About the speaker

- **ID card:**
  - Name: Vicente Rey Bakaikoa
  - Born in: Pamplona / Spain
  - Living in: Grenoble since 1990

- Working in beamline control since 1992

- Heading BLISS group for the last two years
Outline

- Computing at ESRF beamlines
  - BLISS assignment and organization
  - Methods: software development / packaging and delivery

- Beamline control
  - Three layered control system
  - Taco/Tango
  - Experiments and sequences
  - Graphics / Data visualization / Analysis

- Experiments
  - Performance
  - Electronics developments
  - Detectors

- Automation
  - Optics
  - Experiment

- What next?
### ESRF / Computing

#### TBS / Experiments Division

<table>
<thead>
<tr>
<th>Department</th>
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<tr>
<td>BLISS / Software development and support</td>
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<td>C.E. / Electronics development and support</td>
<td>10</td>
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<tr>
<td>SciSoft / Scientific Software</td>
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#### Computing Services

<table>
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<td>System Admin and Networks</td>
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<tr>
<td>Software Engineering Group</td>
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<tr>
<td>Management Information System</td>
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</table>
BLISS

- Beamline Instrument Software Support

- Giving service to ALL ESRF beamlines including CRG’s

- 1 engineer time (rough approx.)
  - 2 Beamlines + specialist work
  - 50% development / 50% support

- Standby service
  - All days from 7am to 11pm
BLISS developments

● Scope:
  ▪ From low-level drivers to data analysis / visualization as far as concerns the successful running of the experiments

● Four development areas:
  ▪ Hardware support software
  ▪ Graphical interfaces
  ▪ Automation projects
  ▪ Infrastructure software

● Method:
  ▪ eXtreme programming inspired
BLISS / Support

- Beamline instrumentation projects:
  - Participate to beamline instrumentation projects
  - Small software developments
  - Experiment macros
  - Beamline specific GUI

- Software consulting / auditing

- Contact person for all computing issues

- Beamline support: installation and problem resolution
BLISS software distribution

- Some numbers:
  - 673 different software packages (do not include beamline specific software)
  - 40 beamlines

- Policy:
  - Guarantee software evolution
  - No automatic spreading of software

- Blissinstaller/blissbuilder based on RPM
  - Package generation / installation
  - Handle versioning / dependencies / platform compatibility

- Centralized database of software installations at beamlines
  - web interface for application history, beamline search, latest changes…
Blissinstaller

![Bliss Installer UI]

Installed Packages
- Control
  - bliss_control
  - Driver
  - HWR
  - Spec
    - Core
    - CPLLOT
    - SPEC

Available Packages
- Name
  - Remote Server:
    - Admin
    - Applications
    - Beamlines
    - Control
      - bliss_control
      - Driver
      - Drivers

Package information (click on the package number to show)
- Project name: SPEC
- Project Description: ESRF local SPEC Distribution

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Beamline Control System...
Software structure

USER
- GUI
- WEB app

SERVICES
- SPEC
- Auto. Seq.
- Analysis
- DB. Server

DEVICES
- Motors
- Video
- Detectors
- Drivers...
Electronics and computers

- Front-end computers
  - VME (os9) on Motorola 680x0
  - Linux and PCI / cPCI
  - PCI to VME and cPCI integration with bus extender cards

- Console
  - Solaris / Linux

- Electronics
  - Motors:
    - VPAP (soon Icepap)
    - but also Galil, Micos, PI, Newport, Newfocus…
  - Counter/Timer:
    - VCT6 and P201
    - but also Lecroy / Ortec…
  - I/O
    - ICV712 / ICV150 / ICV196
    - Wago
  - Serial line / GPIB
    - VME now PCI
  - …

- Detectors
  - Canberra MCA / XIA / Oxford
  - CCD and image plates (all flavours)
TACO

- Inter-process communication via **SUN RPC**

- Clients and servers exists in OS9, UNIX (HP-UX, Solaris, Linux), Windows… only C

- **Tools** include HDB, configuration tools

- **Developed at ESRF.** Used also in FRM-II neutron source (Garching-Munich) and Hartebeesthoek Radio Astronomy Observatory (South Africa).
Tango

- Inter-process communication using Corba
- Client and server API in C++, Java and Python
- Compatible with Taco
- Features include:
  - graphical development tools, event notification, automatic polling thread for each device, graphical java toolkit, remote administration of servers and configuration...
- Developed as a collaboration between ESRF, Elettra, Soleil and Alba
SPEC

- **Commercial** Program by Certified Scientific Software (CSS).
  - ESRF holds a source license.
  - Used at ALL ESRF beamlines (including CRG’s). Distributed with our tools.

- **Sequencer and experiment application**
  - Diffractometer geometries included
  - Accumulated knowledge on synchrotron experiments
  - Hundreds of devices supported

- **Evolution** (often triggered by BLISS)
  - Support added for Taco, Tango (and EPICS)
  - Support for 2D detectors and arrays
  - GUI on spec: Integration evolution (pipes then full server mode)
  - Macro and pseudo device support

- **But…**
  - Basic command line interface and programming features
  - Not for surveying or polling devices
BLISS graphical framework

- Python / Qt
- Components
  - Hardware repository / hardware object classes
  - Graphical Bricks
  - Application editor

- Hardware objects classes exists to communicate with SPEC (through spec server features) and TACO/TANGO servers… but anything can fit
A beamline GUI is made of “cemented” bricks

- bricks ensure a standard *look & feel*
- bricks improve reliability

GUI Bricks communicate with Hardware Objects, thus creating a link between hardware (control software) and graphical elements
Framework at work
Data Visualization

- Online data visualization for scans, spectra and detector images.

- Communication transparent and overhead-free.

- Based on shared-memory segments

- Only basic analysis
Newplot / PyMca / PyDis
Experiments
Fast: standard counters: hook

- VCT6 Counter/Timer (Bus coupler)
- Count gate
- Int. time: 100 µs
- Data rate: 1.5 MB/s
- Flexmotion
- Hook kernel buffer
- Hook driver

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<td>2</td>
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</table>

- System call
- SPEC + Plot
- TACO call
MUSST / ICEPAP…

- Developed at ESRF

- MUSST
  - Fully programmable acquisition card with histogramming memory, counters, encoders and I/O channels
  - Used already for shutter synchronization and diagnostics at MX beamlines
  - Does also fast MCA acquisition

- ICEPAP
  - Under development
  - Features will include synchronization and diagnostics, software selection of motor for fast scanning, feedback through programmable embedded controller.
  - For example: motor feedback loop on the error signal from a BPM.
  - Price consideration
  - Compatible with existant cabling: preserving investment consideration

- Other cards: Opium (for signal handling), APD/ACE for avalanche photodiodes and energy discrimination, BPM developments

- Towards a framework for all continuous scans
ADSC Quantum 315r

- 6140 x 6140 – 16 bit:
  - 18 MB / image (bin. 2x2)
  - 75 MB / image (full frame)

- Current operation @ ID23:
  - 40 fr/min (bin. 2x2) ⇒ 12 MB/s
  - 20 fr/min (full frame) ⇒ 24 MB/s
  - Limit rate to central disk server: 60 MB/s

- But:
  - Images read for display & data analysis while writing
  - NFS ⇒ poor online display
  - High throughput!! 1800 images/day (full frame) ⇒ 130 GB
Fast 2D imaging / Frelon

FReLoN camera

spec> ~ Taco server

Linux driver

DMA

PyDis

Espia

Fiber optic
<table>
<thead>
<tr>
<th><strong>Frelon</strong></th>
<th><strong>ID19 (tomography)</strong></th>
<th><strong>ID24 (spectroscopy)</strong></th>
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<td>✓ 2048x1 - binning 32</td>
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<tr>
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<td>✓ 2 ms / image</td>
<td>✓ 2 ms / image</td>
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ID24 (spectroscopy)

- 2048x1 - binning 32
- 10000 spectra
- 40 MB
- Whole buffer
Medipix

- **Features:**
  - 256 x 256 – 14 bit pixel detector
  - 1000 fps ⇒ 130 MB/s

- **Connection & control:**
  - PRIAM (ISG/ESRF)
  - Espia

- **Configuration possibilities:**
  - 1280 x 256 @ 1000 fps ⇒ 650 MB/s
  - PCI Express (?)
Automation
Optics automation

- Hardware developments and beamline design essential to get right diagnostics
  - Wago, beam viewer lines, beam position monitors

- Based largely on simple spec scans with basic data analysis

- Based on beamline layout: get scientist knowledge into the software

- Sophisticated analysis (wavefront) developed for mirror focusing
Experiment automation: MX

- **Motivation**
  - High-throughput
  - Sample changers / diffractometers
  - Standardization at all MX beamlines

- **Includes**
  - Beam delivery
  - Sample mounting and handling
  - Data collection
  - Sample and experiment database
  - Data analysis

- **Results**
  - Faster and easier experiments when done manually
  - Pipeline mode for unattended experiments
  - 50 datasets collected in one single day
  - MXPress service

- **Now working on remote access**
MX collection Full sequence

Crystallisation Information

Sample transport via courier

Preparation
Beamline configuration, alignment, validation.

Mount Samples
Robotic sample changer.

Align Samples
Computer assisted alignment.

Initial Measurements
Indexing (strategy), XANES scan.

Collect Diffraction Data

Integrate/Reduce

Information feedback during data collection (solid line) and further back for sample screening (dashed line).
# ISPyB

![ISPyB Image]

## ISPyB Interface

### Shipment

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<tr>
<th>Name</th>
<th>Code</th>
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## Summary

- [Image Detail]
- [ISPyB Features]
- [User Guide]

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**V.Rey Bakaikoa**  
**APS / Beamline Controls Workshop**  
**May 4th 2006**
Data Collection / mxCuBE

- User / expert mode
- Sample mounting / centering
- Start alignment sequences
- Beam centering
- Collect / MAD experiments
- Connect with DB and DNA
- All MX beamlines equipped with same software
What next?

- Detectors
  - Ever faster (Dalsa, Sarnoff)
  - Flat panel and pixel detectors
- Nano-positioning / nano-focusing
- Automation
  - Remote access
  - Web services
- Further deployment of BLISS framework and Tango
- Beamline auditing
- Beamline configuration editor and associated database
And thanks for your attention