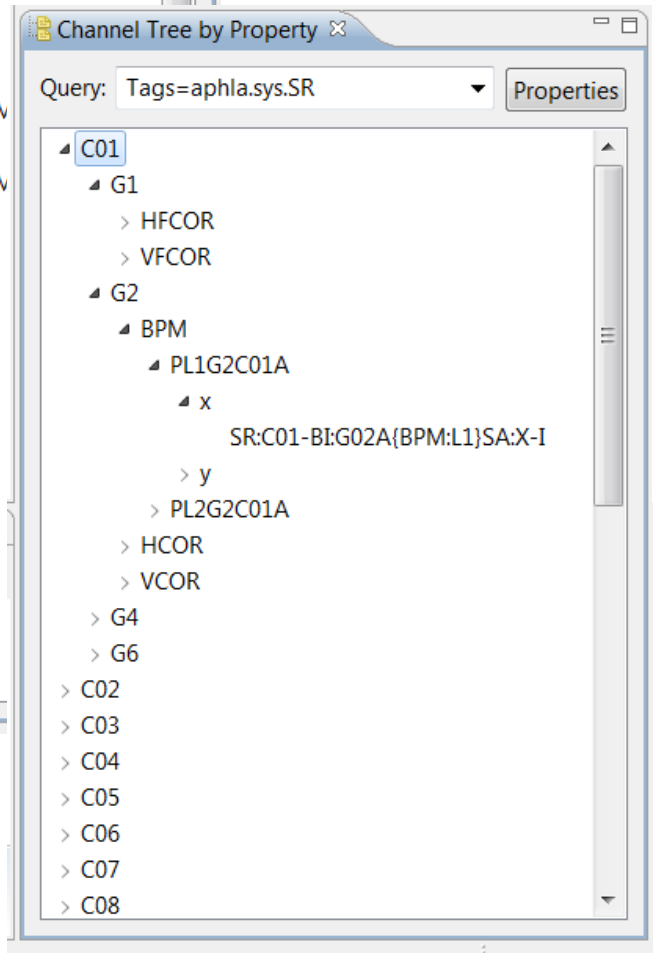


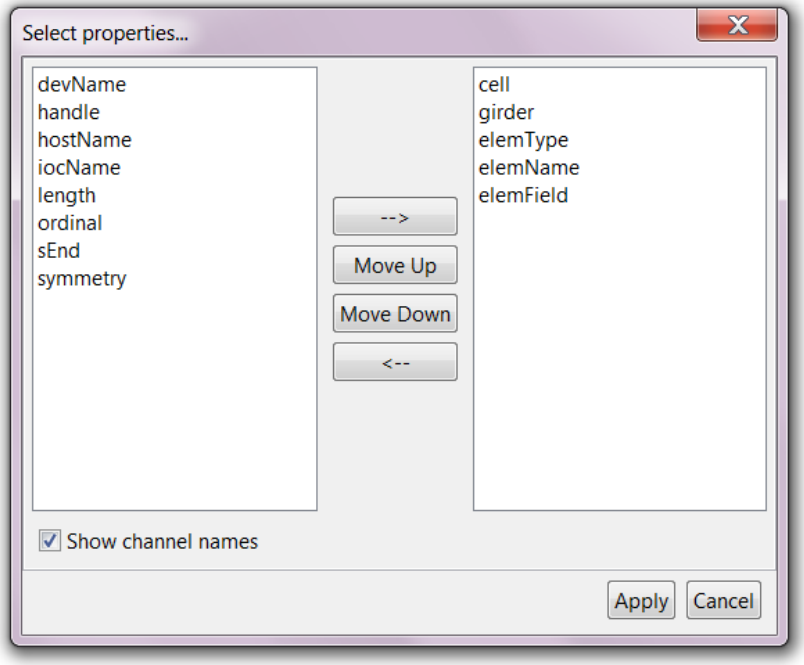
CS-Studio Uses Channel Finder Service



CS-Studio Uses Channel Finder Service





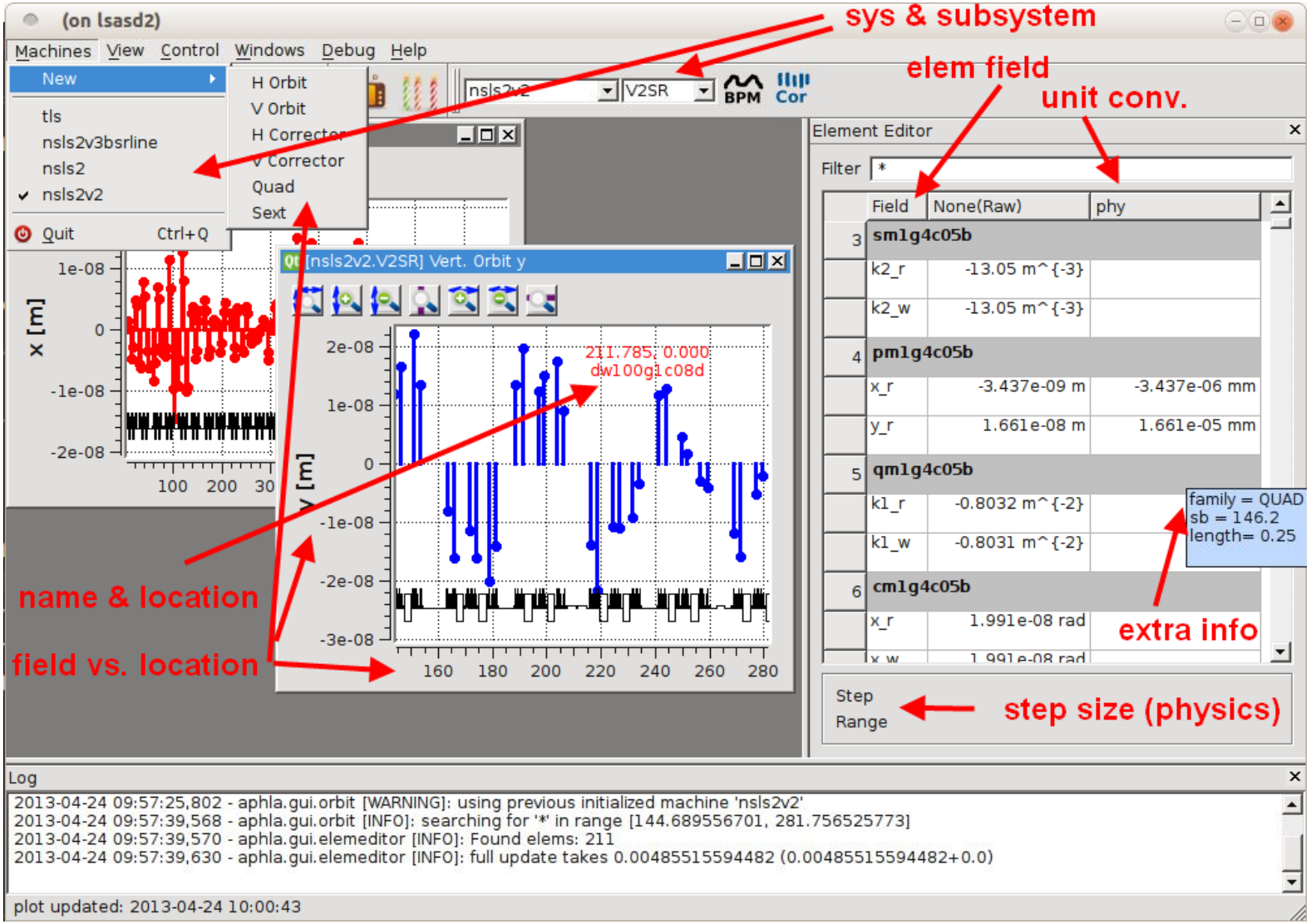


Dynamically creates hierarchical views based on channel property values

Thin Clients Can Be Developed for Physics and Beam Line Applications

```
# get Pvs from element name and field tuple
  bpmpvs = [getExactElement(b).pv(field=f)[0] for b,f in bpmrec]
  trimpvs = [getExactElement(t).pv(field=f, handle='setpoint')[0]
          for t,f in trimrec]


  # correct orbit using ORM (from current lattice)
  for i in range(repeat):
     ret = caRmCorrect(bpmpvs, trimpvs, m, ref=np.array(bpmref), **kwargs)
```

Thin Clients Can Be Developed for Physics and Beam Line Applications



Conclusions

- More than a flat name space is needed to satisfy the needs of equipment engineers and machine users conveniently.
- Tags and Properties provide a flexible way to associate functionality with a particular signal and also provide additional useful information associated with that signal, such as position and length.
- A network service to provide these views has been deployed in all of our python physics applications.
- Acknowledgement: This work is part of a large push to develop a set of middle layer of services for physics commissioning, machine operations, experiment control, data acquisition, and data analysis. It uses the Normative Type for a table as does many of the RPC services and is integrated into Control System Studio through that Normative Type..

Please See These Related Presentations

WECOBA02

Distributed Information Services for Control Systems

Vasu Vuppala, Eric Thomas Berryman (NSCL, East Lansing, Michigan), Leo Bob Dalesio, Donald Dohan, Guobao Shen, Kunal Shroff (BNL, Upton, Long Island, New York), Miha VitoroviÄ, Klemen Zagar (Cosylab, Ljubljana), Karin Rathsman, Garry Trahern (ESS, Lund), Dong Liu (FRIB, East Lansing), Chungming Paul Chu, Sheng Peng (FRIB, East Lansing, Michigan), Huihui Lv, ChunHong Wang, Zhuo Zhao (IHEP, Beijing)

TUPPC130

The Design of NSLS-II High Level Physics Applications

Lingyun Yang, Jinhyuk Choi, Yoshiteru Hidaka, Guobao Shen, Guimei Wang (BNL, Upton, Long Island, New York)

THCOAAB09

Olog and Control System Studio: A Rich Logging Environment

Kunal Shroff, Arman Arkilic, Leo Bob Dalesio (BNL, Upton, Long Island, New York), Dejan Dežman (Cosylab, Ljubljana), Eric Thomas Berryman (NSCL, East Lansing, Michigan)