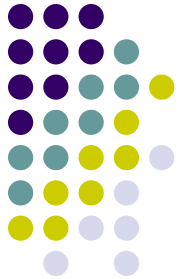
TINE Control System Overview and Status

P. Bartkiewicz, P. Duval, S. Herb, H. Wu (DESY/ Hamburg)

and

S. Weisse (DESY/ Zeuthen)

TINE: A Quick Tour



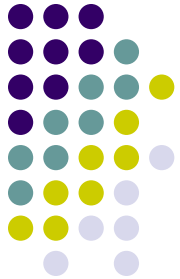
- Three-fold Integrated Networking Environment
  (->Keep your eye on the word "*Integrated*")
- Mature Control System
  - CERN Isolde Spin-off (~1991)
  - All the usual central services :
    - Archive, Alarm, Naming, Security, Logging, etc.
- Small Footprint
  - TINE Kernel written in C (just like your Operating System) or Java
  - Berkeley Sockets (NO SunRPC, CORBA, or other 3rd Party dependencies !)
  - Either Single-threaded or Multi-threaded mode
- Easy to Install
- High Performance
- Plug and Play
- Scalable to very large machines !

Large machines @ DESY

Smaller machines ….

Control Systems101

Control Systems (one way or another) have to deal with …



- **Distributed** end points and processes
- **Data Acquisition** (front end hardware)
- **Real-time** needs (where necessary)
- **Process control** (automation, feedback)
- **Central Services** (Archive, Alarm, Name Resolution, …)
- **Security** (who's allowed to do what from where?)
- **States** (Finite State Machines, sequencing, automation…)
- **Time synchronization** (time stamps, cycle ids, etc.)
- **Databases** (configuration, machine data, post-mortem data, …)
- **Statistics** (control system itself, operation, …)
- **Logging** (central, local, application, …)
- **Data transport** (data flow, *control system protocol*, scalability)

Data Flow Memes : 0th Order

Transaction-based Client-Server

- Transaction-based Client-Server
  - Client asks, server responds
  - KISS (no management tables) !
  - Suitable for *small* systems
  - Server Load:

Keep It Simple, Stupid !

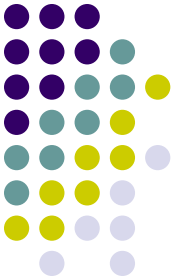
Threads ?

Multi-Core ?

$$L_S \sim N_C \times N_T \times L_D \times U_T$$

L_S = Load on Server/sec (CPU cycles spent)
N_C = Ave. num clients
N_T = Ave num transactions / client
L_D = Ave Load handling a dispatch
U_T = Ave update rate

Data Flow Memes : 0th Order



Transaction-based Client-Server

- Network Load:

$$L_N \sim N_C \times N_T \times P_T \times U_T \times 2$$

L_N = Load on Network (bytes/sec)
N_C = Ave. num clients
N_T = Ave num transactions / client
P_T = Ave Transaction Payload
U_T = Ave update rate
2 = outgoing + incoming payloads ~equal

Threads ?

Multi-Core ?

- Increase Scalability => Reduce the Load

Reduce any of these factors !

Data Flow Memes : 1st Order

Contract-based Publish-Subscribe

- Contract-based Publish-Subscribe
  - Kiss **KISS** goodby !
    - Contract and connection management
    - Transaction => managed contract + table of clients
    - Larger systems
    - Server Load :

N_C (Number of Clients) no longer a factor !

$$L_S \sim N_T \times L_D \times U_T$$

L_S = Load on Server/sec
N_T = Ave num transactions / client
L_D = Ave Load handling a dispatch
U_T = Ave update rate

Data Flow Memes : 1st Order

Contract-based Publish-Subscribe

- Network Load:
  - Similar, but:
    - Factor 2 gone!
    - Can use '*Send on Change*' to reduce U_T
    - Can use *multicast* to reduce N_C

$$L_N \sim N_C \times N_T \times P_T \times U_T$$

L_N = Load on Network (bytes/sec)
N_C = Ave. num clients
N_T = Ave num transactions / client
P_T = Ave Transaction Payload
U_T = Ave update rate

- Great Benefit to Scalability!
  - BUT: API can still allow inefficiency !
  - AND: Who is doing the programming ?

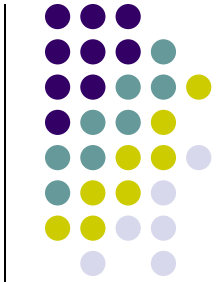
Data Flow Memes : 2nd Order

Contract-Coercion

- Analyze the transaction request
  - Map to an existing contract if possible
  - Anticipate future requests and renegotiate the contract with the client
    - e.g. “if he’s asking for BPM#1, then he’ll probably want BPM#2 as well”
  - Guide synchronous and asynchronous acquisitions
    - Don’t monitor ‘static data’
    - Don’t synchronously poll monitorable data.
    - Trap ‘foolish’ update intervals
  - KISS is a distant memory

  - Briefly review 3 Control System Architecture Models …

Control System Models
(a review)

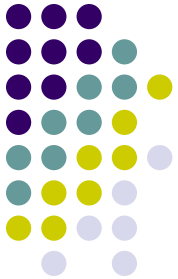


- Model I: Database Model
  - EPICS, VISTA (i.e. VSystem not the OS)
  - Control system data are *elements in a database*.
  - Transfer *Process Variables*
    - pvData have names
    - Actions are ‘get’, ‘set’, ‘monitor’
  - BUT: Some things aren’t variables at all !
    - e.g. command and calls

Control System Models
(a review)

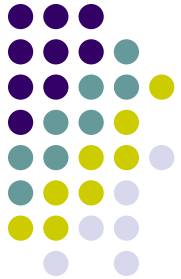
- Model II: Device Server Model
  - TANGO, DOOCS, ACS, STARS*, TINE*
  - Elements are controllable objects managed by a device server.
  - Instance of such an object is a *device*, with a hierarchical name.
  - Actions pertaining to a device given by its *properties* !
    - i.e. *get*, *set*, *monitor*, *call* some *property* OR *command*
  - BUT: some things aren't devices !
    - e.g. "*" is NOT a device.
  - AND: some services are *Property-orientated* !

Control System Models (a review)



- Model III: Property Server Model
  - STARS*, TINE* (maybe ACS?)
  - Elements are *services* with *properties* (or methods)
  - Same basic hierarchy as Device Server Model
  - Properties have Keywords
    - (instead of Devices having Properties)
  - e.g. Middle layer services
    - Name Server
    - Central Alarm Server
    - Central Archive Server
    - CDI Server
    - etc.
  - BUT: Not everything divides cleanly into *Device Server* or *Property Server* !

TINE Data Types



- Primitives (byte, short, int*, long*, float, double, char*)
- Fixed-length Strings (“NAME16”, “NAME32”, “NAME64”, …)
- Doublets (FLTINT, “INTINT”, “DBLDBL”, “NAME32INT”, …)
- Triplets (“FLTINTINT”, “NAME16FLTINT”, …)
- Quadruplets (“FLTINTINTINT”, “INTINTINTINT”, …)
- Specials (“USTRING”, “UNAME”, “SPECTRUM”, “IMAGE”, “HISTORY”, …)
- Bitfields :
  - CF_BITFIELD8, CF_BITFIELD16, CF_BITFIELD32, CF_BITFIELD64
    - Data type: DBITFIELD
    - Bitfield Registry

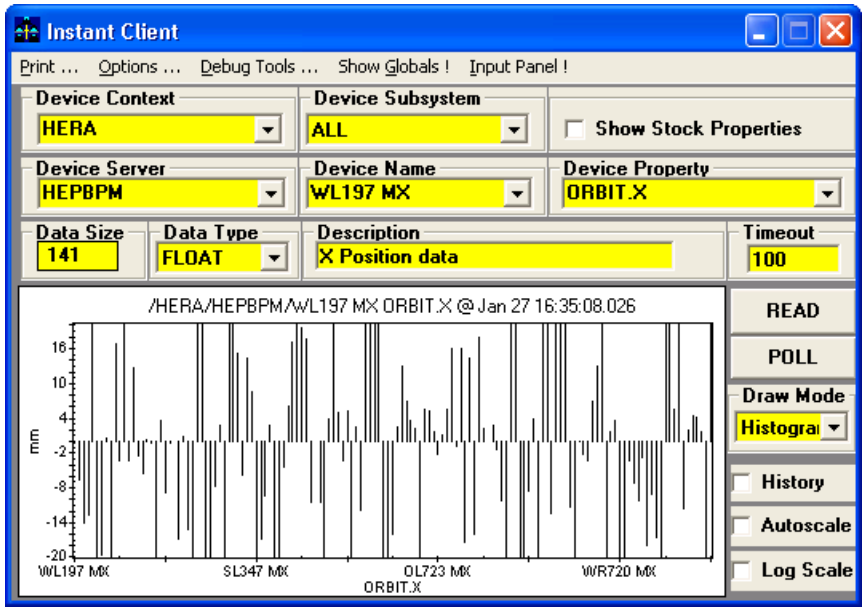
- **User-defined “Tagged Structures” !!!**
  - Structure registered at both ends (client, server)
    - Client can ‘discover’ structure fields !

*Platform dependent

TINE Naming Convention

Engineer's View or Machine Physicist's View

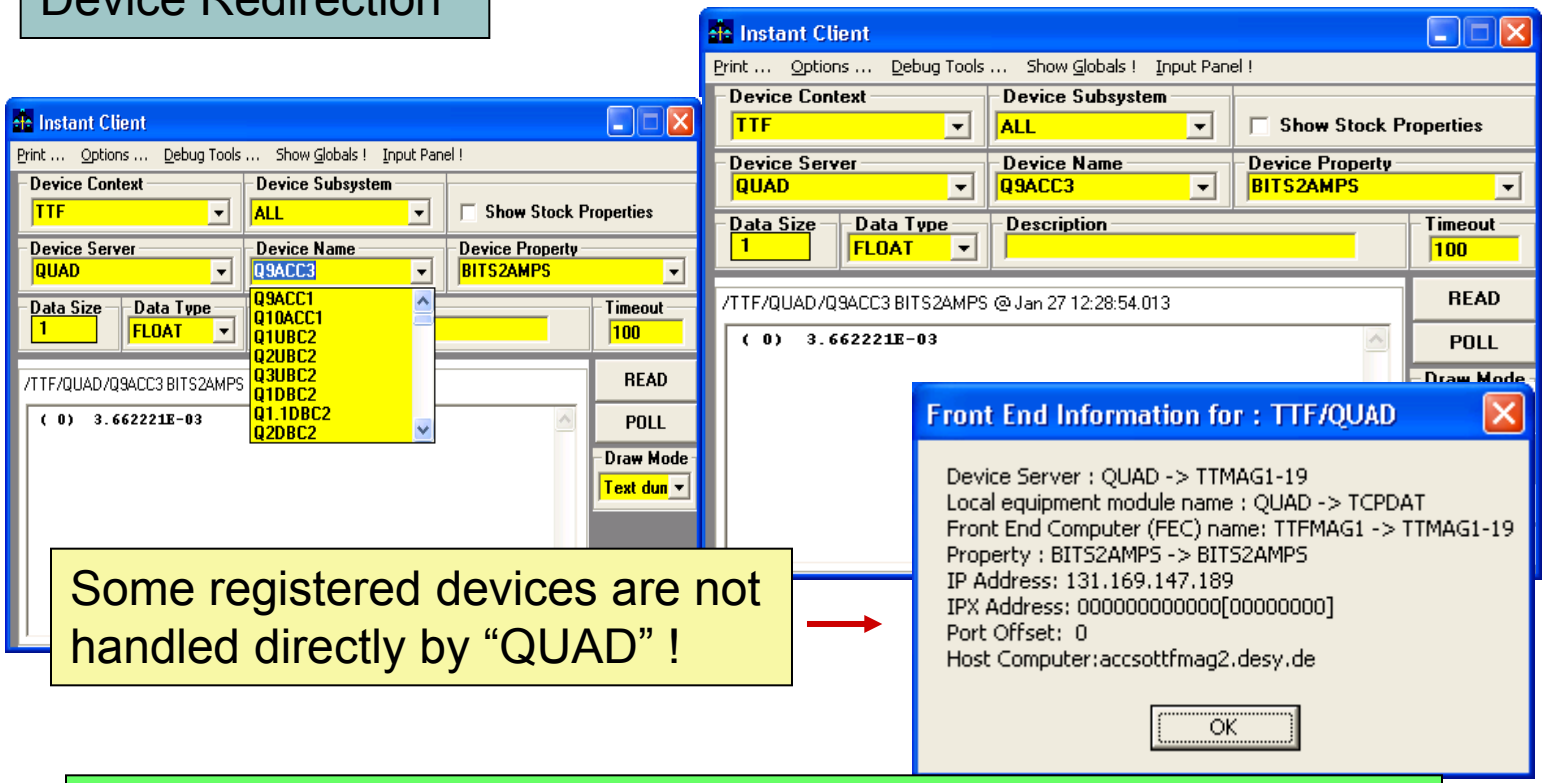
- Hierarchical
- Device is specified by :
  - **Device Context** (*Facility* in DOOCS, *Domain* in TANGO)
  - **Device Server** (or **Group**) (*Device* in DOOCS, *Family* in TANGO)
  - **Device Name** (*Location* in DOOCS, *Member* in TANGO)
- Data endpoint is specified by:
  - **Property** (*Property* in DOOCS, Attribute/Command in TANGO)
    - Are really 'methods' or 'calls'



Note: **Device Subsystem** is not part of the name space, but is a browseable element!

TINE Address Redirection

Device Redirection



Some registered devices are not handled directly by “QUAD” !

Wildcard calls (e.g. /TTF/QUAD/*/BITS2AMPS) still work !

Property Redirection (e.g. “Orbit.X.ARCH” -> central archive server)

TINE ENS: Plug and Play

I want to be known to the system as "**BPM.P**" in the context "**HERA**"

Does BPM.P already exist for HERA?

-> **Yes** : Is same address as already registered?

-> **Yes**: **Accept** and increment reboot count

-> **No**:

Is the currently listed BPM.P for HERA running ?

Yes : **Refuse** and send "in-use" message

No : **Accept** and update database

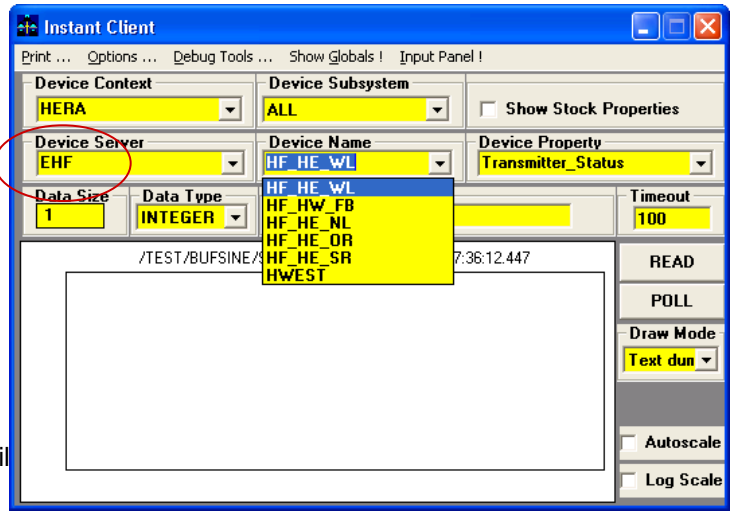
-> **No** : **Accept** and update database

Equipment Name Server (ENS)

- Forward accepted requests to secondary name servers

Plug and Play (joining a group)

I want to be known to the system as “**ERF.WL**” in the context “**HERA**” and join the group “**EHF**”



- ERF.WL registers with ENS as before
- ERF.WL registers group EHF with GENS

  Does group EHF exist ?

  Yes:

  Is ERF.WL a member?

  Yes: Update device list if different

  No: join group

  No:

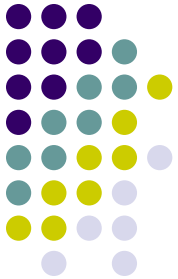
  Create Group and register Group as Server in Context HERA with the ENS

- Clients see a “Server” called “EHF”
- Selected Device is redirected to the appropriate physical server.

TINE Client API …

- Fundamental API is :
  - Link based and Not Channel based !
  - Narrow Interface
  - **NOT** ‘get’, ‘set’, and ‘monitor’ !!!
  - Think of ‘calls’ a la RPC or RMI …
  - Synchronous data acquisition
  - Asynchronous data acquisition
    - Callbacks, events

Client API: Synchronous Calls
(schematic API …)



/<context>/<server>/<device>

e.g.: “/PETRA/Vacuum/WLB.HP141”

Device Property or Method

e.g.: “Pressure”

ExecLink(devName, devProperty, dout, din, access, timeout)

Output Data object (returned from Server)

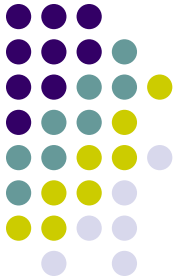
Input Data Object (sent to Server)

Access flags:

READ, WRITE, + misc.

Atomic Set/Get, i.e. ‘call’!

Client API: Synchronous Calls
(schematic API …)



/<context>/<server>/<device>

e.g.: “/PETRA/Vacuum/WLB.HP141”

Device Property or Method

e.g.: “Pressure”

GET {

ExecLink(devName, devProperty, dout, din, READ, timeout)

}

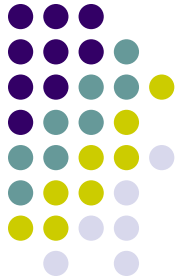
Output Data object (returned from Server)

Input Data Object (sent to Server)

Access flags:

READ, WRITE, + misc.

Client API: Synchronous Calls



e.g. A call to the orbit correction server:

din = tagged struct with optics, current orbit, beam parameters;

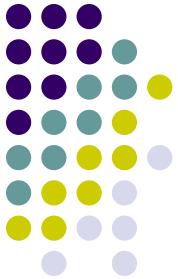
dout = tagged struct with new optics, projected corrected orbit;

ExecLink(“/SERVICE/ORBCOR”, “EFFCOR”, dout, din, READ, 1000)

e.g. “Command” Properties: “RESET”, “INIT”, “START”, …

ExecLink(“/HERA/Transfer/P”, “STOP”, NULL, NULL, WRITE, 1000)

Client API: Asynchronous Calls
(schematic API …)



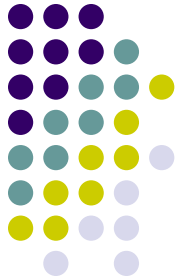
Analogous to synchronous parameters …

AttachLink(devName, devProperty, dout, din, access, pollrate,
void (*callback)(int,int), callbackID, mode)

Callback with callback id and status code …

DATACHANGE
TIMER
SINGLE
EVENT (scheduled)
NETWORK
GROUPED
WAIT
+ …

TINE API
(Application Programmer's Interface)



- C, C++
- VB
- ActiveX
- Java
- C#, VB.NET
- Command line scripts
- Python, Perl Bindings
- Plus …

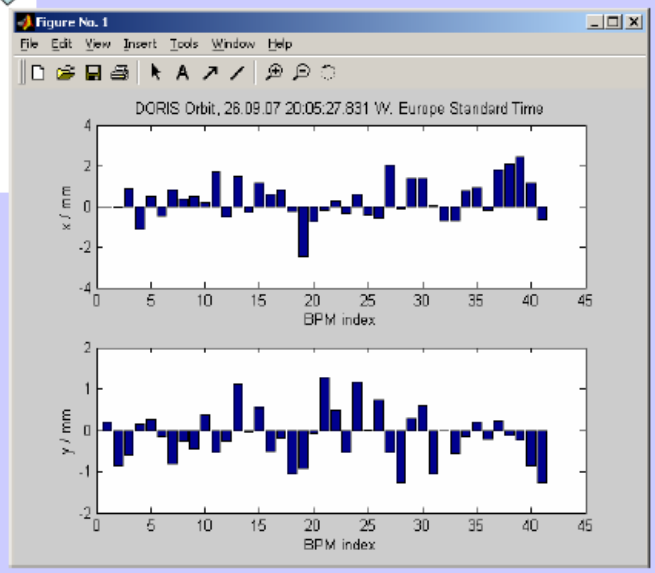
TINE and MatLab …

Example: DORIS Orbit

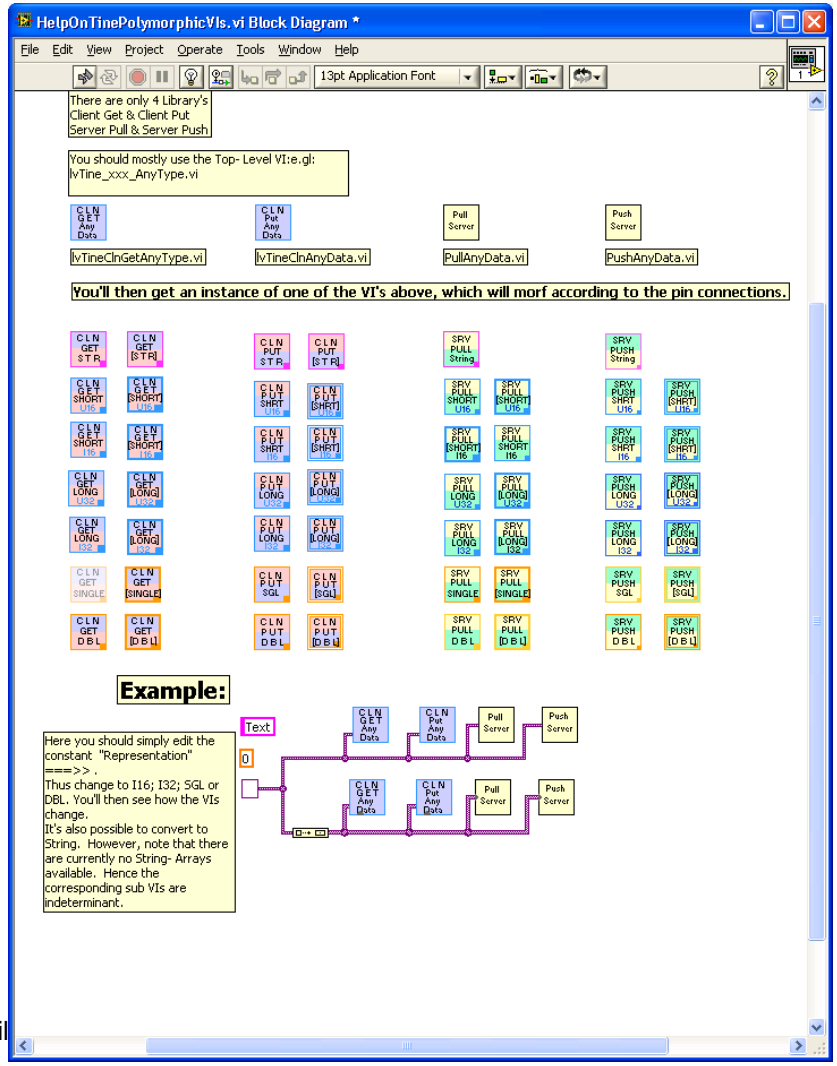
Simple script (“M-file”) to read and plot the DORIS orbit

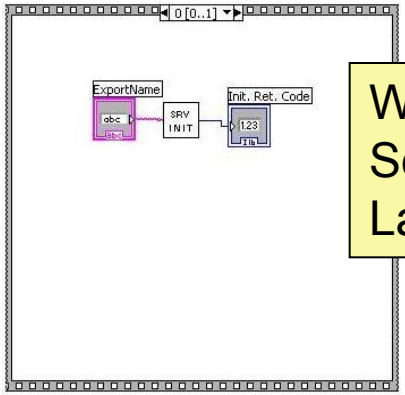
```
val = tineread('/DORIS/DOORBIT/#0      [ORBIT]');

figure(1)
subplot(2,1,1)
bar(1:41, val.ORBIT(2:42))
xlabel('BPM index')
ylabel('x / mm')
title(['DORIS Orbit, ' val.timestamp])
subplot(2,1,2)
bar(1:41, val.ORBIT(44:84))
xlabel('BPM index')
ylabel('y / mm')
```

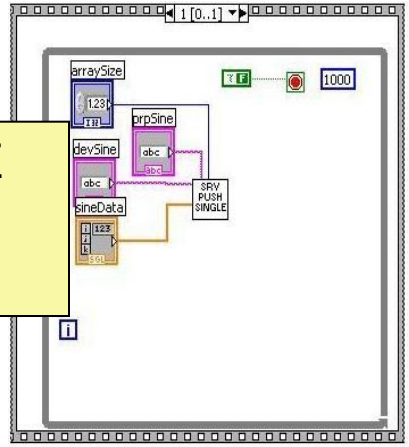


TINE and LabView …



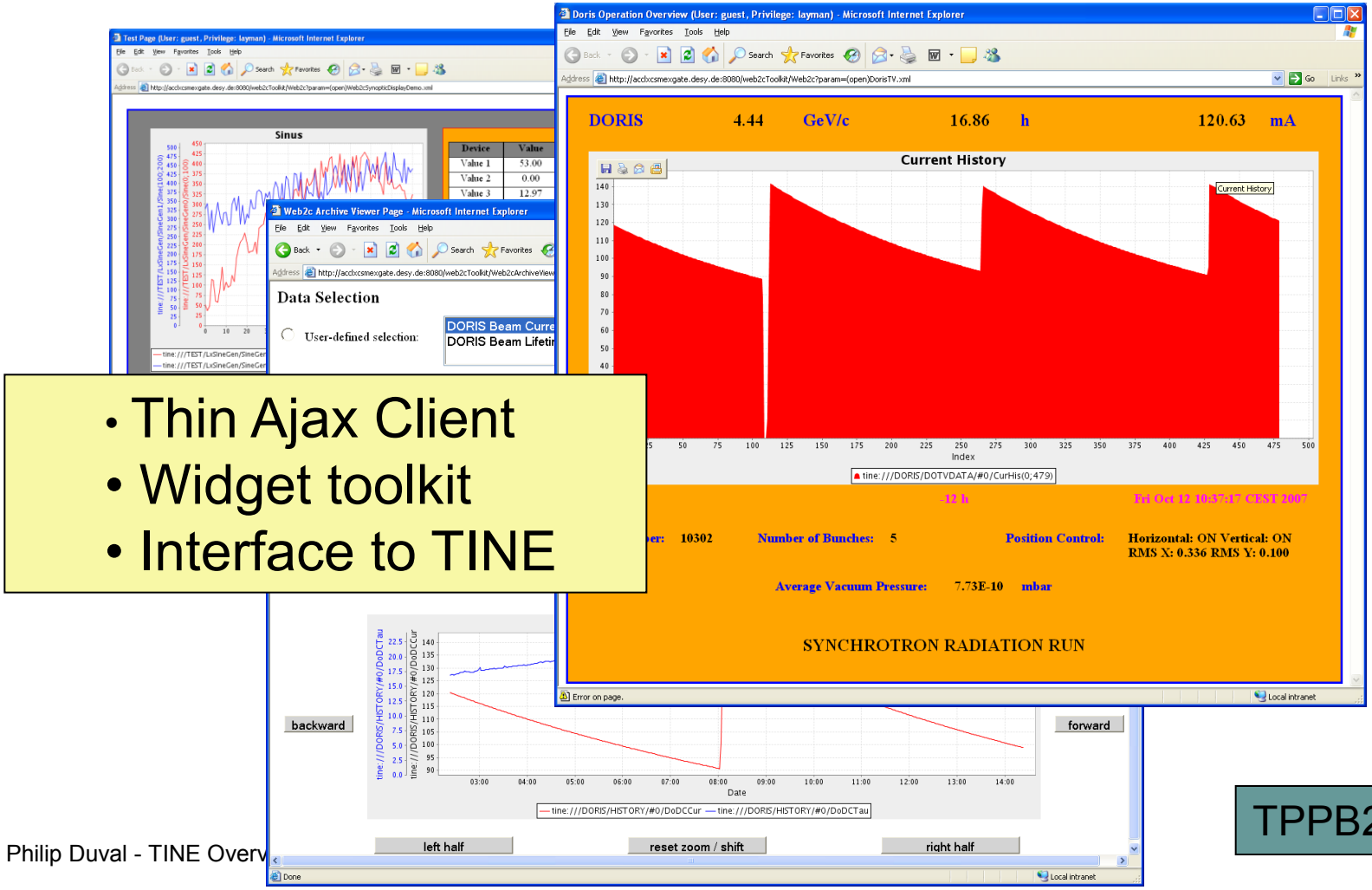


Write TINE Servers in LabView !



Write TINE Clients in LabView !

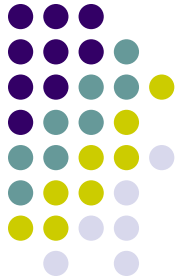
TINE and Web Tools
(Web2C: Web-based Controls Client)



- Thin Ajax Client
- Widget toolkit
- Interface to TINE

TPPB27

TINE Device Layer



- “Do it yourself” + your hardware API
  - Use those Windows drivers your hardware comes with!
  - You’ve already got a stand-alone system: how do you connect it to the control system?
- EPICS IOCs (asyn drivers) + Epics2Tine
- LabView VIs + TINE LabView
- DOOCS + DOOCS API

- **CDI** (Common Device Interface) !!!
  - Bus plugs for CANOpen, SEDAC, RS232, SiemensPLC, TwinCatADS, Libera, … (asyn?)
- **TICOM** (TINE CanOpen Manager)

TINE Archive System

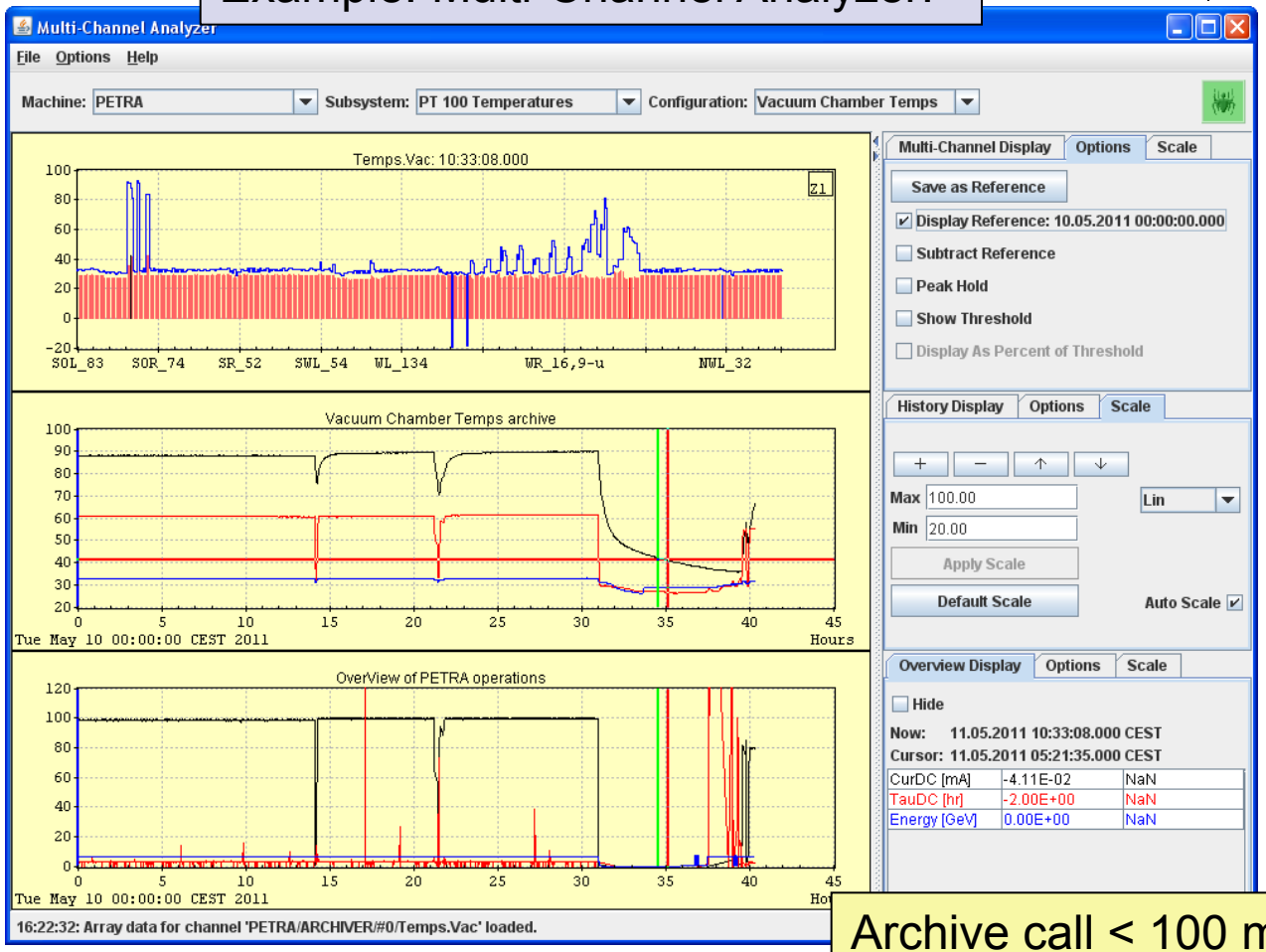
(lickity split data retrieval !)

Example: Multi-Channel Analyzer:

All temperatures as “snapshot” (vs. selected reference)

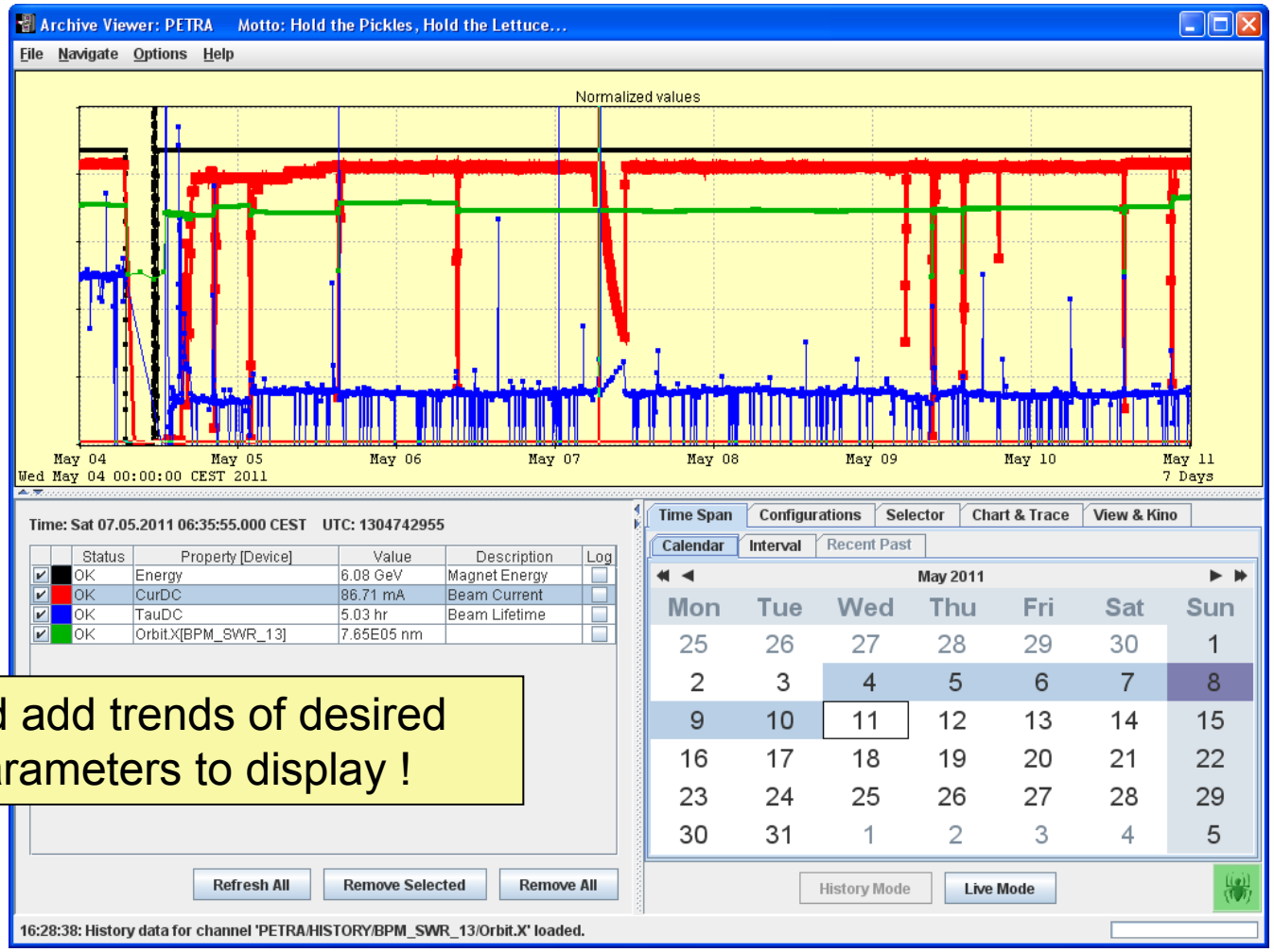
Histories of selected sensors:

Histories of machine operation parameters:



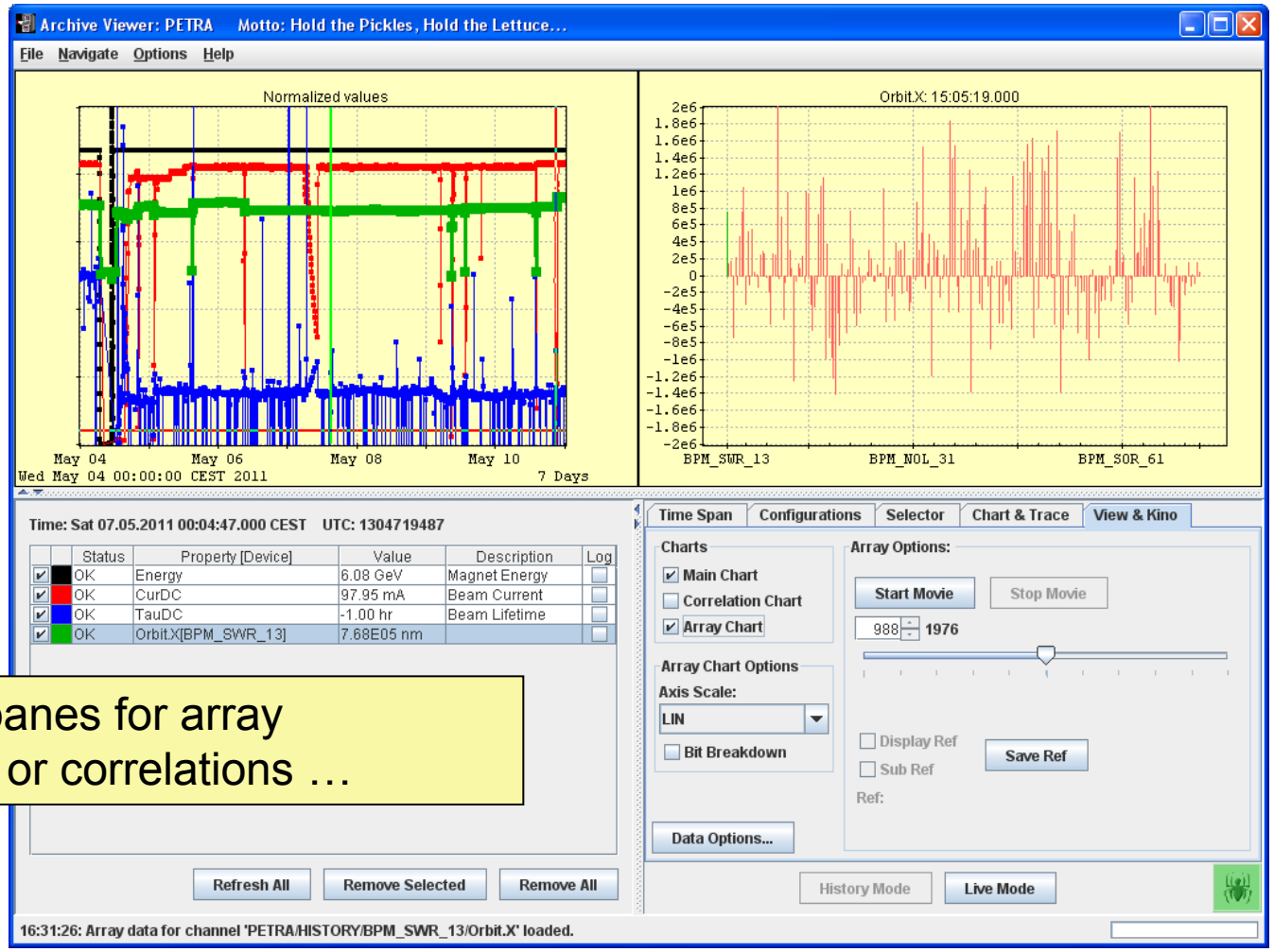
Archive call < 100 msec

TINE Archive System



Browse and add trends of desired machine parameters to display !

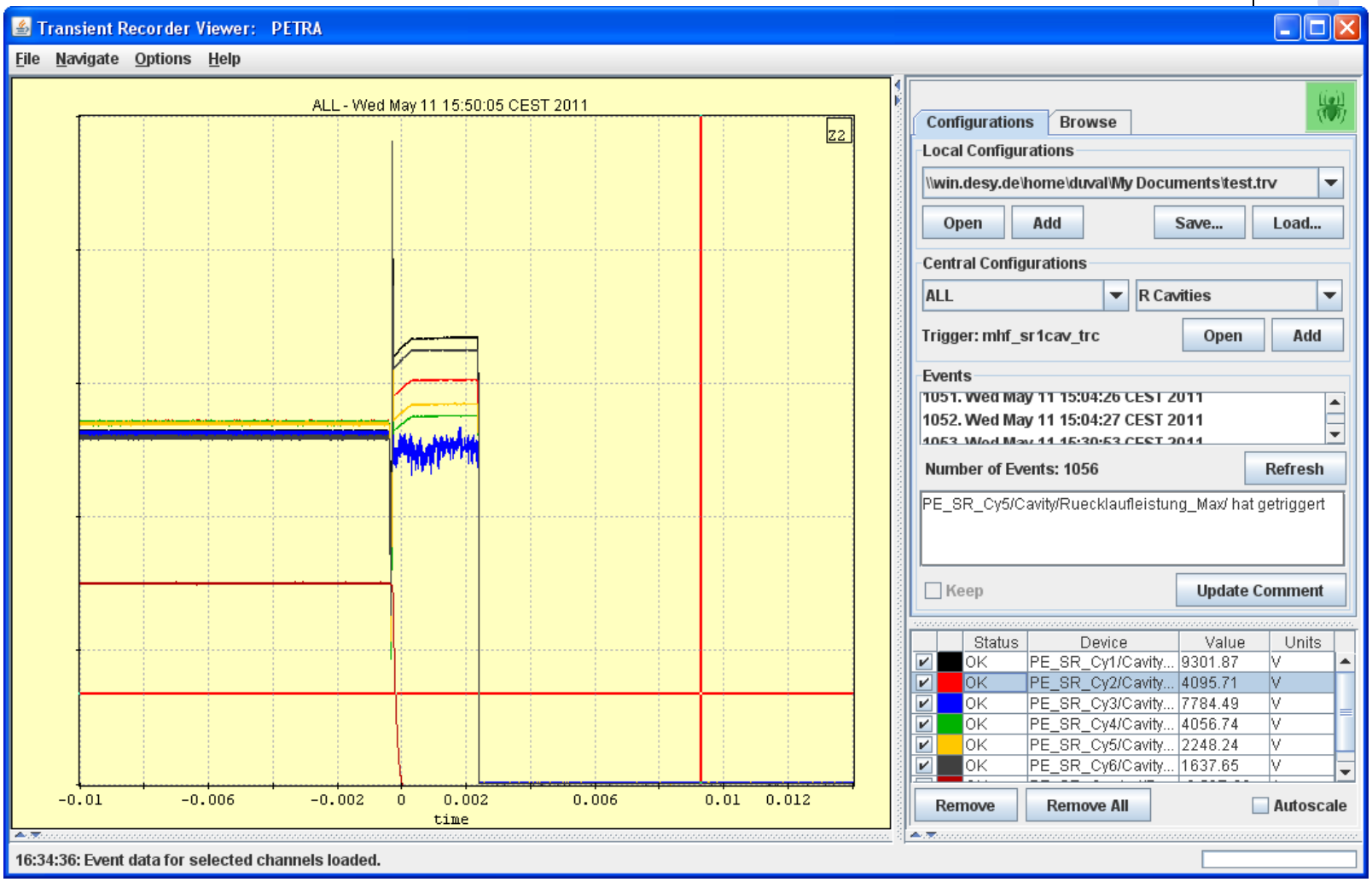
TINE Archive System



Add other panes for array ‘snapshots’ or correlations …

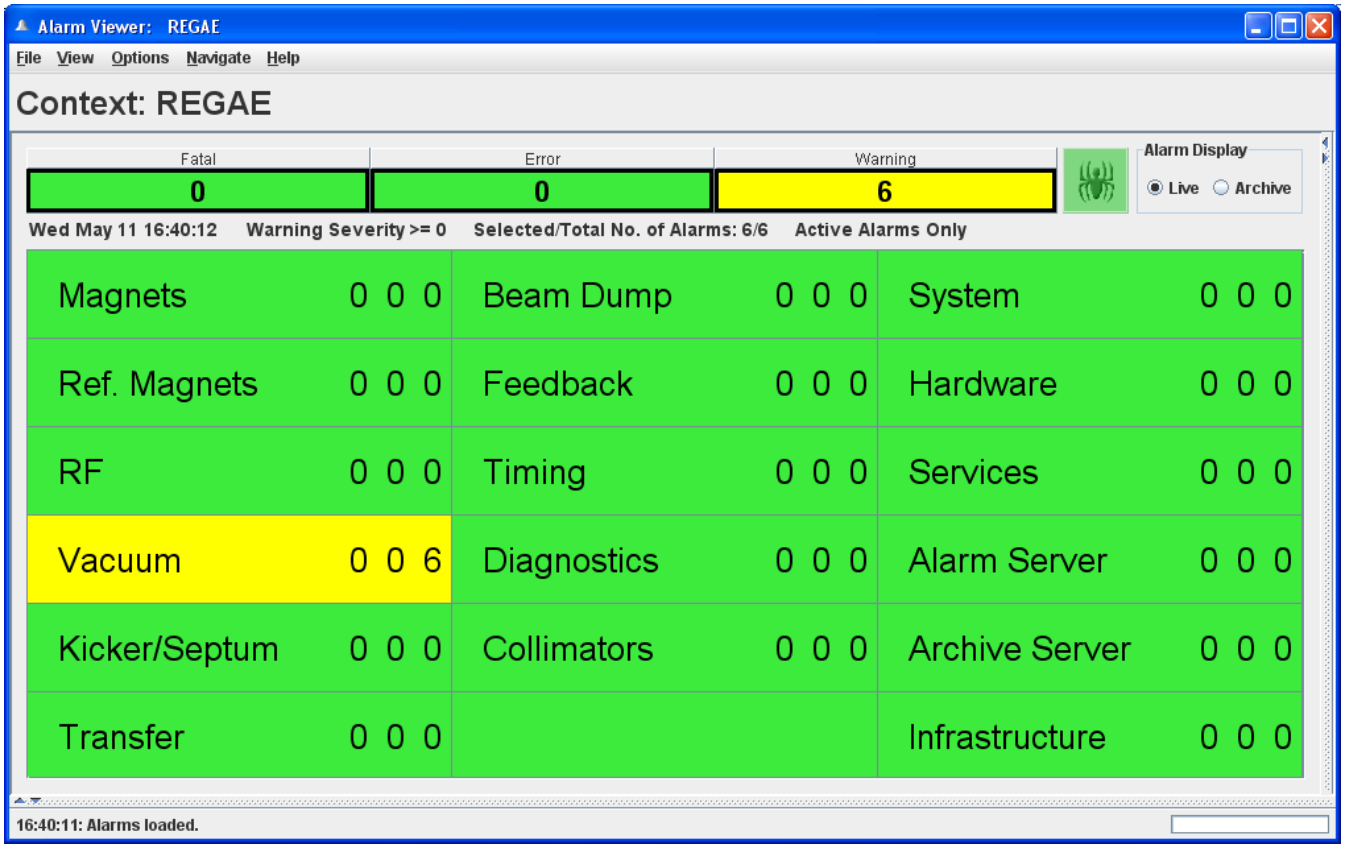
TINE Archive System

(post-mortem and events …)



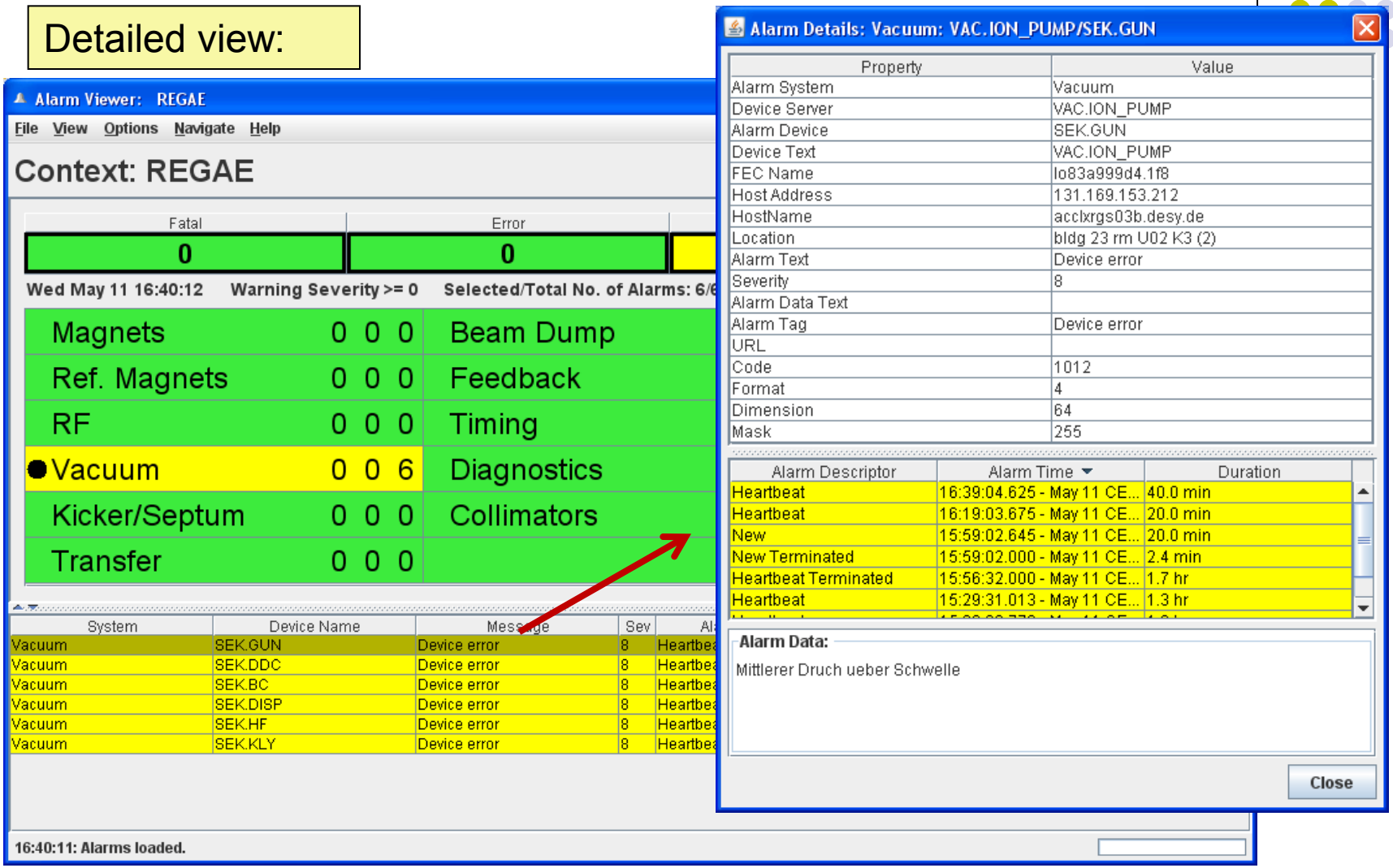
TINE Alarm System

Compact Overview



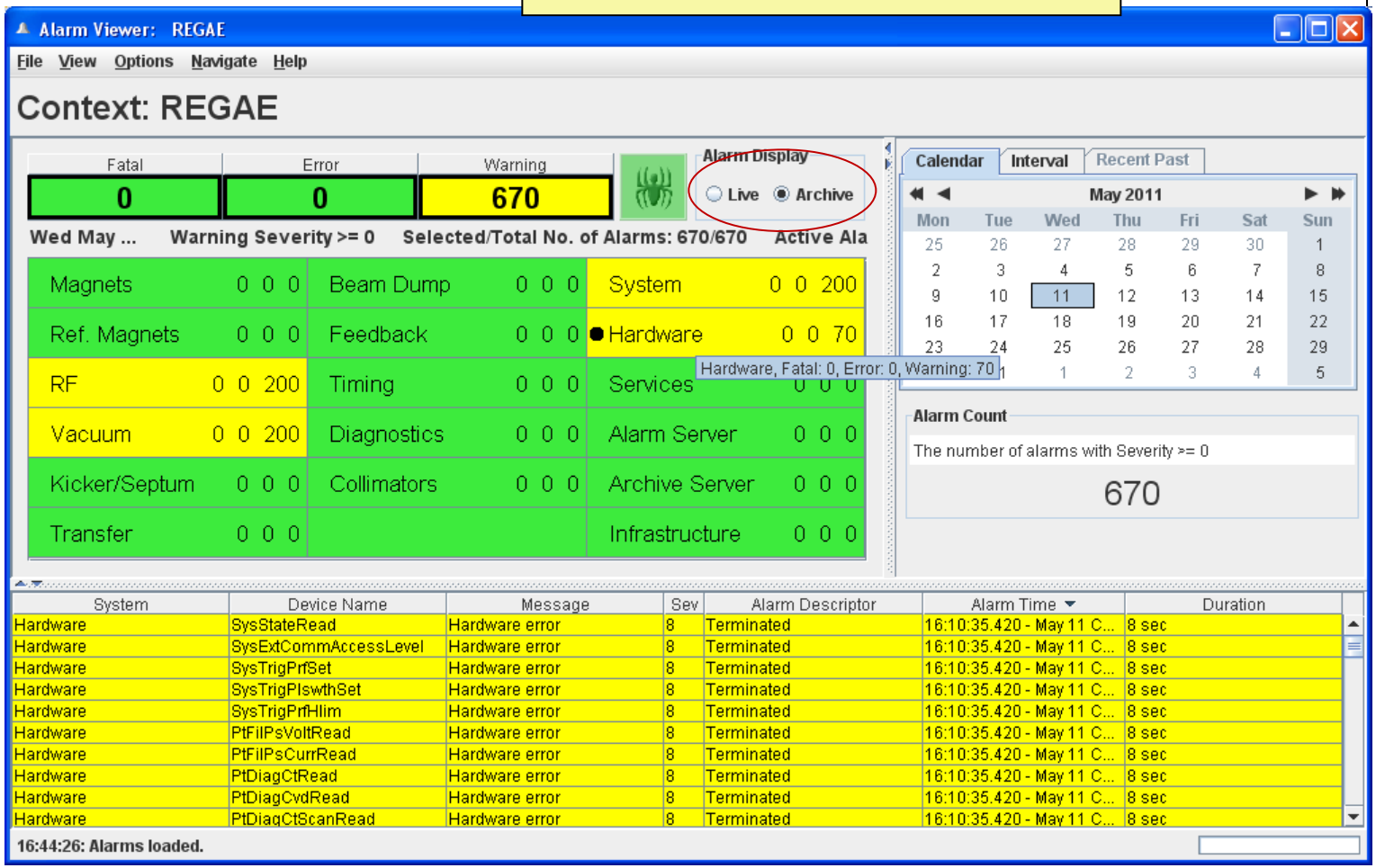
TINE Alarm System

Detailed view:

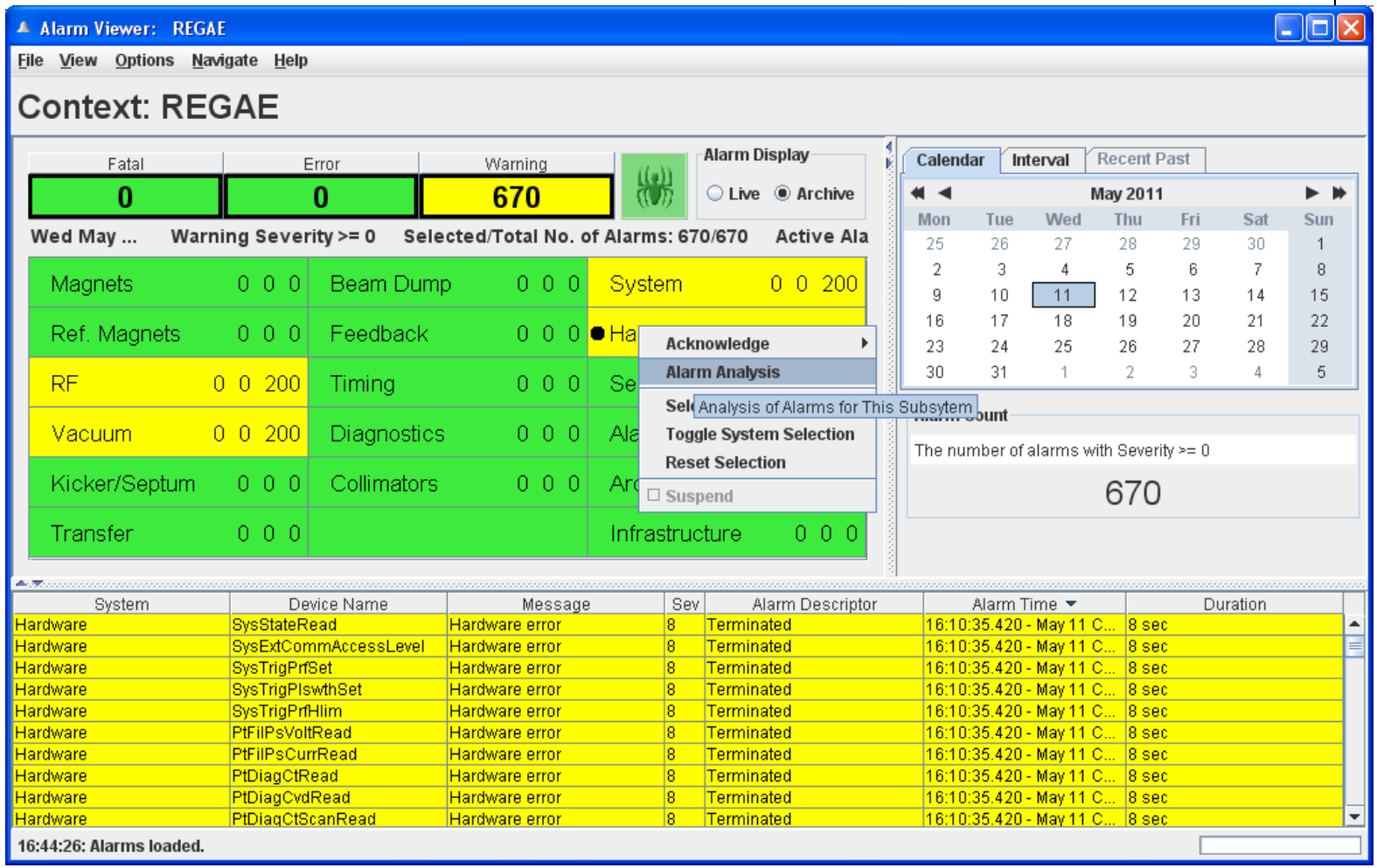


TINE Alarm System

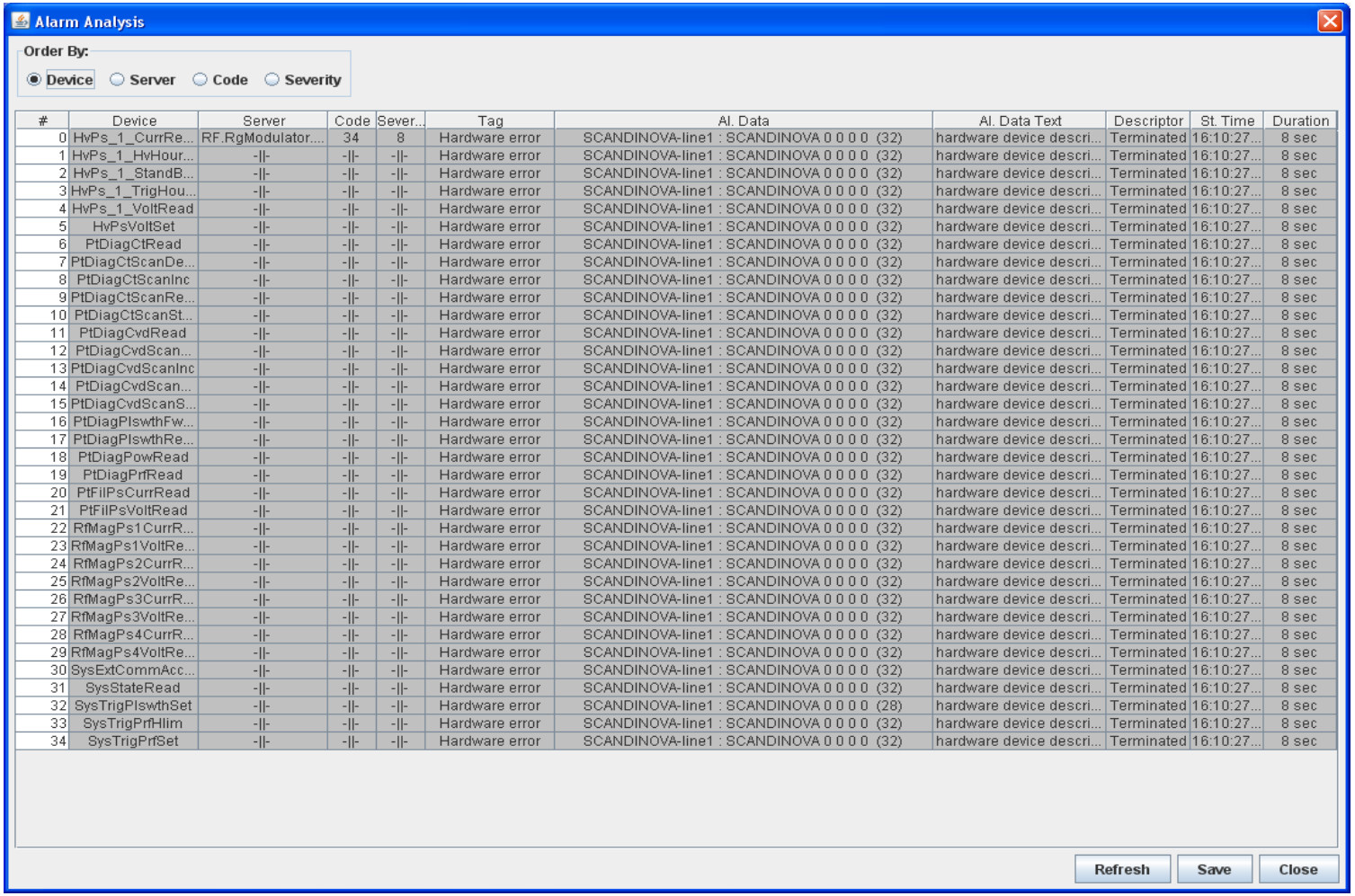
Add the alarm are archived !



TINE Alarm System
(alarm analysis)



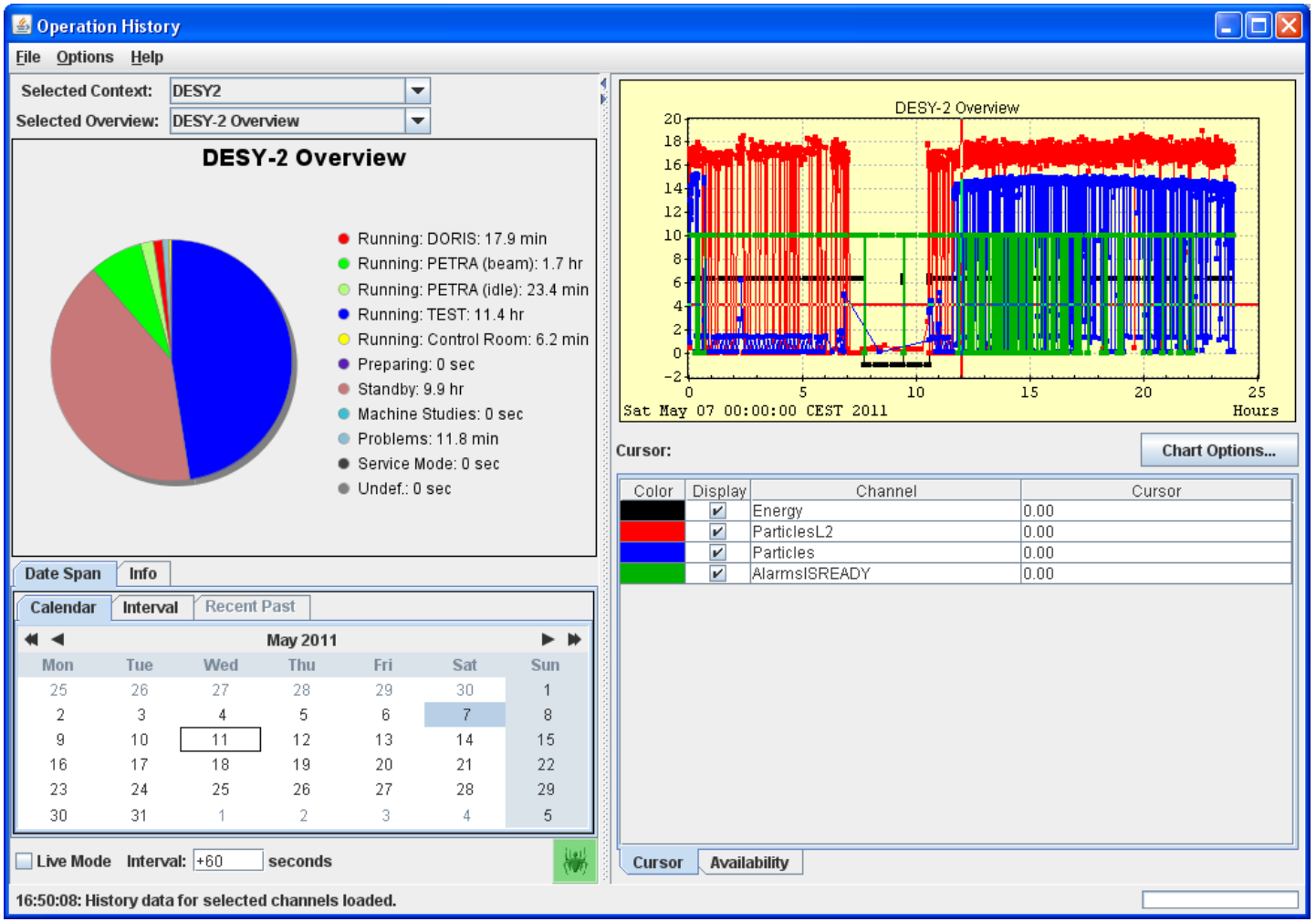
TINE Alarm System
(alarm analysis)



#	Device	Server	Code	Sever...	Tag	Al. Data	Al. Data Text	Descriptor	St. Time	Duration
0	HvPs_1_CurrRe...	RF.RgModulator....	34	8	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
1	HvPs_1_HvHour...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
2	HvPs_1_StandB...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
3	HvPs_1_TrigHou...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
4	HvPs_1_VoltRead	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
5	HvPsVoltSet	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
6	PtDiagCtRead	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
7	PtDiagCtScanDe...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
8	PtDiagCtScanInc	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
9	PtDiagCtScanRe...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
10	PtDiagCtScanSt...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
11	PtDiagCvdRead	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
12	PtDiagCvdScan...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
13	PtDiagCvdScanInc	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
14	PtDiagCvdScan...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
15	PtDiagCvdScanS...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
16	PtDiagPlswthFw...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
17	PtDiagPlswthRe...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
18	PtDiagPowRead	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
19	PtDiagPrfRead	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
20	PtFilPsCurrRead	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
21	PtFilPsVoltRead	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
22	RfMagPs1CurrR...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
23	RfMagPs1VoltRe...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
24	RfMagPs2CurrR...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
25	RfMagPs2VoltRe...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
26	RfMagPs3CurrR...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
27	RfMagPs3VoltRe...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
28	RfMagPs4CurrR...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
29	RfMagPs4VoltRe...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
30	SysExtCommAcc...	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
31	SysStateRead	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
32	SysTrigPlswthSet	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (28)	hardware device descri...	Terminated	16:10:27...	8 sec
33	SysTrigPrfHlim	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec
34	SysTrigPrfSet	-||-	-||-	-||-	Hardware error	SCANDINOVA-line1 : SCANDINOVA 0 0 0 0 (32)	hardware device descri...	Terminated	16:10:27...	8 sec

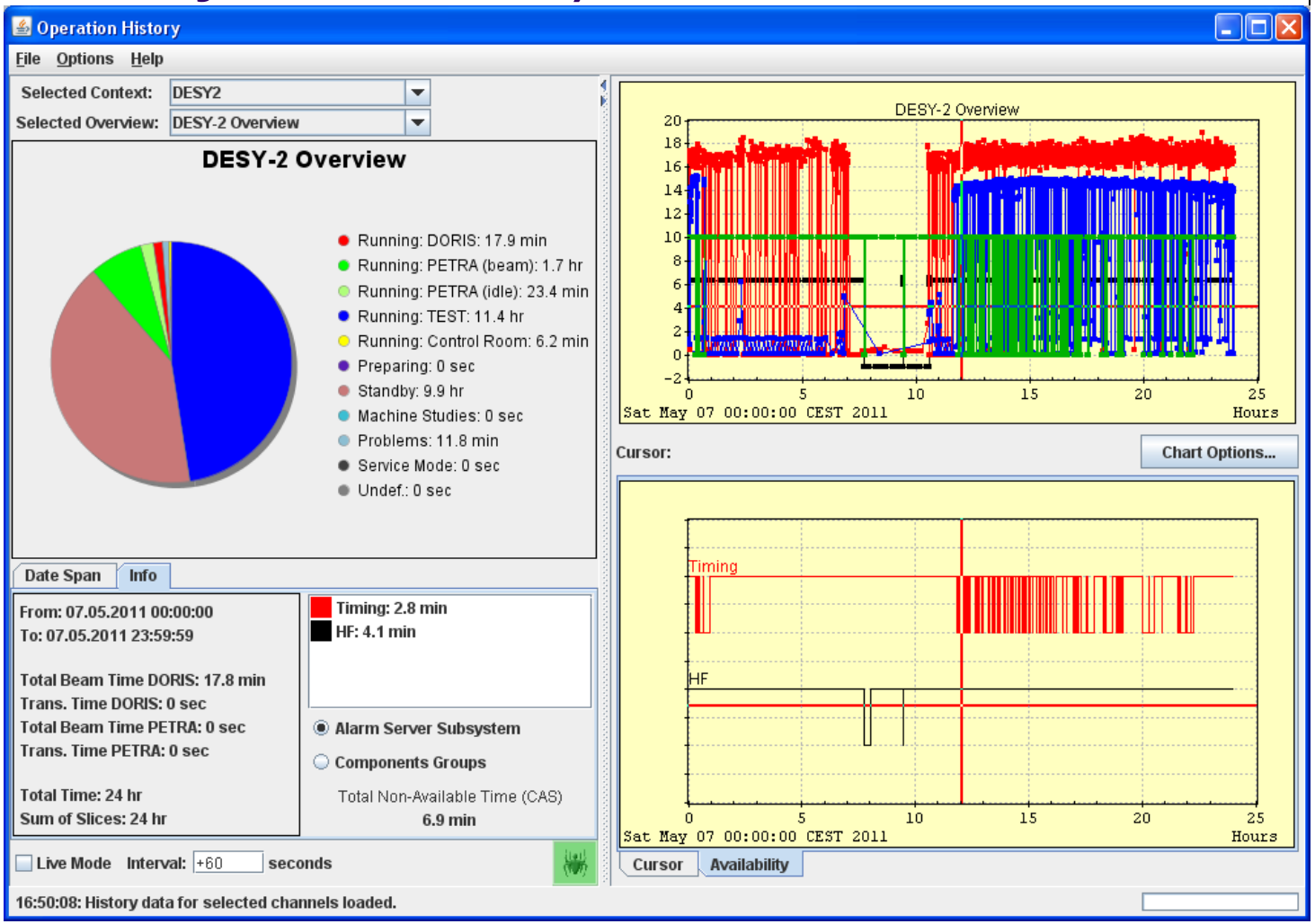
Operations + Availability

(typical day at DESY2 …)

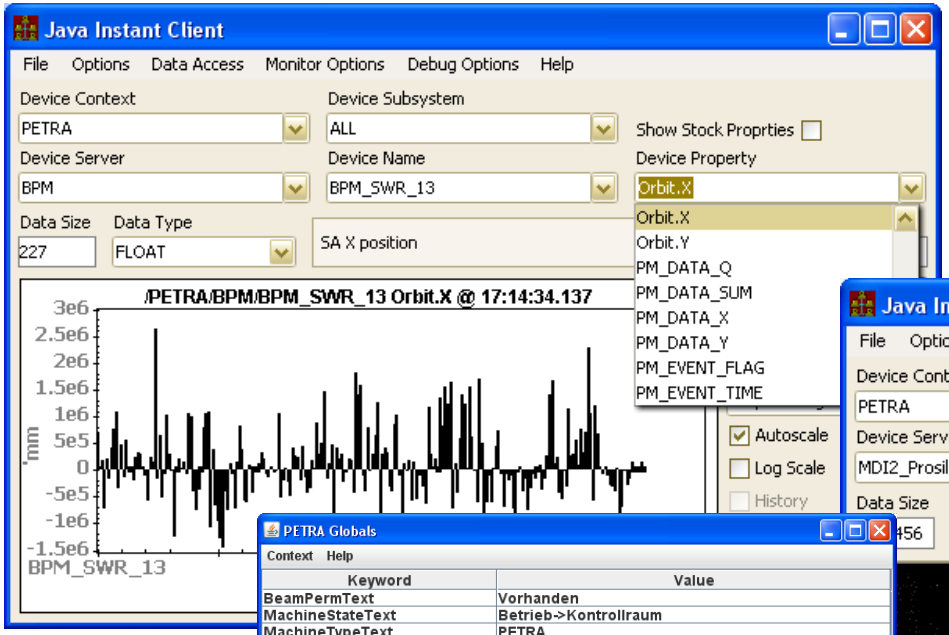


Operations + Availability

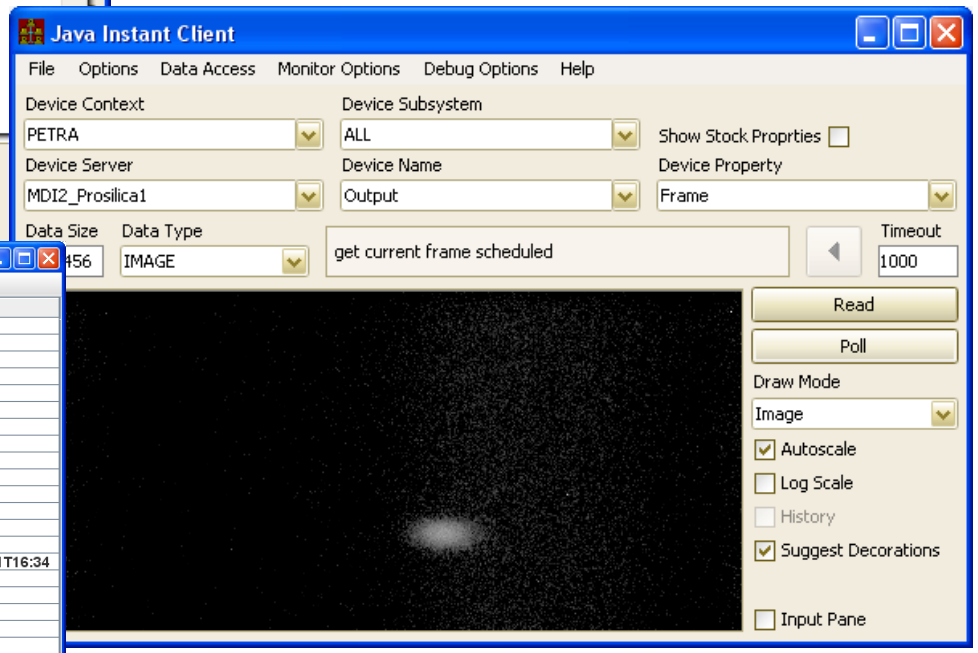
(typical day at DESY2 …)

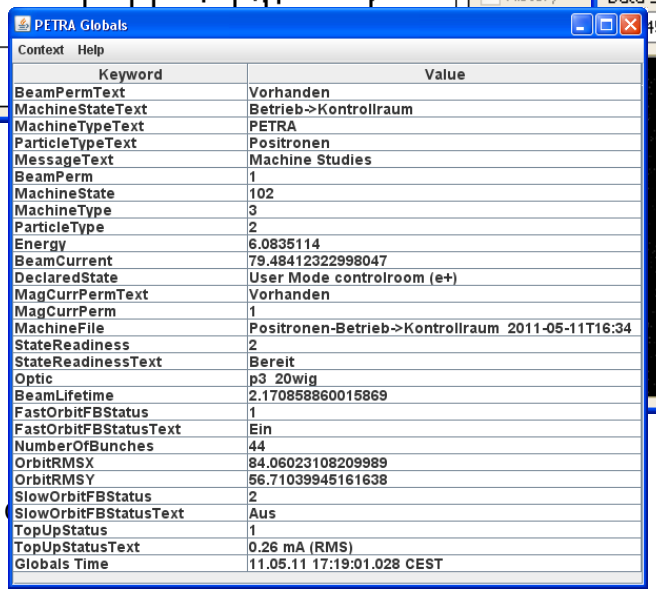


TINE generic tools ….



The “Instant Client” control system browser ….

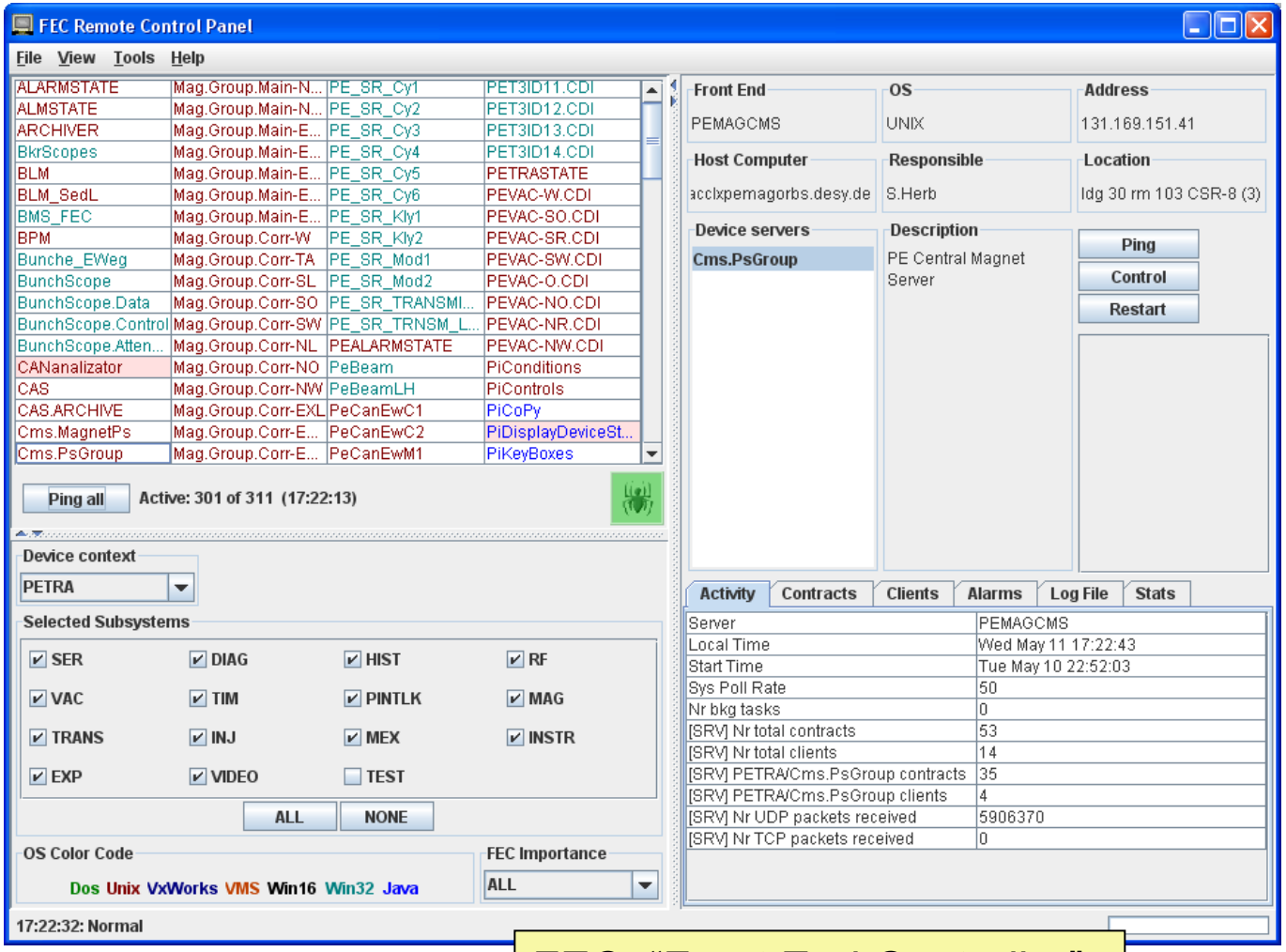




Keyword	Value
BeamPermText	Vorhanden
MachineStateText	Betrieb->Kontrollraum
MachineTypeText	PETRA
ParticleTypeText	Positronen
MessageText	Machine Studies
BeamPerm	1
MachineState	102
MachineType	3
ParticleType	2
Energy	6.0835114
BeamCurrent	79.48412322998047
DeclaredState	User Mode controlroom (e+)
MagCurrPermText	Vorhanden
MagCurrPerm	1
MachineFile	Positronen-Betrieb->Kontrollraum 2011-05-11T16:34
StateReadiness	2
StateReadinessText	Bereit
Optic	p3 20wig
BeamLifetime	2.170858860015869
FastOrbitFBStatus	1
FastOrbitFBStatusText	Ein
NumberOfBunches	44
OrbitRMSX	84.06023108209989
OrbitRMSY	56.71039945161638
SlowOrbitFBStatus	2
SlowOrbitFBStatusText	Aus
TopUpStatus	1
TopUpStatusText	0.26 mA (RMS)
Globals Time	11.05.11 17:19:01.028 CEST

TINE ‘Globals Viewer’

TINE Front End Management

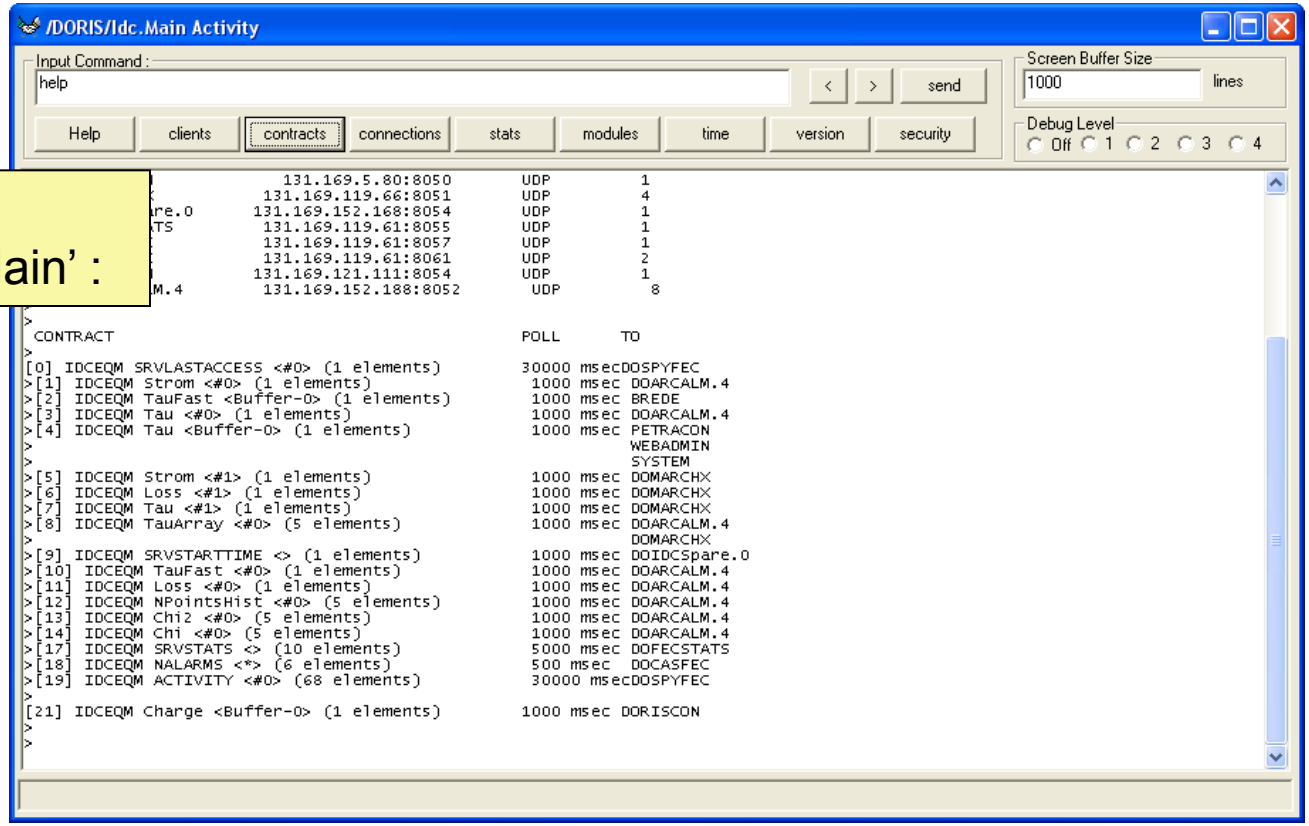


FEC: “Front End Controller”

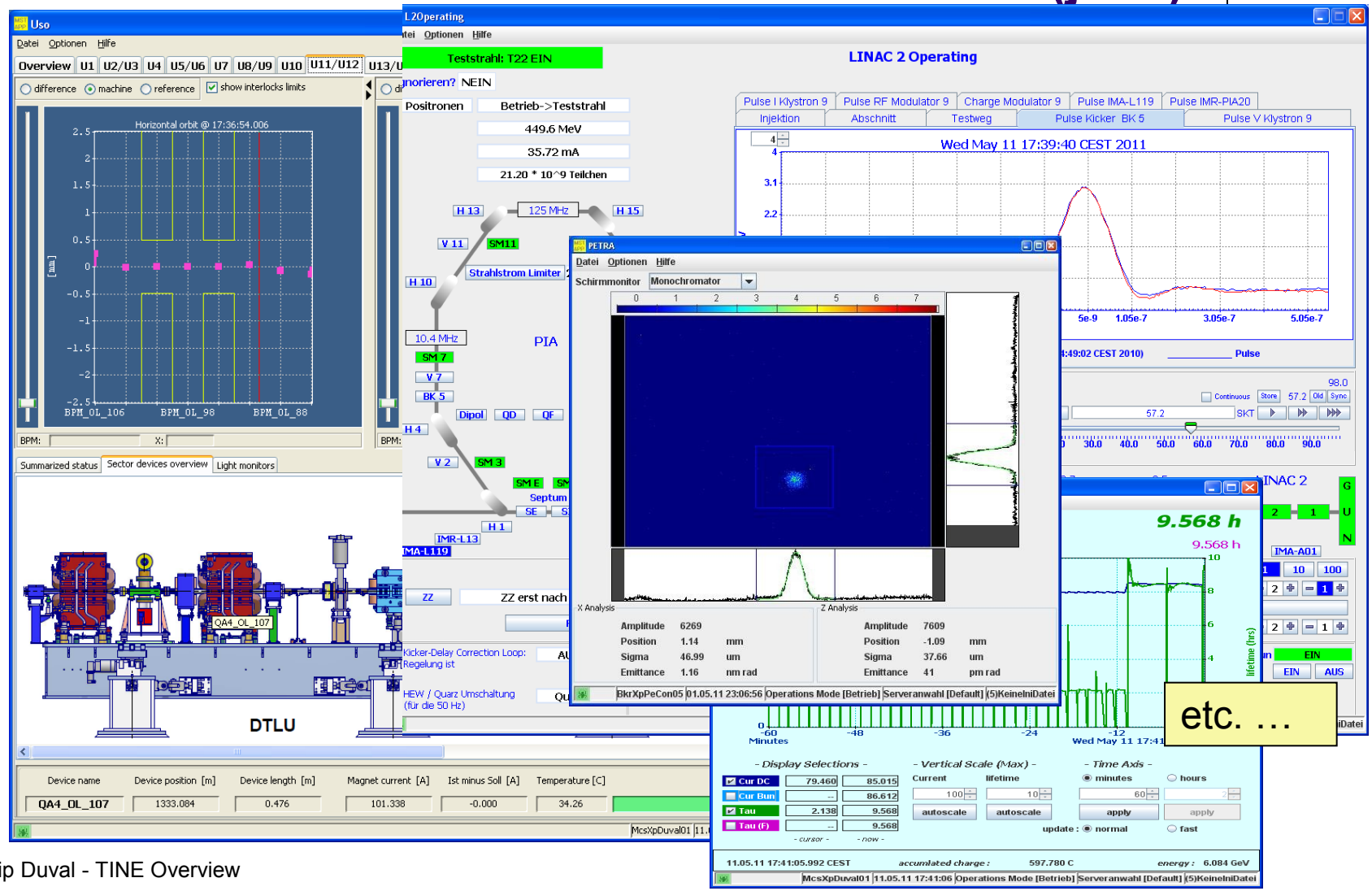
TINE Front End Management

- The ‘attachfec’ utility
  - On local host: attachfec <FECNAME>
  - From remote client: attachfec “/Context/Server”

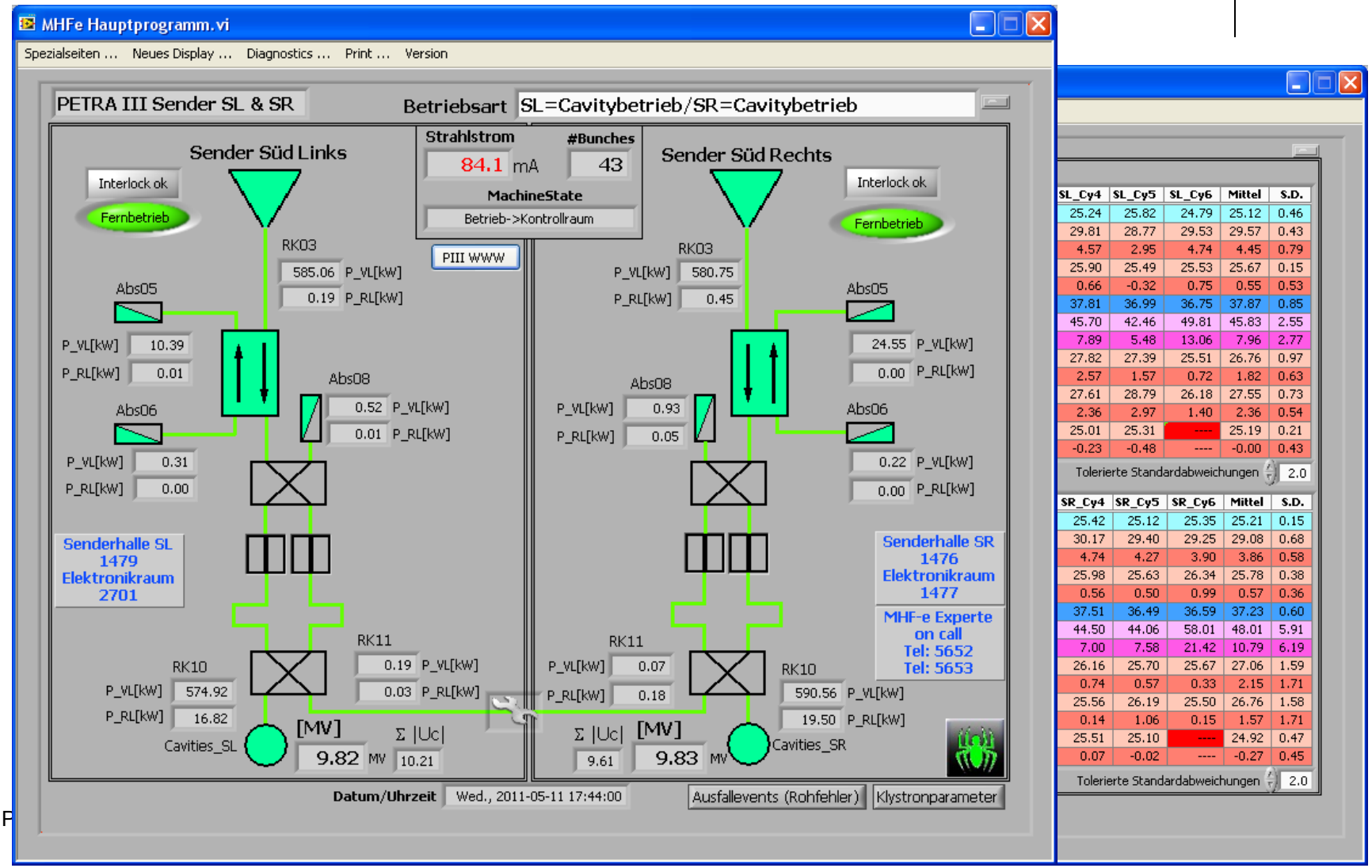
e.g.
‘attachfec /DORIS/Idc.Main’ :



TINE Clients : Rich Clients (java)



TINE Clients: Rich Clients
(LabView)



SL_Cy4	SL_Cy5	SL_Cy6	Mittel	S.D.
25.24	25.82	24.79	25.12	0.46
29.81	28.77	29.53	29.57	0.43
4.57	2.95	4.74	4.45	0.79
25.90	25.49	25.53	25.67	0.15
0.66	-0.32	0.75	0.55	0.53
37.81	36.99	36.75	37.87	0.85
45.70	42.46	49.81	45.83	2.55
7.89	5.48	13.06	7.96	2.77
27.82	27.39	25.51	26.76	0.97
2.57	1.57	0.72	1.82	0.63
27.61	28.79	26.18	27.55	0.73
2.36	2.97	1.40	2.36	0.54
25.01	25.31	----	25.19	0.21
-0.23	-0.48	----	-0.00	0.43

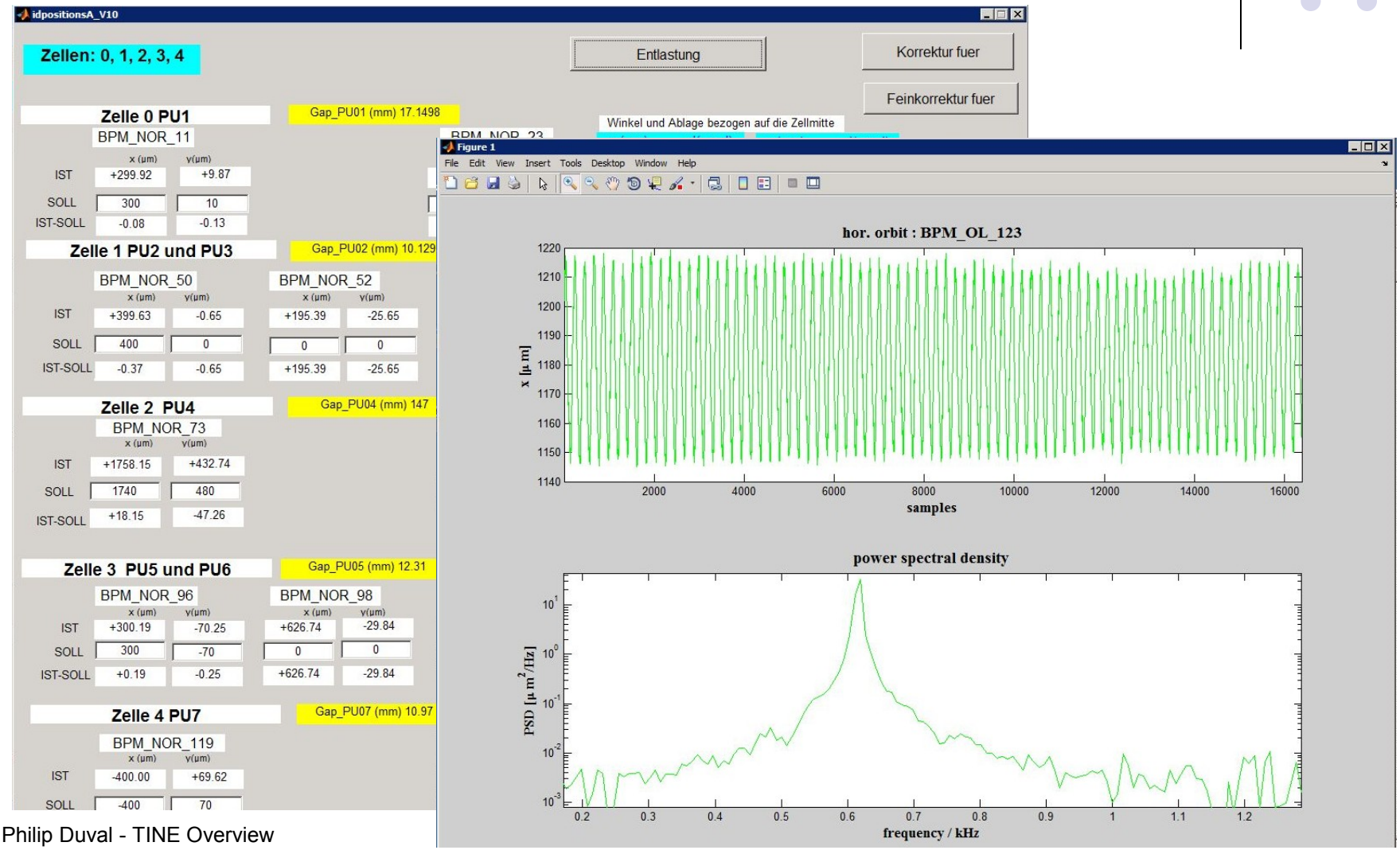
Tolerierte Standardabweichungen 2.0

SR_Cy4	SR_Cy5	SR_Cy6	Mittel	S.D.
25.42	25.12	25.35	25.21	0.15
30.17	29.40	29.25	29.08	0.68
4.74	4.27	3.90	3.86	0.58
25.98	25.63	26.34	25.78	0.38
0.56	0.50	0.99	0.57	0.36
37.51	36.49	36.59	37.23	0.60
44.50	44.06	58.01	48.01	5.91
7.00	7.58	21.42	10.79	6.19
26.16	25.70	25.67	27.06	1.59
0.74	0.57	0.33	2.15	1.71
25.56	26.19	25.50	26.76	1.58
0.14	1.06	0.15	1.57	1.71
25.51	25.10	----	24.92	0.47
0.07	-0.02	----	-0.27	0.45

Tolerierte Standardabweichungen 2.0

TINE Clients: Rich Clients

(MatLab)

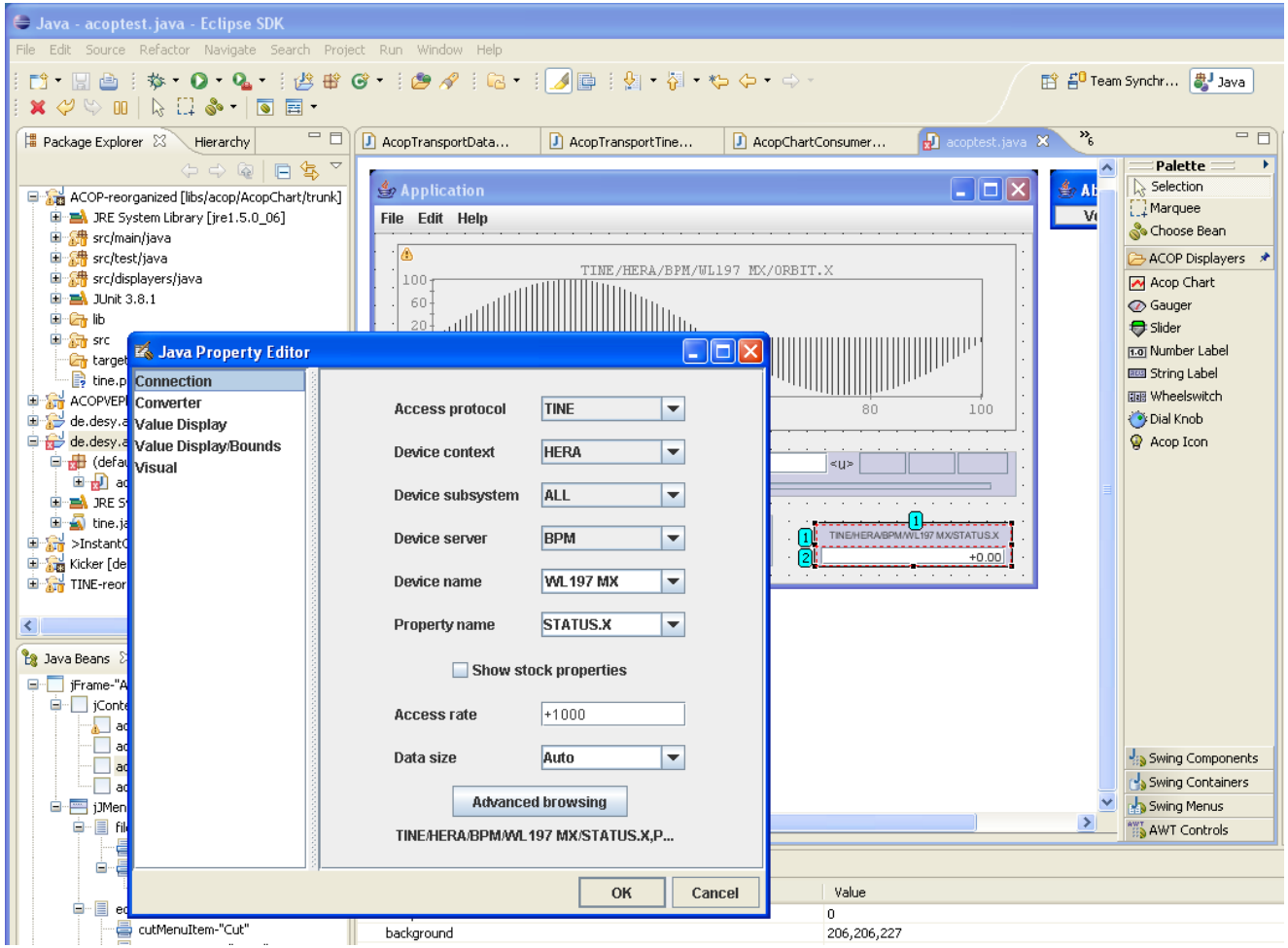


TINE and Java ACOP
(for rich clients)

No Frameworks !

Use Eclipse, NetBeans, or whatever …

Browse Control system at **design-time** with property panels or *customizer* …



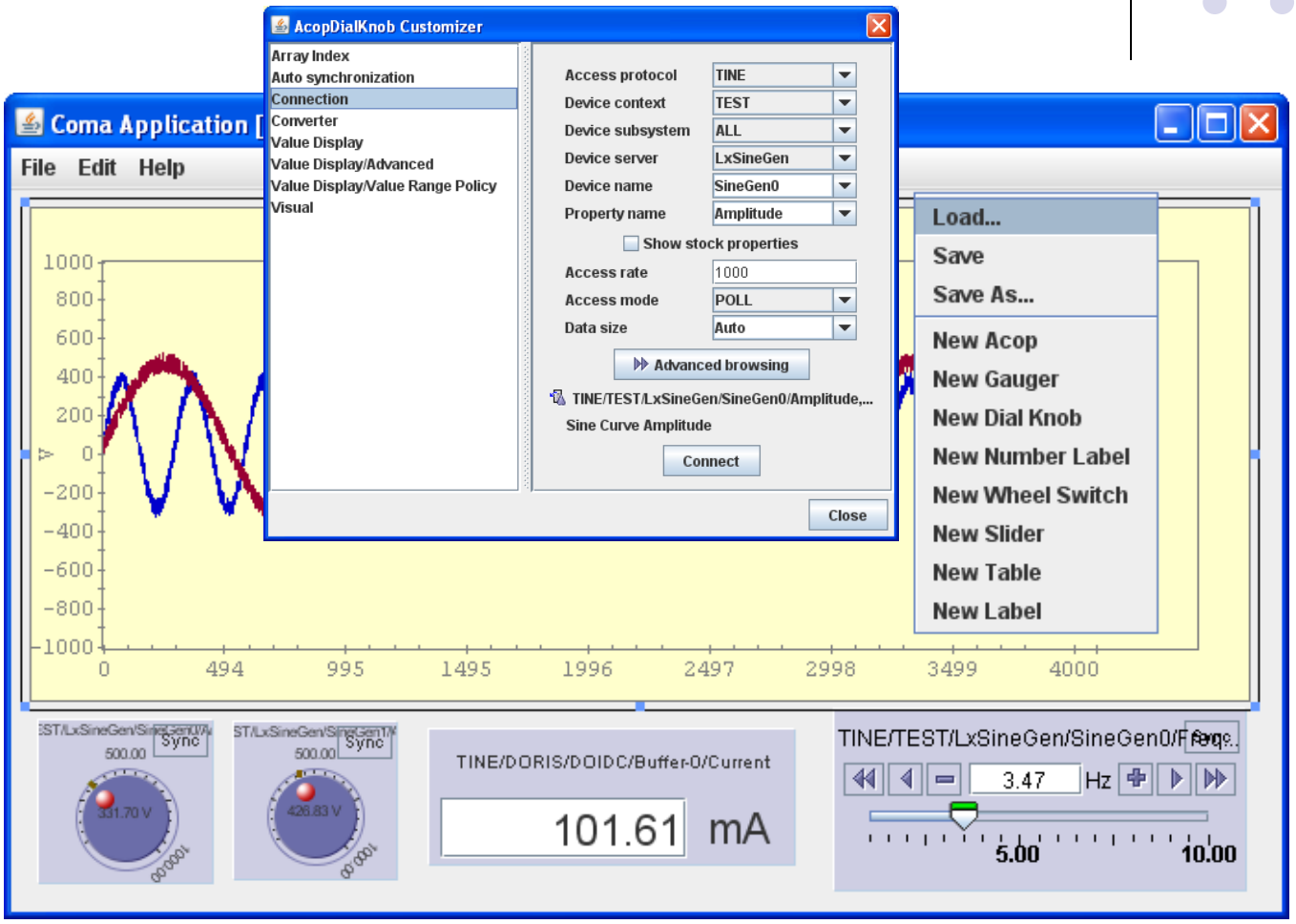
TINE and Java ACOP + COMA
(for simple clients)

No Frameworks !

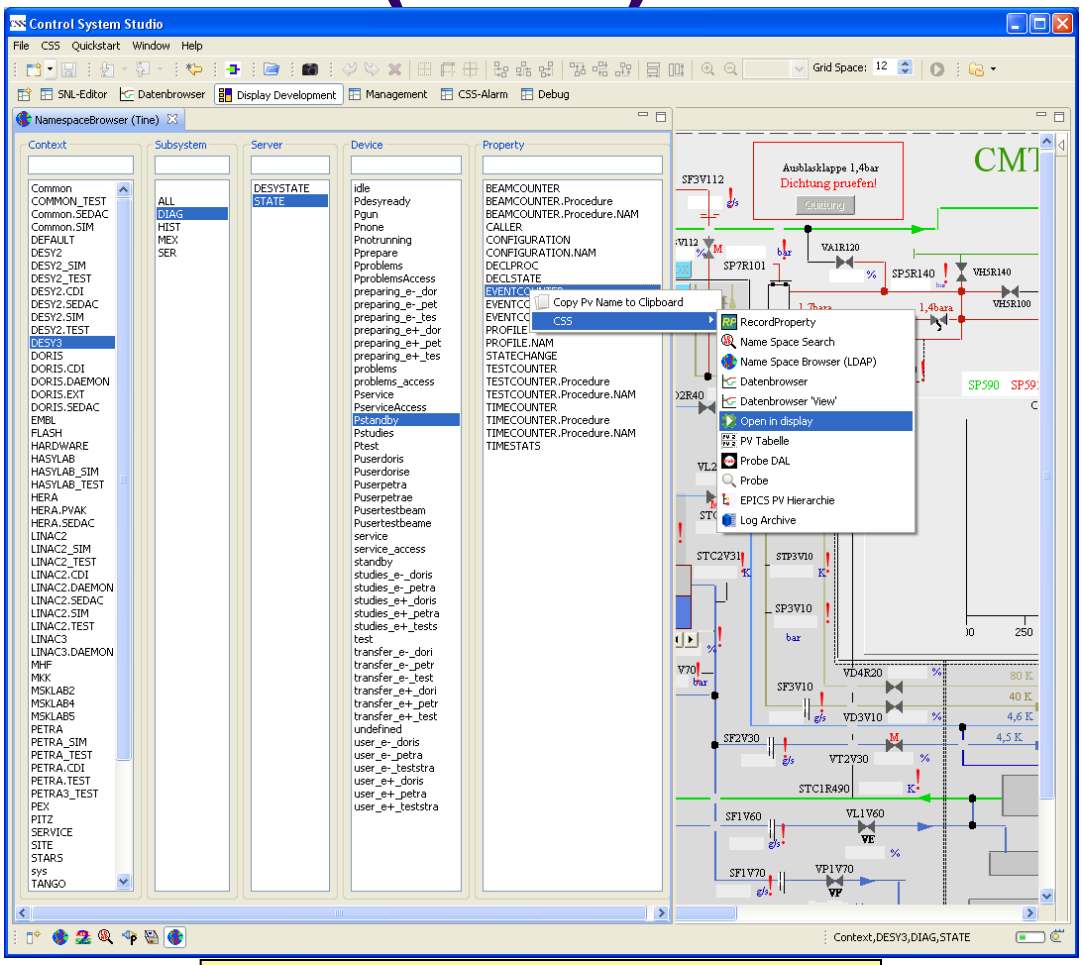
Lightweight!

Just start a coma application (e.g. an empty coma application)

Browse Control system at **run-time** with *customizer* …



TINE and Control System Studio (CSS)



Namespace Browser (TINE)

Call up:

- Display
- *PV-Table*
- ……

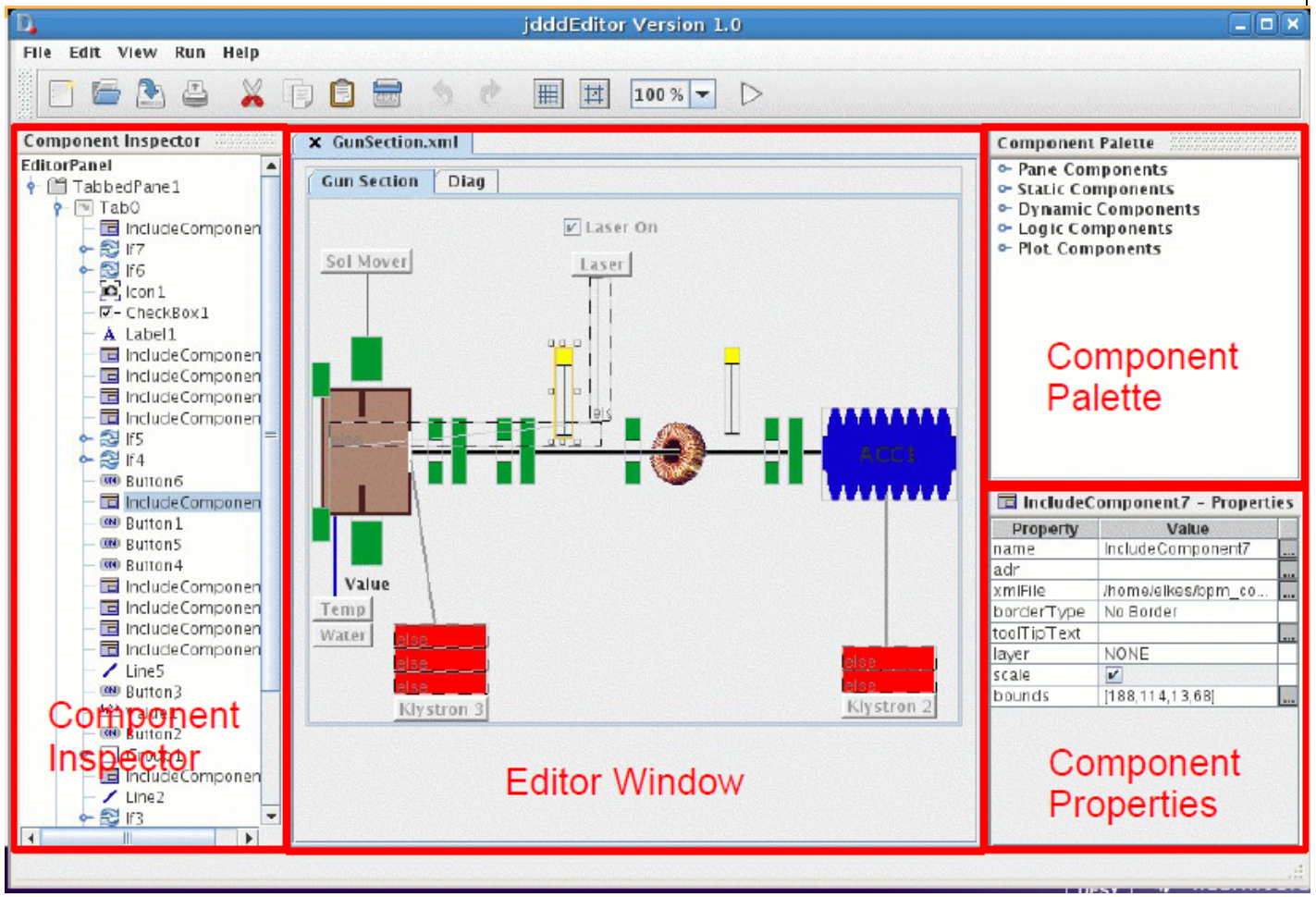
Drag and Drop

- Into *PV-Table*
- Into Display (edit mode)

No DAL support for PV-Table - yet

See: http://adweb.desy.de/mcs/TINE_Users_Meeting/2008Dec05/CSS-TINE%20Meeting-2008-12-05-2008-12-05.pdf

TINE and jddd



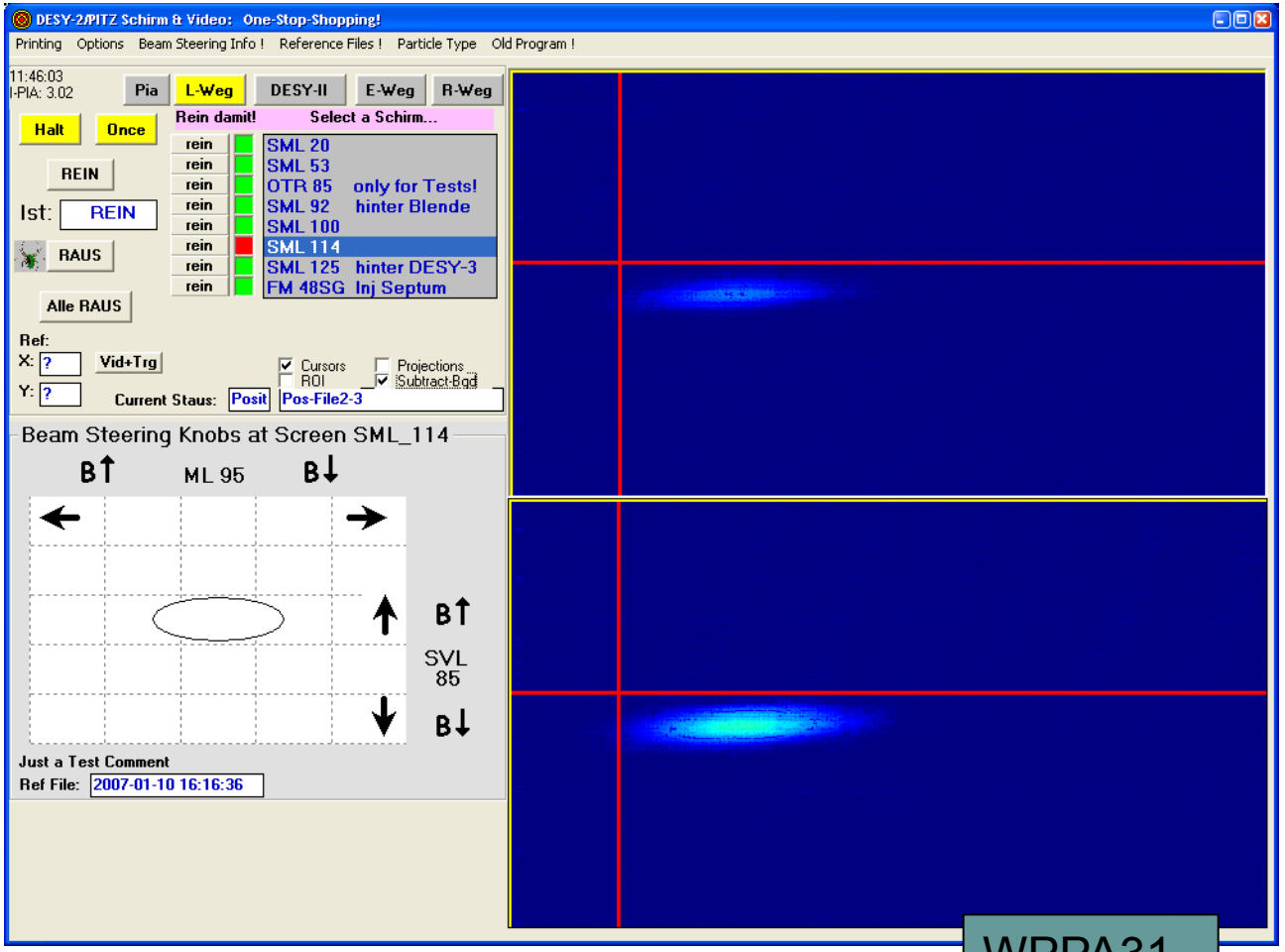
See: http://adweb.desy.de/mcs/TINE_Users_Meeting/2008Nov07/jdddTalkNew.pdf

TINE Video
(Multicasting + Scheduling)

.5 Mbyte Video Frames @ 10 Hz multicast (100 Mb ethernet). (also runs fine @ 20 Hz)

Uses the **NETWORK** switch => as many clients as you want!

Server calls the **Scheduler** when a new frame is grabbed => as real-time as it gets !!!

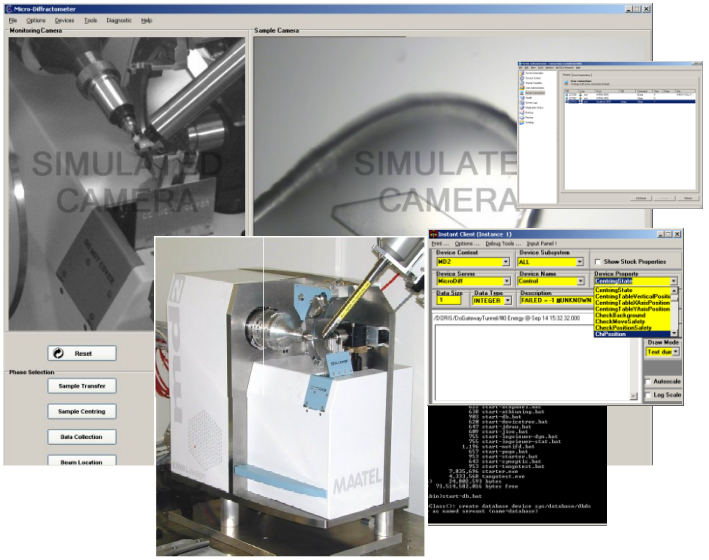


TINE Platforms …

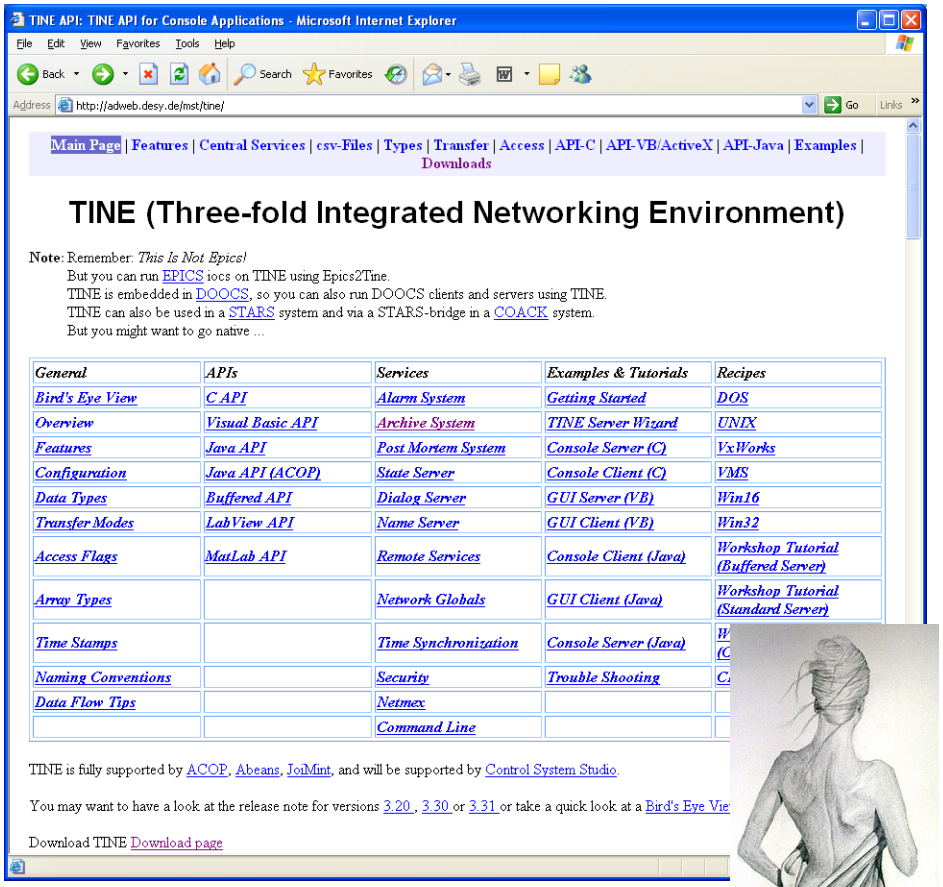
- DOS
- Win16, Win32 (9x, NT, 2K, XP, …), Win64 ?
- Win CE
- Unix (Solaris, HP, OSF, SGI, Ultrix, …)
- Linux, FreeBSD (32 bit, 64 bit)
- ELINOS
- MAC OS X
- VxWorks
- VMS (Vax, Alpha)
- LynxOS
- NIOS (plugs, single-threaded LWIP, …)
- Java, Mono, (.NET)

TINE and Connectivity to other systems

- Already embedded in DOOCS
- Epics2Tine runs on any EPICS ioc
- Connect to STARS/COACK via STARS bridge
- Tango2Tine



TANGO2TINE example MD2 Goniometer

TINE : Where to get it …

- http://tine.desy.de
  - Visit the *download* section and chose your platform.
  - Use setup tools available.
  - Installation takes a few minutes
  - Don't expect too many miracles (you might have to read a README.txt or two).
- Email to tine@desy.de