



*National Synchrotron Radiation Research Center*

# *EPICS Applications in the Taiwan Light Source*

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NSRRC





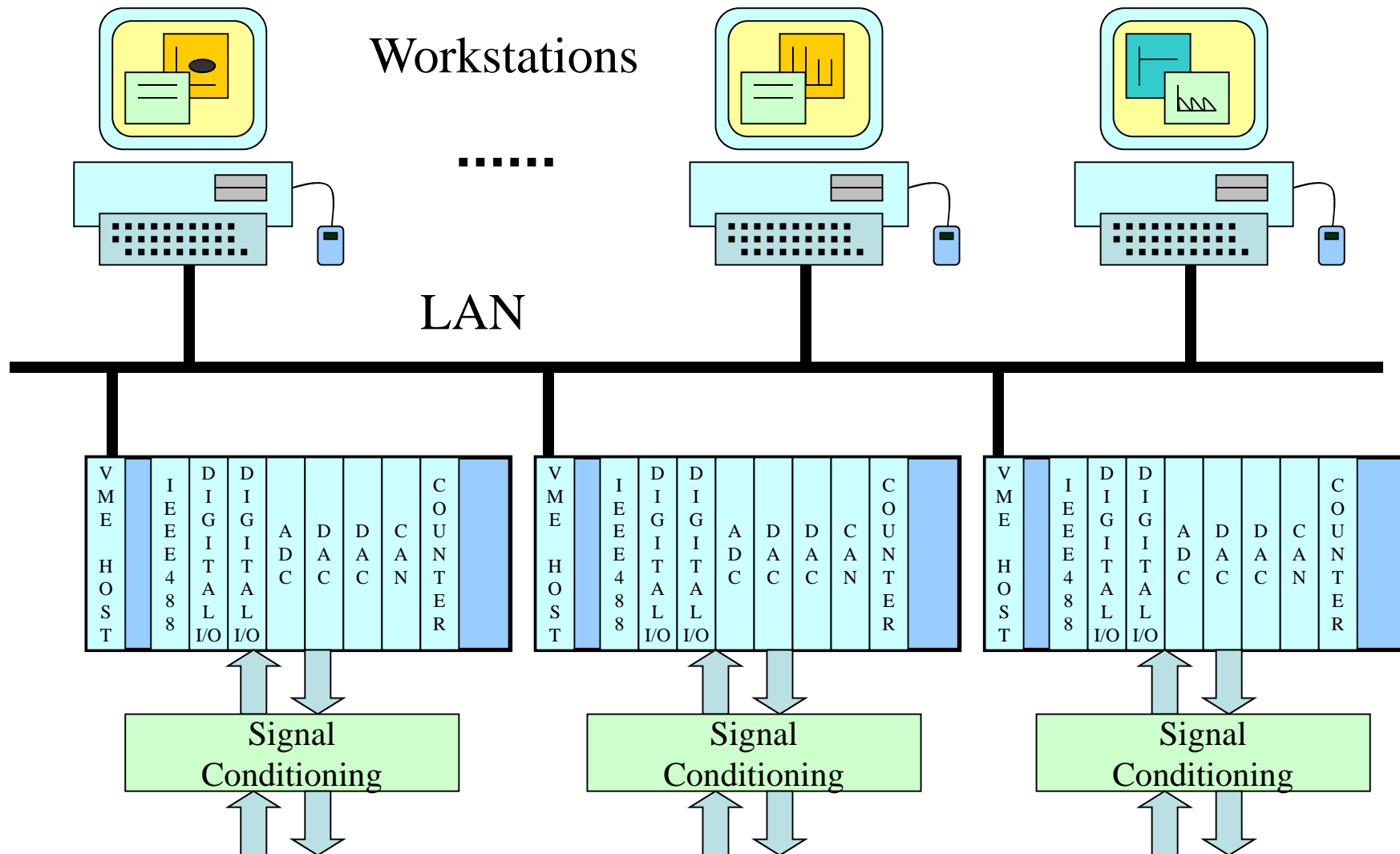


# TLS control system introduction





# Architecture - Standard Model



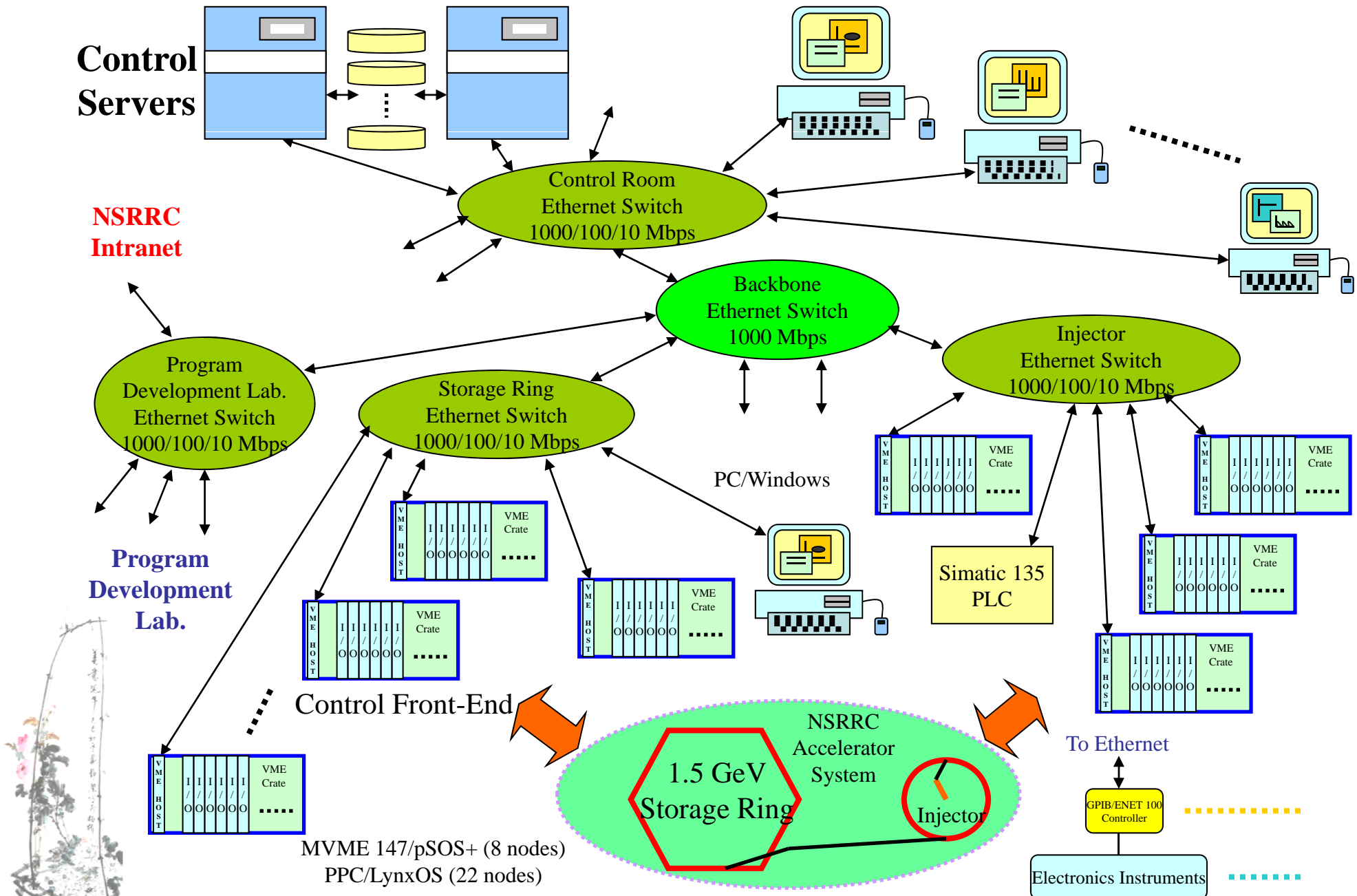
Three Basic Components of the Standard Model:

- \* Operator Interface
- \* Data Communication
- \* Front-end Computers (VME + Realtime operation system)



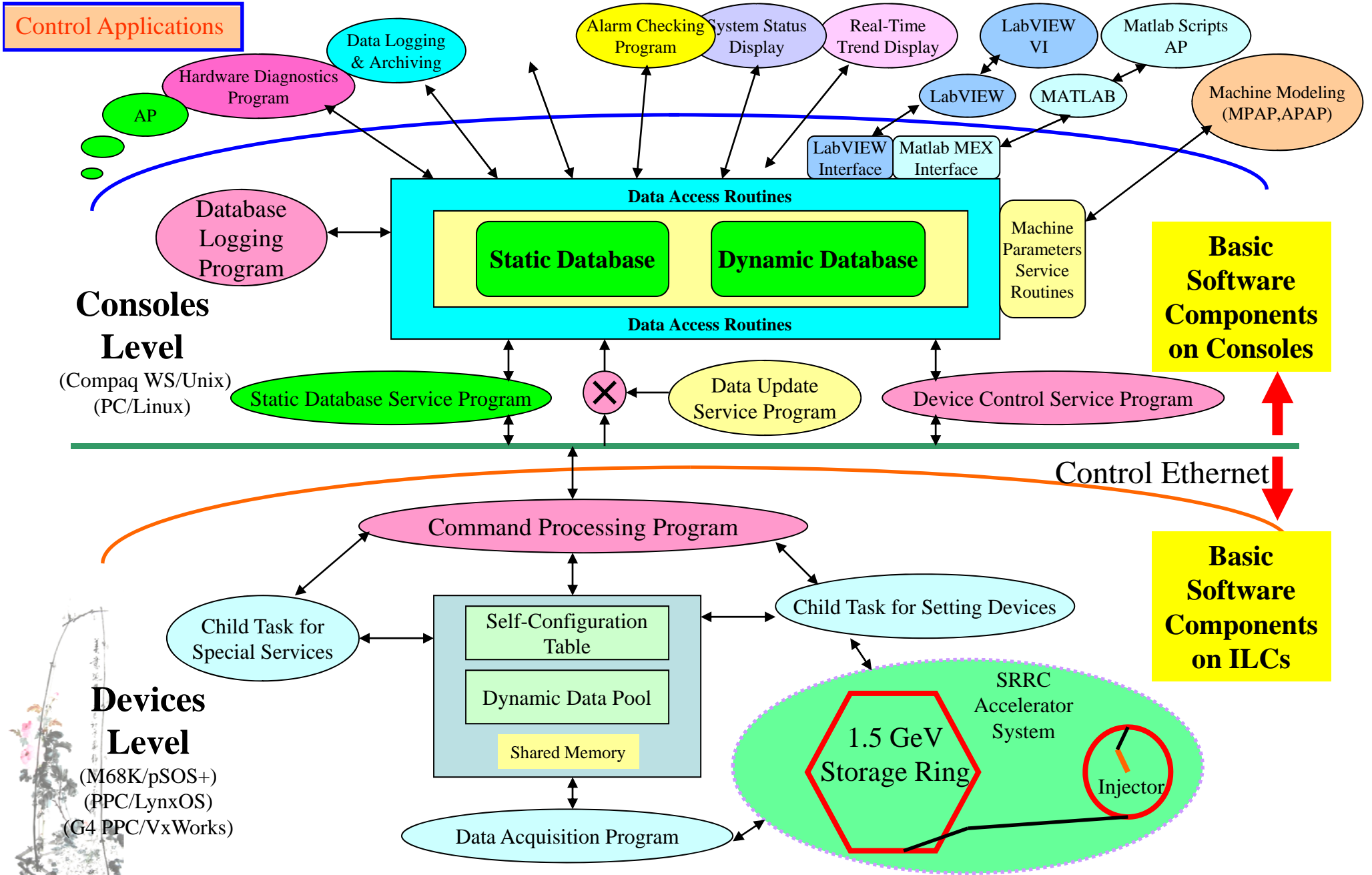


# Control System Hardware Architecture of TLS





# Control System Software Structure





# Migrate to EPICS motivation

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- Network loading.
- Amount of signals.
- For TPS project training.
- For old hardware upgrade.





# Original control system

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## Pros:

Simple udp broadcast.

Good software real time.

## Cons:

Amount of broadcast packets.

reduce network performance.

Only support to small scale signals.







# EPICS control system

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## Pros:

- Peer to peer TCP Protocol reduces network loading.
- Large scale signal.

## Cons:

- Just reduce software real time performance a little bit with network interface, but is enough to large scale control system.





# Migrate to EPICS motivation

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- Network loading.
- Amount of signals.
- For TPS project training.
- For old hardware upgrade.





# Migrate to EPICS motivation

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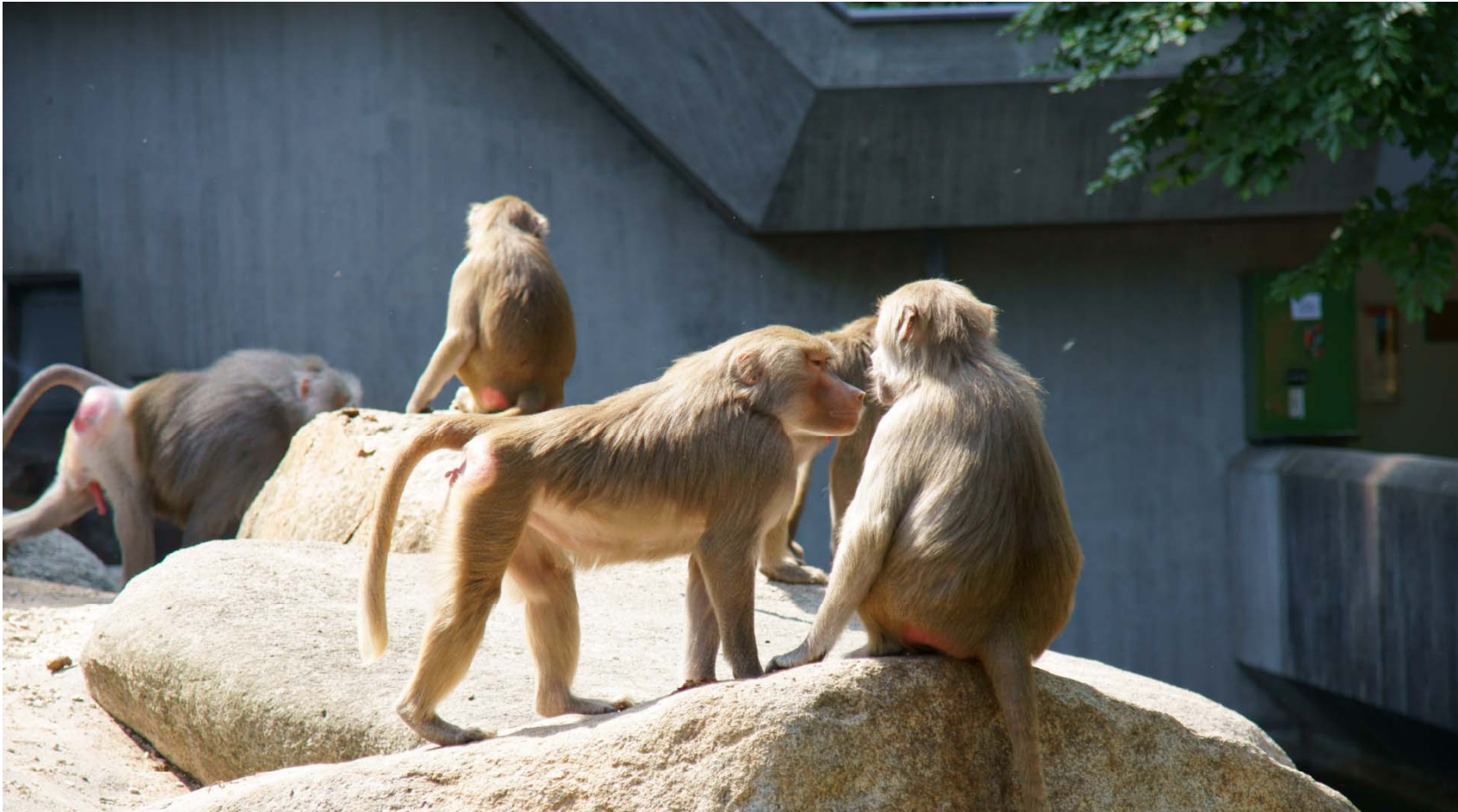


Powerful,  
but  
isolated,  
lonely



**Standalone!**  
**No communication!!**  
**No cooperation!!**





Open, Popular.  
Good team or group cooperation.  
Good communication, same protocol.





# EPICS Devices and Applications in the TLS





# EPICS Devices in the TLS

The screenshot shows the **bpm.vi** software interface. On the left, there are images of two hardware devices: **Bergoz BPM** and **I-TECH DBPM**. In the center, there are three large colored boxes representing different BPM types: **ADC VME** (blue), **Digital BPM(QDR, VME)** (green), and **Digital BPM (Libera Brilliance), EPICS** (purple). On the right, there is a table of BPM parameters and a plot area.

bpm.par	
Name	Enable:1
r1bpm0	1
r1bpm1	1
r1bpm2	1
r1bpm3	1
r1bpm4	1
r1bpm5	1
r1bpm6	1
r1bpm7	1
r1bpm8	1
r1bpm9	1
r2bpm0	1
r2bpm1	1
r2bpm2	1
r2bpm3	1
r2bpm4	1
r2bpm5	1
r2bpm6	1
r2bpm7	1
r2bpm8	1
r2bpm9	1
r3bpm0	1
r3bpm1	1
r3bpm2	1
r3bpm3	1
r3bpm4	1
r3bpm5a	0
r3bpm5	1

At the bottom, there is a control panel with various settings: **Line Style** (Line), **Point Style** (Points), **Bar Style** (Bar1), **Xrms** (0.0465), **Yrms** (0.0465), and a data table with columns **Dy** and **Users/control/tmp/bpm.dat**.

Decorative elements include a **Software bridge** logo with a fish and a bridge, and a red stamp that says **Service to TLS database** and **Service to EPICS**.



# EPICS Devices in the TLS

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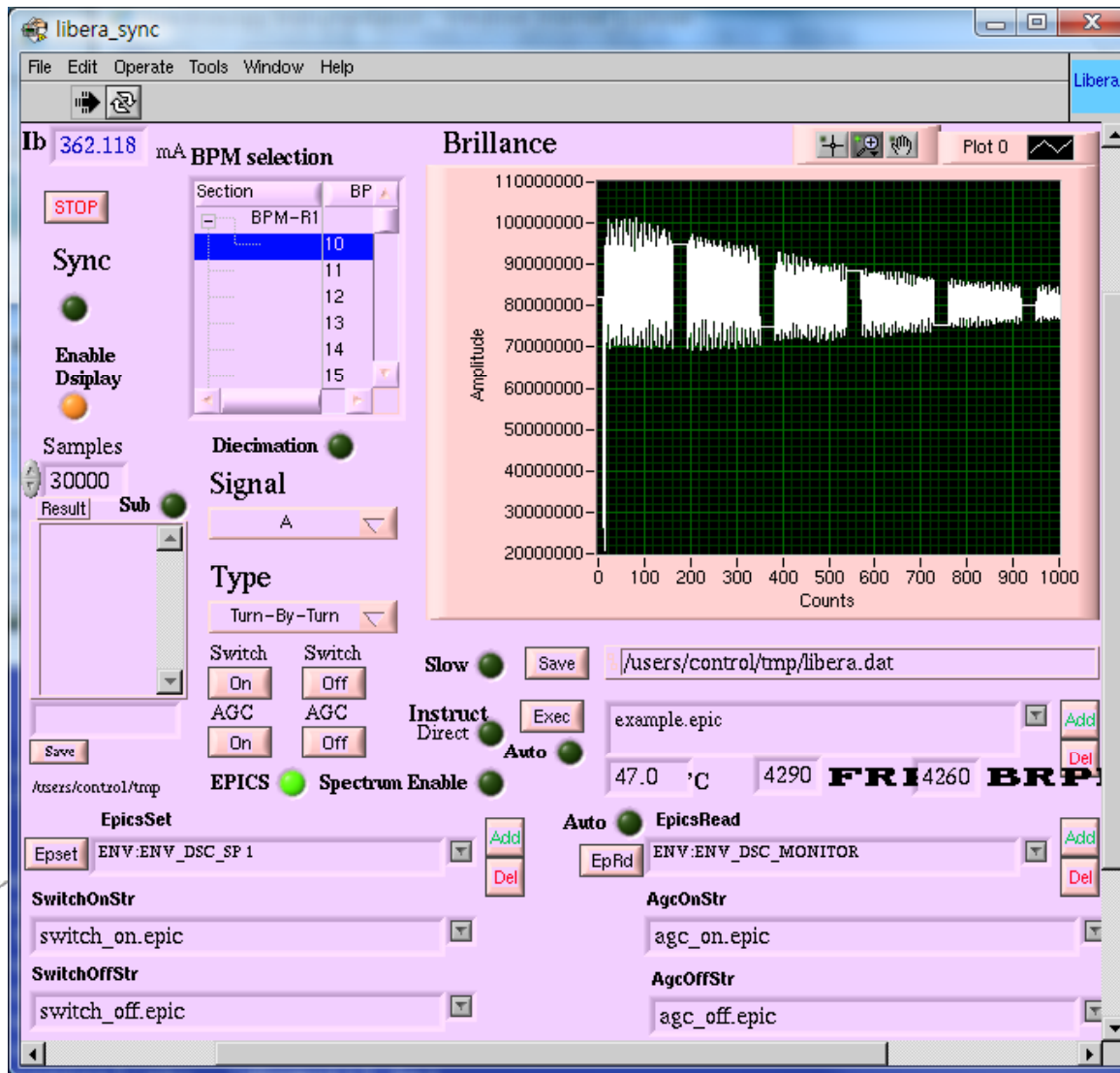
- ✓ Transverse feedback  
iGp
- ✓ Longitudinal feedback  
iGp12
- ✓ Bunch-by-Bunch RF front-end  
I-Tech bbfe
- ✓ Digital camera system  
allied vision technologies (prosilica)  
camera+areadetector
- ✓ 10KHz BPM data service system
- ✓ Vibrataion measurement system
- ✓ Temperature measurement system







# EPICS CA Applications (1)



BPM control panel

*LabviewCA (LVCA\*)  
in the Redhat Linux 9,  
ES 3.8, ...,4.6, ...,5.5  
platform  
+ shared memory*



*Be Adapted in linux  
labview 6.1, 7.1,  
should be adapted in the  
labview 8.x*



# EPICS CA Applications (1) Cont.

Turn-By-Turn

Switch On Off

AGC On Off

EPICS Spectrum Enable

Save

/users/control/trmp

EpicsSet

Epset ENV:ENV\_DSC\_SP 1

SwitchOnStr

switch\_on.epic

SwitchOffStr

switch\_off.epic

Add

Del

```
ENV:ENV_SWITCHES_SP 255
ENV:ENV_DSC_SP 2
ENV:ENV_ENV_GAIN -10
ENV:ENV_EXTSWITCH_SP 0
DD1:DD_IGNORE_TRIG_SP 1
DD1:DD_REQUEST_CMD 1
DD1:DD_ON_NEXT_TRIG_CMD 1
```

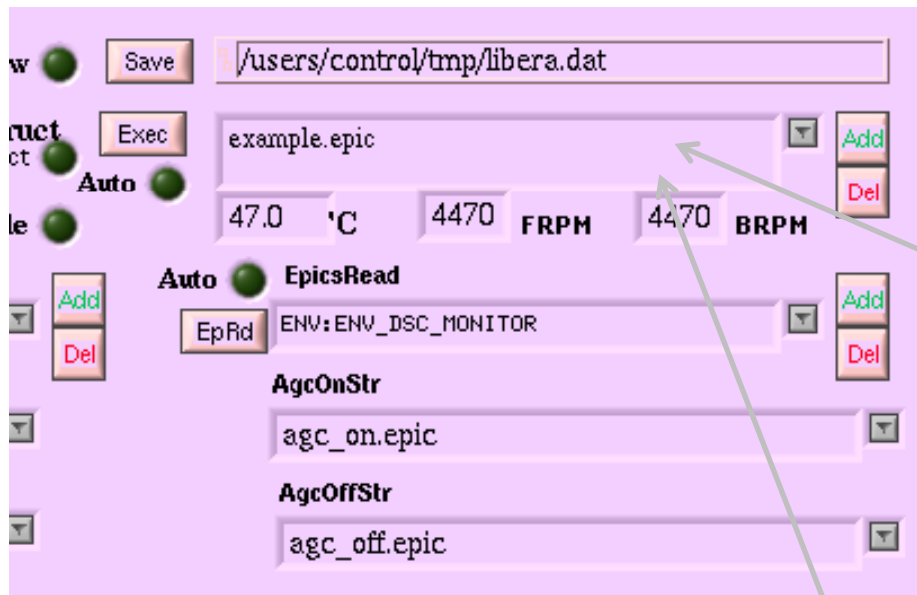
- Add: add EPICS record
- Del: delete EPICS record

● Epset: Execute EPICS set function

- switch\_on.epic
- switch\_on\_all.epic
- switch\_on\_single.epic
- switch\_on\_r1.epic
- switch\_on\_r2.epic
- switch\_on\_r3.epic
- switch\_on\_r4.epic
- switch\_on\_r5.epic
- switch\_on\_r6.epic



# EPICS CA Applications (1) Cont.



```
example.epic
liberal dbpm10
liberaf dbpm10 -2 1024
liberat dbpm10 -2 1024
gain_large.epic
gain_200_350mA.epic
gain_80_220mA.epic
gain_20_100mA.epic
gain.epic -45
gain_60mA.epic
gain_small.epic
agc_on_all.epic
```

```
gain.epic -45
gain_60mA.epic
gain_small.epic
agc_on_all.epic
agc_off_all.epic
liberasetup dbpm70
liberap2.epic 10 67
ffan_all.epic
bfan_all.epic
temp_all.epic
epicsphoton fe09
epicsinstall dbpm69 TLS-SR-DI-BPM-35A
```

- New Libera install
- EPICS install
- PV name setup

**“Replace Libera” don’t need expert**



# EPICS CA Applications (2)

## Bunch-by-Bunch feedback system

Non-EPICS Device

Embedded EPICS

iGp

Hybrid network



Bunch-by-bunch front-end  
(Longitudinal feedback)



iGp12



EPICS IOC



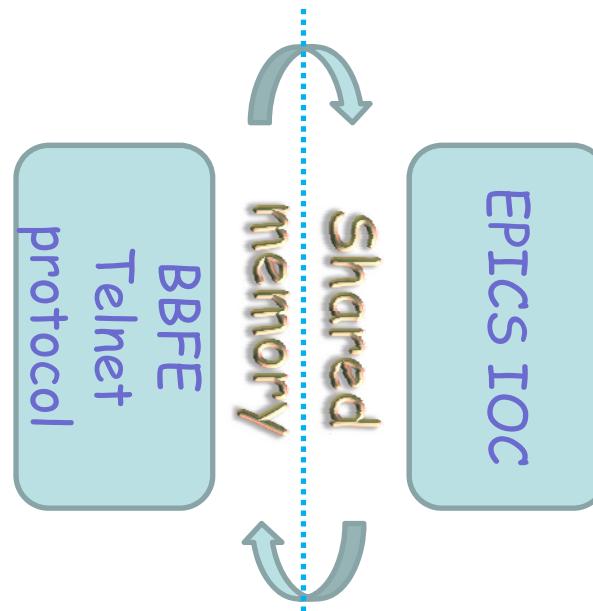


# EPICS CA Applications (2) cont.

## BBFE

- Telnet communication protocol
- Shared memory + EPICS IOC
- For porting to any platform

**BBFE**  
**TLS Bunch-by-Bunch FeedBack Front End**  
 Heartbeat: 182483 [EXIT] [Reset]  
 Temperature & FAN Status:  
 Temp.: 36 °C Alarm: NOB  
 Speed: 4200 4410 RPM  
 Input Level: Phase of LO Signal:  
 X: -20 -20 dBm Shift: 0 0 deg  
 Y: -20 -20 dBm LO\_X: 158 158 deg  
 I: -10 -10 dBm LO\_Y: -20 -20 deg  
 MC Phase Shift: LO\_T: 8 8 deg  
 CLK 1: 0 0 deg LO\_L: -151 -151 deg  
 CLK 2: 28 28 deg  
 CLK 3: 0 0 deg  
 CLK 4: 136 136 deg  
 Temp.Lim: 62 °C [Save/Restore] [Print]



**Configuration Save/Restore**  
 DEVICE: TLS-SR-DI-BBFE [HELP] [EXIT]  
 CONFIGURATION SAVE/RESTORE  
 bbfe2011-0503  
 [SAVE] [RESTORE]

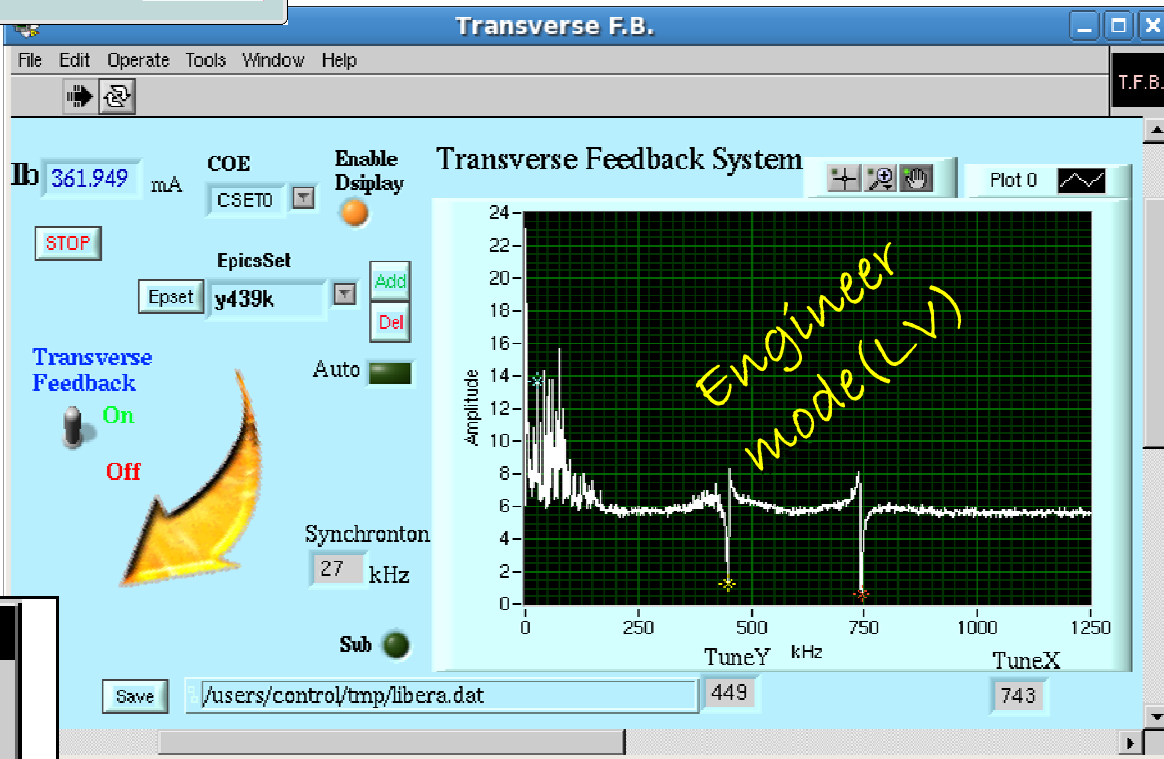
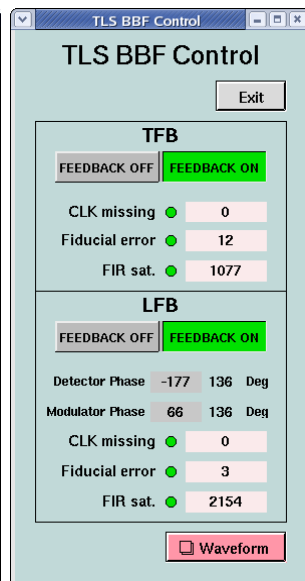
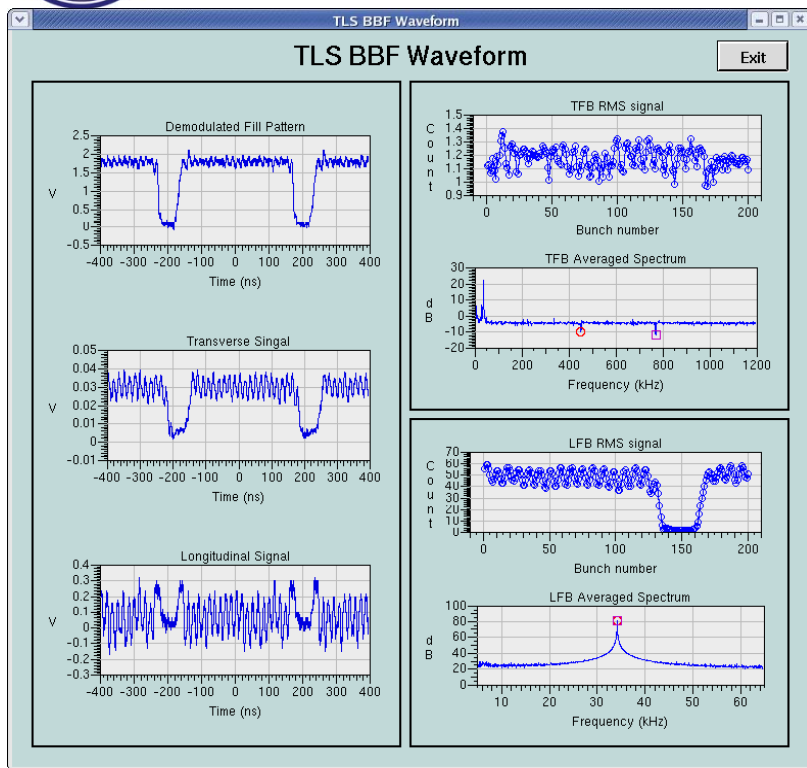
**\_popup**  
 Filter: /users/control/opi/bbfe/files/\*  
 Directories: opi/bbfe/files/, opi/bbfe/files/..  
 Files: bbfe2011-0214, bbfe2011-0214B, bbfe2011-0215, bbfe2011-0215B, bbfe2011-0503, bbfe2011-0503B  
 Selection: /users/control/opi/bbfe/files/  
 [OK] [Filter] [Cancel] [Help]





# EPICS CA Applications (3)

## Bunch-by-Bunch feedback system control page

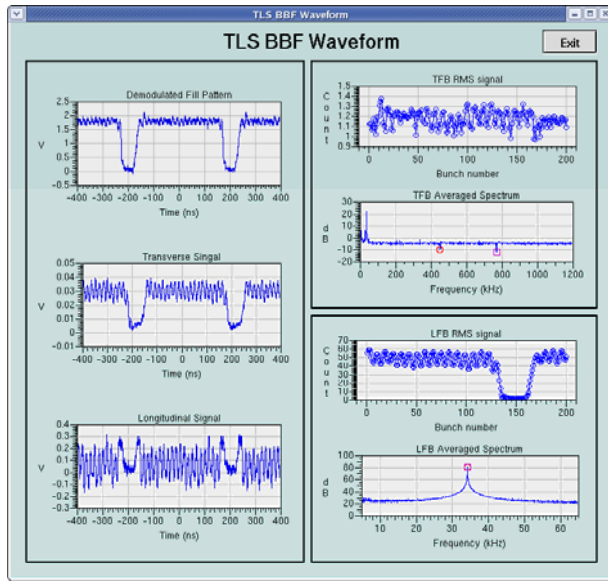


y439k  
y455k  
y470k

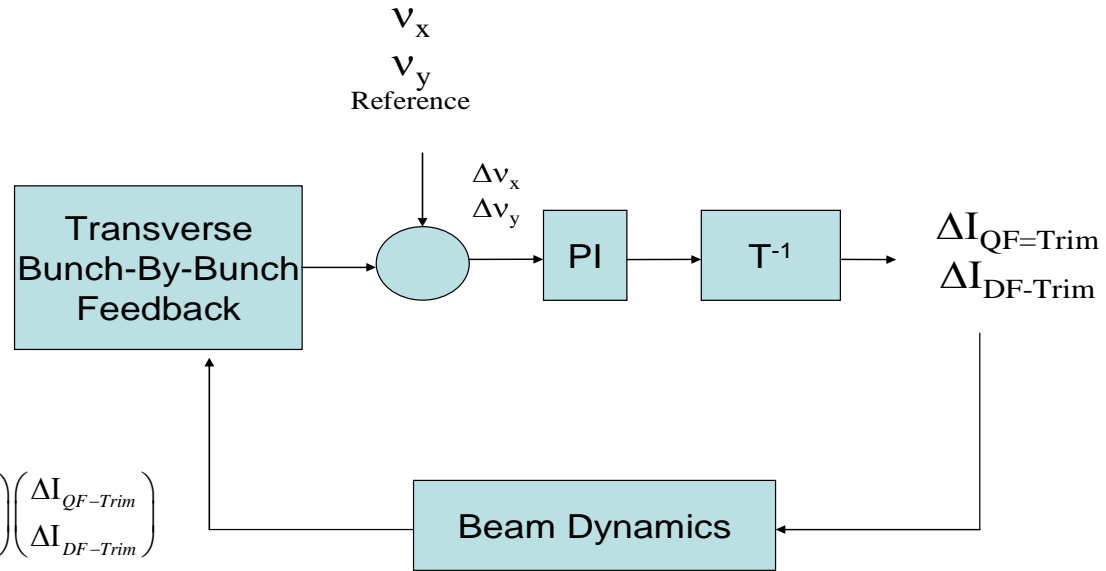




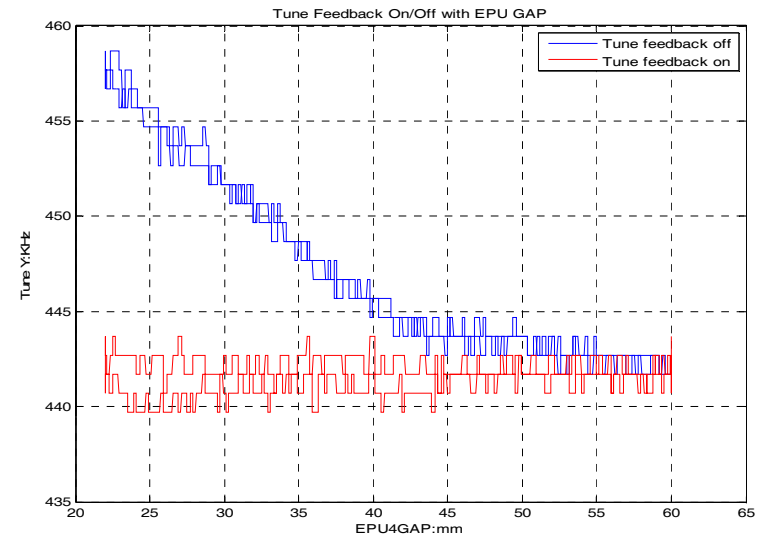
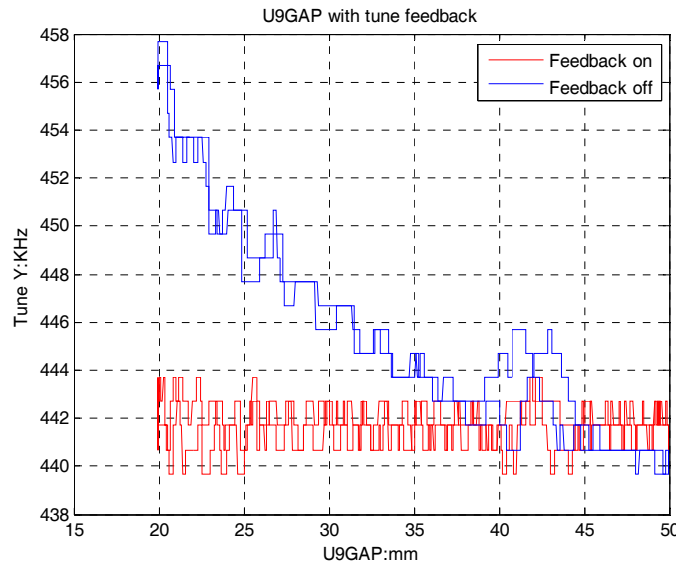
# EPICS CA Applications (3) cont.



## Tune feedback

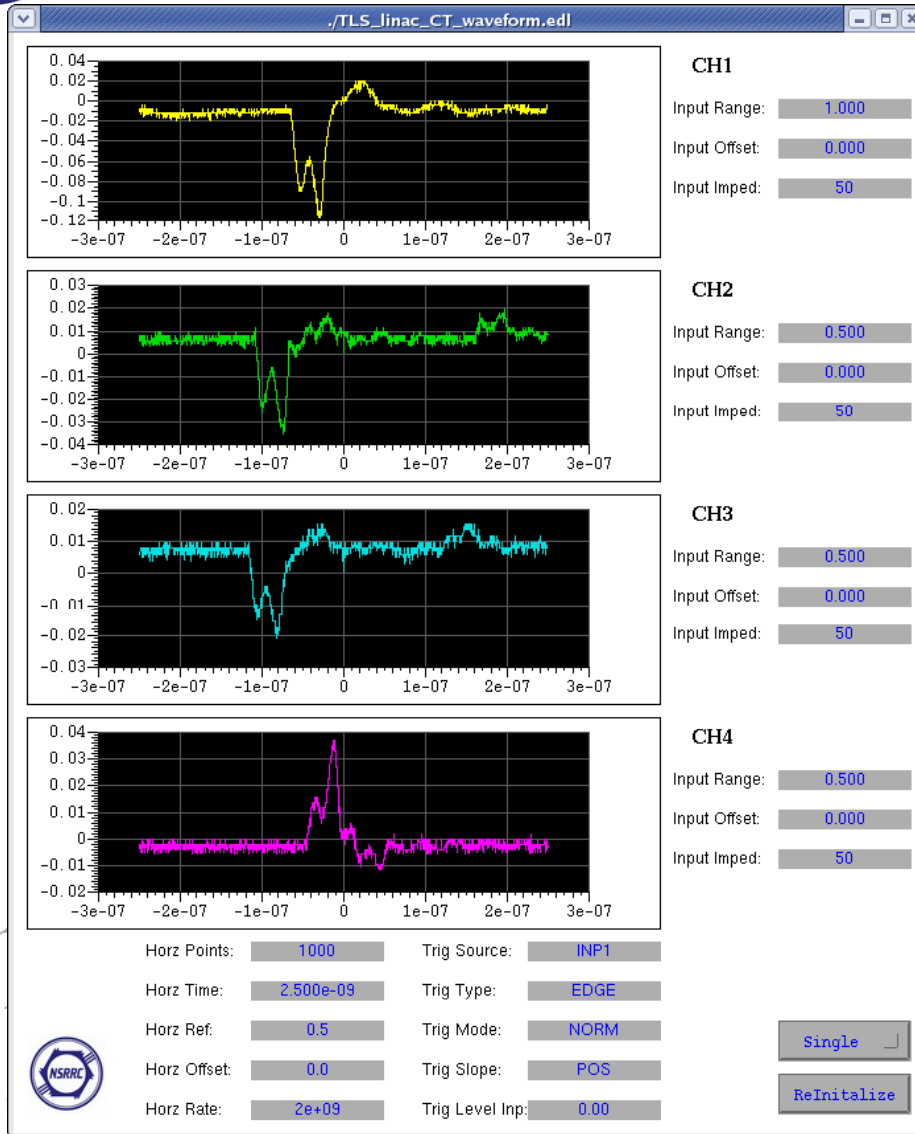


$$\begin{pmatrix} \Delta v_x \\ \Delta v_y \end{pmatrix} = (T) \begin{pmatrix} \Delta I_{QF-Trim} \\ \Delta I_{DF-Trim} \end{pmatrix} = \begin{pmatrix} t_{11} & t_{12} \\ t_{21} & t_{22} \end{pmatrix} \begin{pmatrix} \Delta I_{QF-Trim} \\ \Delta I_{DF-Trim} \end{pmatrix}$$



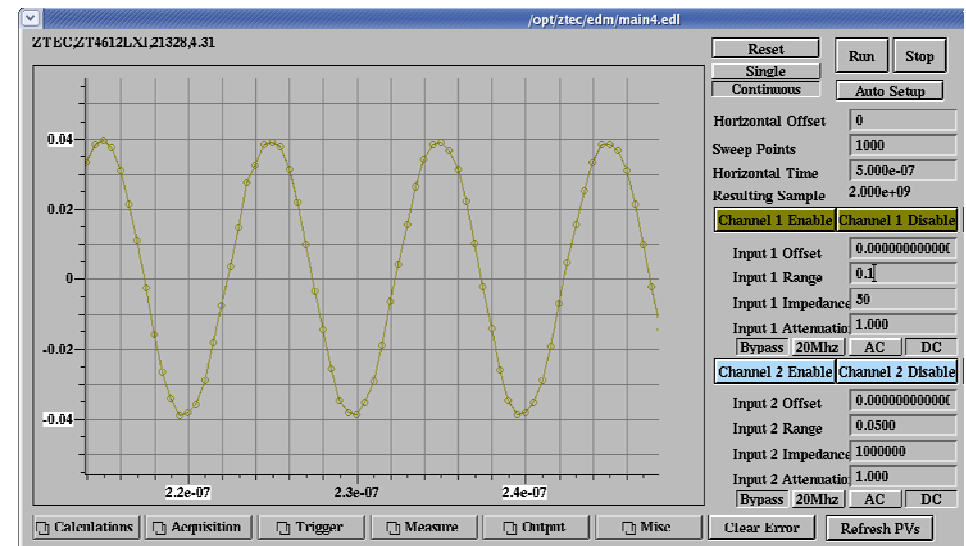


# EPICS CA Applications (4)



## EPICS Oscilloscope applications

### ZTEC EPICS Oscilloscope







# EPICS CA Applications (5)

Circular buffer



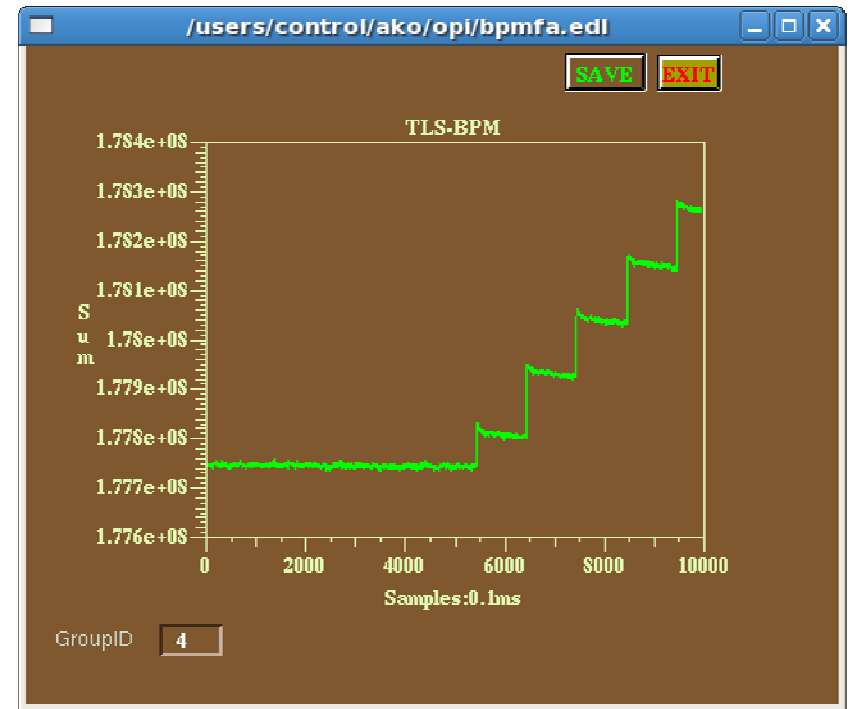
BPM fast data waveform capture system

- 10KHz sampling rate
- Circular buffer



snapshot

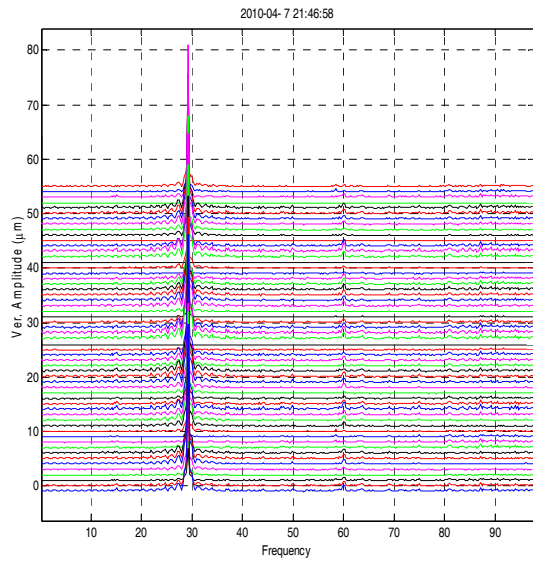
EPICS IOC



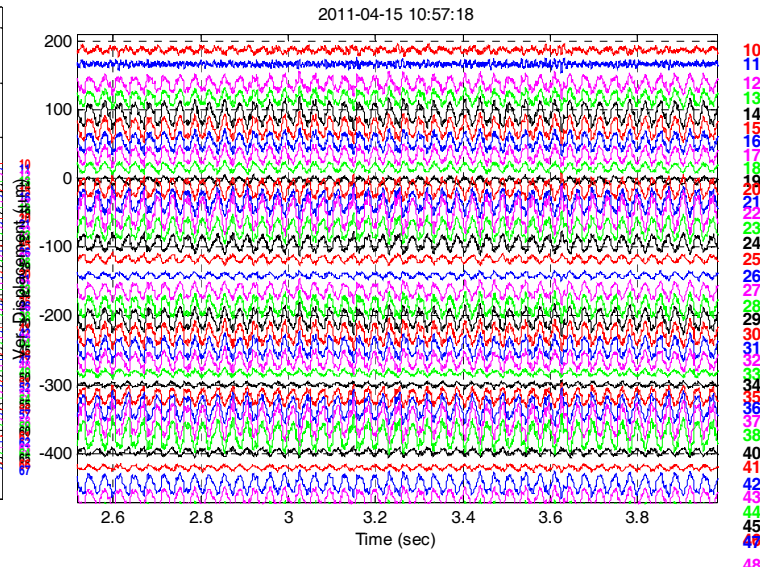


# EPICS CA Applications (5) Cont.

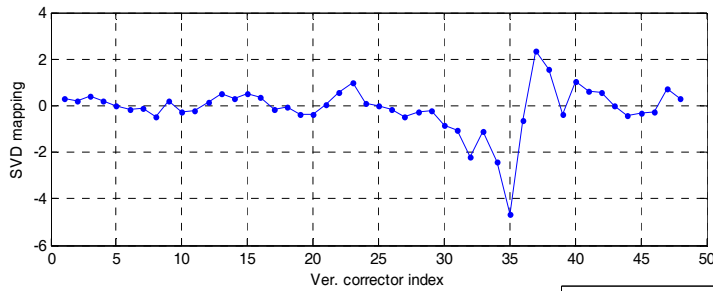
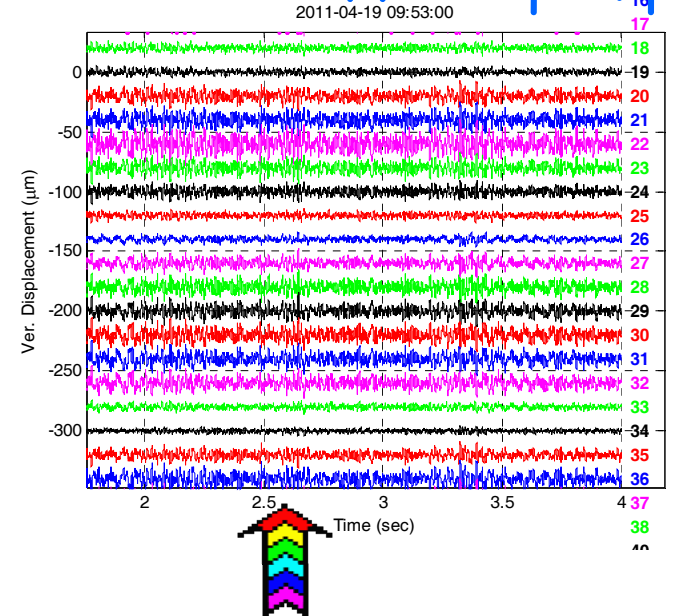
## BPM Spectrum



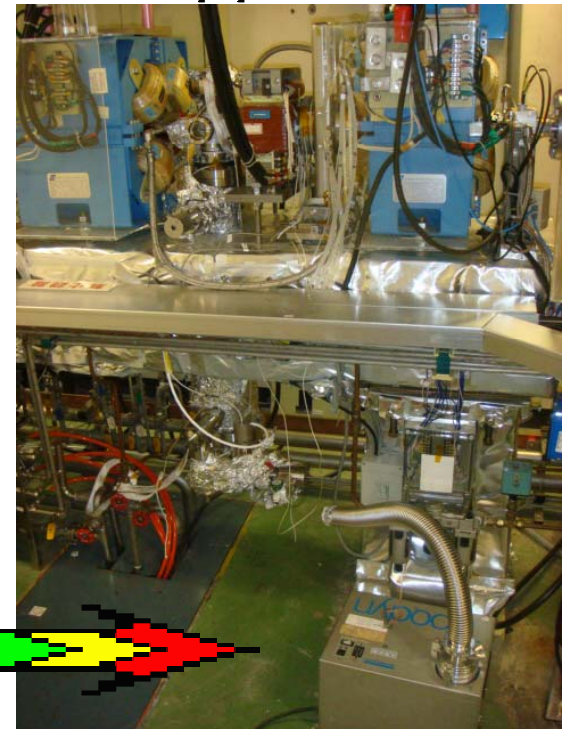
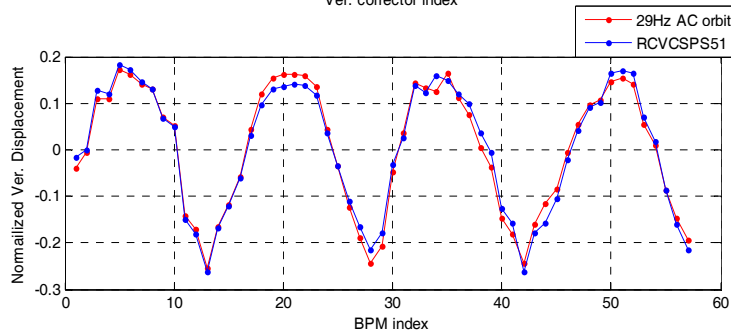
## BPM FA waveform



## Turn off ion pump

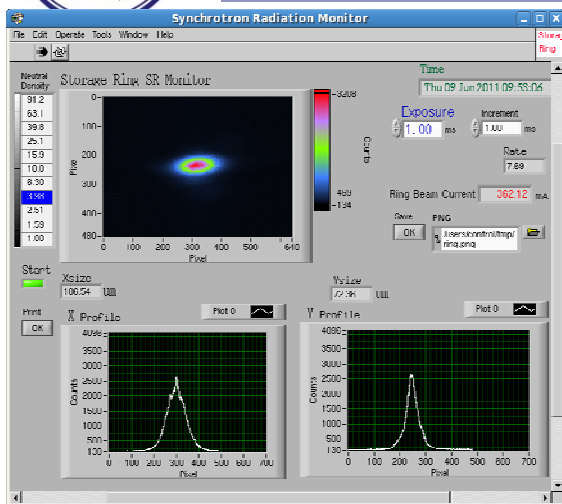


## Perturbation Source Analysis





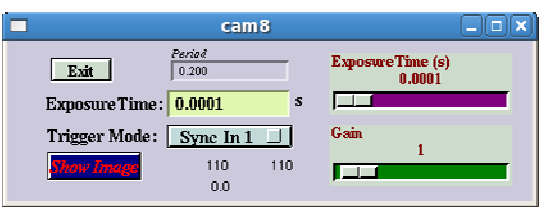
# EPICS CA Applications (6)



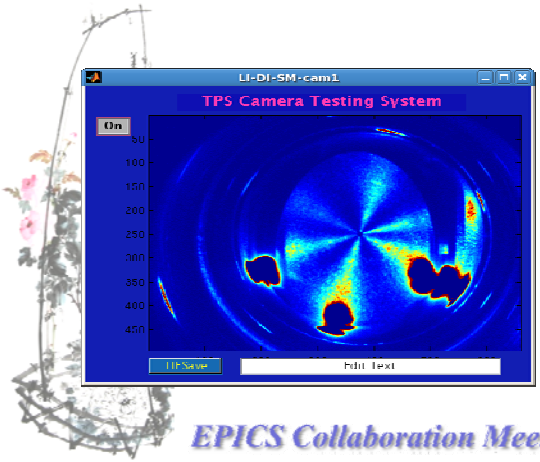
Firewire camera +DCAM protocol\*



Gigabit ethernet camera +areaDetector module for EPICS



- EDM: parameter control
- Matlab: image display(labCA)



\*Some firewire cameras don't support DACM<sub>27</sub>



# What is the TLS CS Next Step

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## Strategic for TLS maintenance

Maximize usage of the maintenance with limitation budget

=> better performance

=> take advantage of new technique developments

=> Reduce manpower requirement

=> Share same hardware and software as TPS project as possible

Keep existed system as possible

New development go to EPICS directly

Upgrade item go to EPICS directly after TPS

**Upgrade to new system with EPICS interface  
in the future→**

**Slowly,  
Step-by-step,  
No Pain,  
Seamless,  
Suitable budget**





# What is the TLS CS Next Step - cont.

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## ➤ Projects on-going :

EPICS embedded cPCI multi-channels 24 bits ADC for:

Booster synchrotron magnet current monitoring.

Storage ring dipole/quadrupole/sextupole magnet current monitoring.

## ➤ Problems need address:

GUI.

Archive functionality.

...

➤ **New EPICS system is still need to service original database in TLS before all system upgrade.**





# Summary

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- TLS control system is stable and reliable now.
- EPICS migrate must be going.
- Keep one control system to reduce developing man power.
- TLS control system supports good exercise and training chance for EPICS in TPS.
- The large amount migration after TPS project in the TLS.



Stand here,  
Which top is top?

Stand here,  
Top is still top

Begin:  
Top,  
there

"Five finger mountain"  
neighbor of nsrrc

風巖

風巖

風巖

驗驗

鬪銅

風巖

風巖

風巖

# Thank Your for Your Attention!

Thanks for some efforts  
from instrument and  
control group colleagues.  
For specially,  
kuotung,  
peichen,  
yungsen  
youngko  
.....

Another control three layer:  
In the beginning: *Look at mountain is mountain*  
After some effort: *Look at mountain isn't mountain*  
Final: *Look at mountain is still mountain*