Embedding a TANGO device into a digital BPM

- Global Orbit Feedback
- Digital BPM
- porting of TANGO to ARM processor
- results with the embedded device

Global Orbit Feedback

- goal: equip Elettra storage ring with a fast digital feedback system to improve orbit stability
- requirements:
  - 10 kHz sampling rate
  - sub-micron resolution
  - dump disturbances up to 150 Hz
  - suppress mains disturbances up to 300 Hz

Digital BPM

- analogue BPM electronics replaced by state-of-art digital one:

Instrumentation Technologies “Libera Electron”

Digital BPM

- meet resolution requirements
- digital processing done in FPGA
- beam position data available at 3 different rates:
  - turn-by-turn (single shot buffer reading)
  - 10 Hz
  - 10 kHz

Digital BPM

Libera is equipped with single board computer:

- Intel Xscale XA255 ARM processor
- Linux operating system
- Ethernet interface

- Device management
- Extraction of “slow” data (single-shot and 10 Hz)

TANGO device for Libera

- First developed at Soleil.
- Based on:

  Instrumentation Technologies CSPI library

- Runs on external host
- CSPI library extracts data via TCP/IP socket and multicast over UDP

TANGO device for Libera

- network bandwidth is wasted
- “intermediate server” just for Tango device:

  deployment and troubleshooting more difficult
- full source code available for Tango
- full source code available for omniORB, CORBA library used by TANGO (C++ version)

➔ *develop embedded version of the TANGO device*

porting omniORB to ARM

main difficulties to overcome due to:

- building with a cross-compiler
  - the first stage of compilation builds the IDL compiler
  - the second stage uses the IDL compiler to generate stubs and skeleton classes
  - the third stage compiles core, stubs and skeleton classes

porting omniORB to ARM

IDL sources

CORBA services

i386 binary

ARM binary

C++ source

IDL source

arm-gcc

IDL

CORBA stubs

CORBA core

arm-gcc

omni ORB

omniORB building process

porting omniORB to ARM

IDL sources

CORBA services

i386 binary

ARM binary

C++ source

IDL source

arm-gcc

IDL

CORBA stubs

CORBA core

arm-gcc

omni ORB

omniORB building process

porting omniORB to ARM

IDL
sources

CORBA
service
s

i386 binary

ARM binary

C++ source

IDL source

arm-
gcc

IDL

CORBA
stubs

CORBA
core

arm-
gcc

omni
ORB

copy IDL binaries from “native”
build tree

omniORB building process

porting omniORB to ARM

main difficulties to overcome due to:

- mixed “endianess” of ARM
  - ARM is little-endian (like i386)
  - “double” data on ARM is big-endian !
  - this “weird” case not handled by omniORB:

    result: mangled numbers when exchanging data between different platforms

porting omniORB to ARM

- endianess problem solved by patching omniORB core:

Thanks to Duncan Grisby!

- last manual intervention: patch by hand (using ar) one of the omniORB library objects to overcome some deficiencies of the arm-ld linker

porting TANGO to ARM

- extra step: regenerate CORBA stubs and skeletons with patched omniORB for handling doubles correctly
- followed standard build procedure with minor Makefile adaptations
- TANGO executables must be linked as fully static executables (problem under investigation)

embedded TANGO Device

- Compilation of the Soleil designed TANGO Device for Libera for the ARM single board computer done in a very short time
- Uses the “embedded” version of the CSPI library and the newly compiled TANGO and omniORB libraries
- We had to adjust some thread management code to cope with differences of the environment and CSPI behaviour

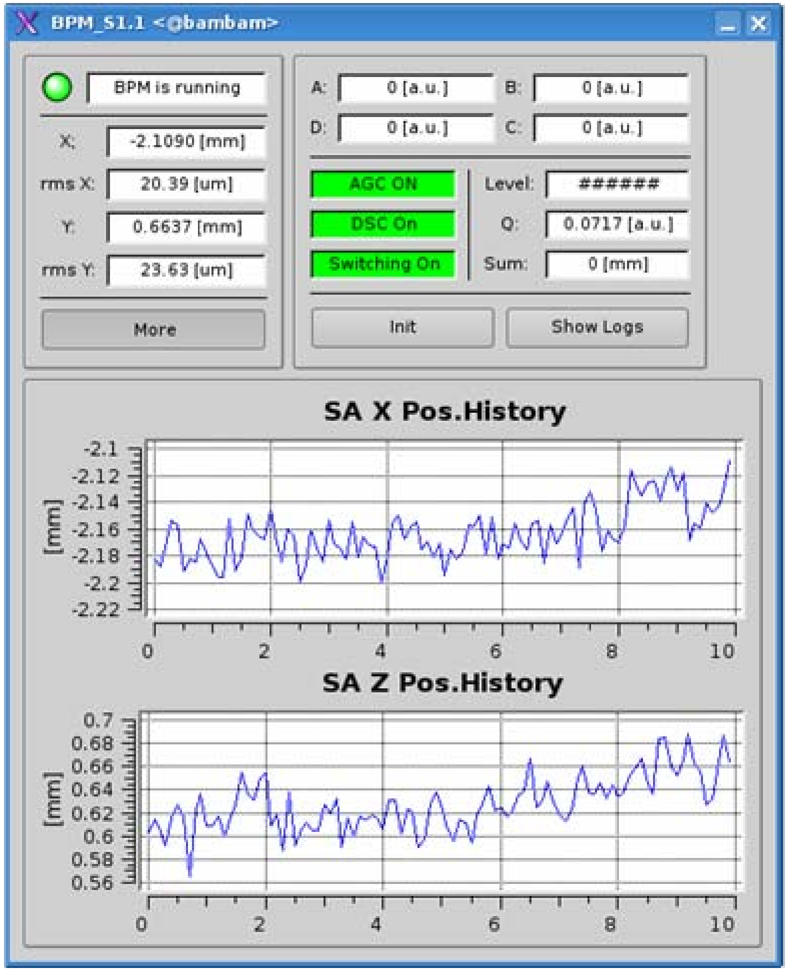
embedded TANGO device

- no problems or bugs due to TANGO or omniORB
- deployed on tens of devices at Soleil and Elettra (96)
- easier mangement
- dramatic cut of network bandwidth

performances

- performances are limited only by the TCP/IP stack of the Libera single board computer
- 8 ms for reading a single BPM position
- less than 50 ms for reading the whole orbit on both planes (182 positions)

we can exploit all TANGO tools



BPM_S1.1 <@bambam>

● BPM is running

X:	-2.1090 [mm]
rms X:	20.39 [um]
Y:	0.6637 [mm]
rms Y:	23.63 [um]

More

A:	0 [a.u.]	B:	0 [a.u.]
D:	0 [a.u.]	C:	0 [a.u.]

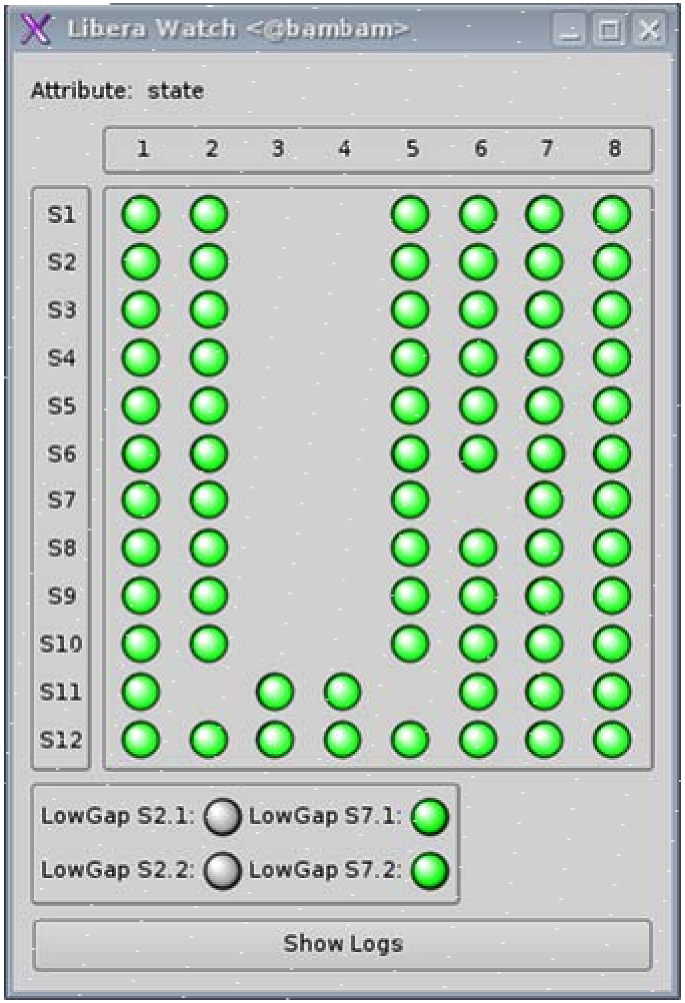
AGC ON	Level:	######
DSC On	Q:	0.0717 [a.u.]
Switching On	Sum:	0 [mm]

Init

Show Logs

SA X Pos.History

SA Z Pos.History



Libera Watch <@bambam>

Attribute: state

	1	2	3	4	5	6	7	8
S1	●	●			●	●	●	●
S2	●	●			●	●	●	●
S3	●	●			●	●	●	●
S4	●	●			●	●	●	●
S5	●	●			●	●	●	●
S6	●	●			●	●	●	●
S7	●	●			●		●	●
S8	●	●			●	●	●	●
S9	●	●			●	●	●	●
S10	●	●			●	●	●	●
S11	●		●	●		●	●	●
S12	●	●	●	●	●	●	●	●

LowGap S2.1: ○ LowGap S7.1: ●

LowGap S2.2: ○ LowGap S7.2: ●

Show Logs

TANGO on ARM...

As a by-product of the BPM project we now have TANGO for ARM:
http://www.elettra.trieste.it/~tango/downloads.html

Lots of gadgets are ready for learning to dance!