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TANGO Introduction

Distributed and Fun

PCaPAC 2014

Who am I?

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- Software Developer

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  in Karlsruhe
- Development and support for TANGO Servers and infrastructure @ ANKA

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ANKA

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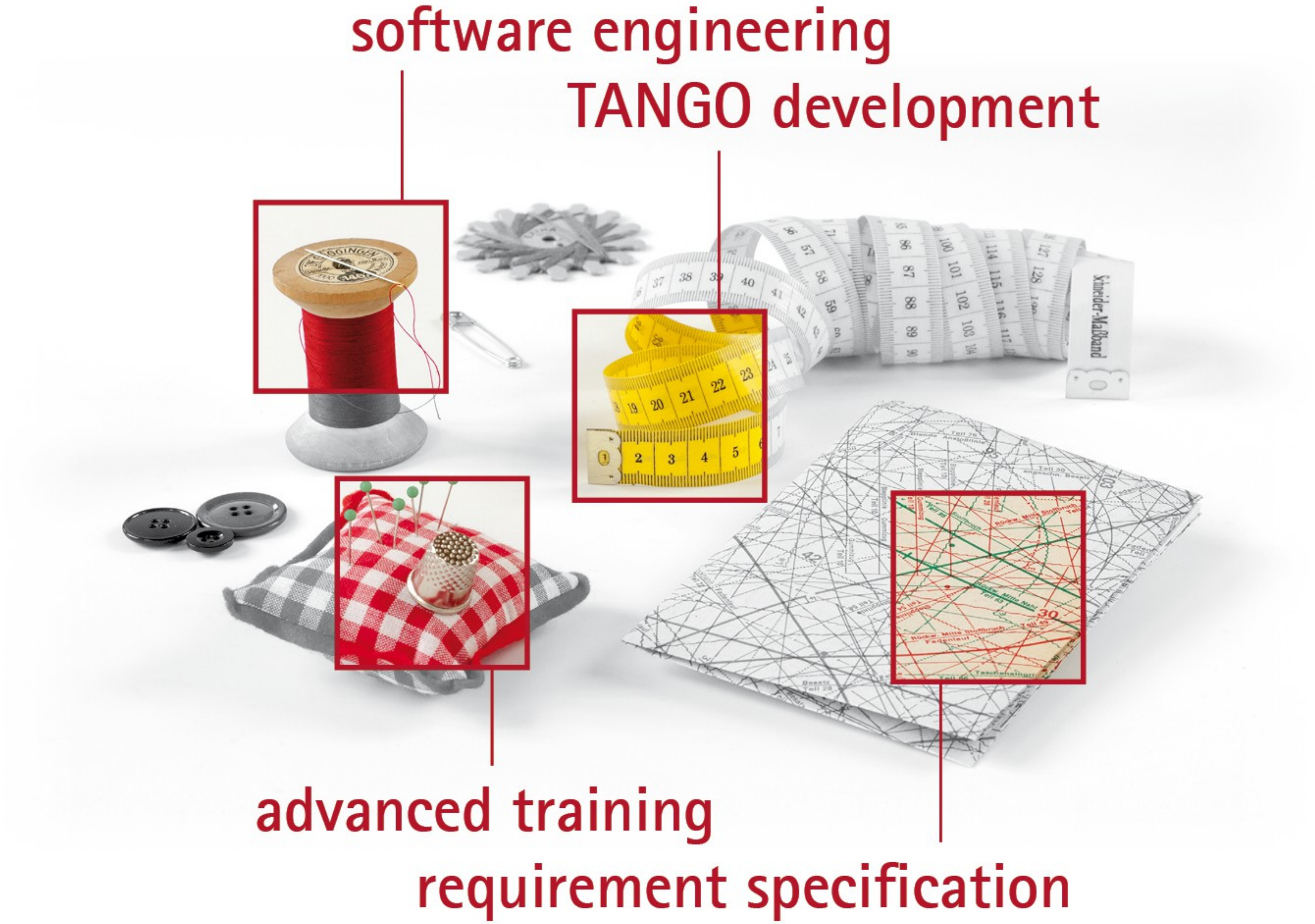


What is TANGO?

- Framework for a distributed control system
- Multi-Language (C++, Java, Python)
- Multi-Platform (Windows, Linux, Solaris etc.)
- Integration into many 3rd-party systems (Matlab, LabVIEW, IGOR Pro etc.)
- Unified interface to hardware devices and equipment

TANGO Collaboration

ESRF

SOLEIL SYNCHROTRON

Elettra Sincrotrone Trieste

ALBA

ANKA

SOLARIS NATIONAL SYNCHROTRON RADIATION CENTRE

eli attosecond

eli beamlines

DESY

MAX IV

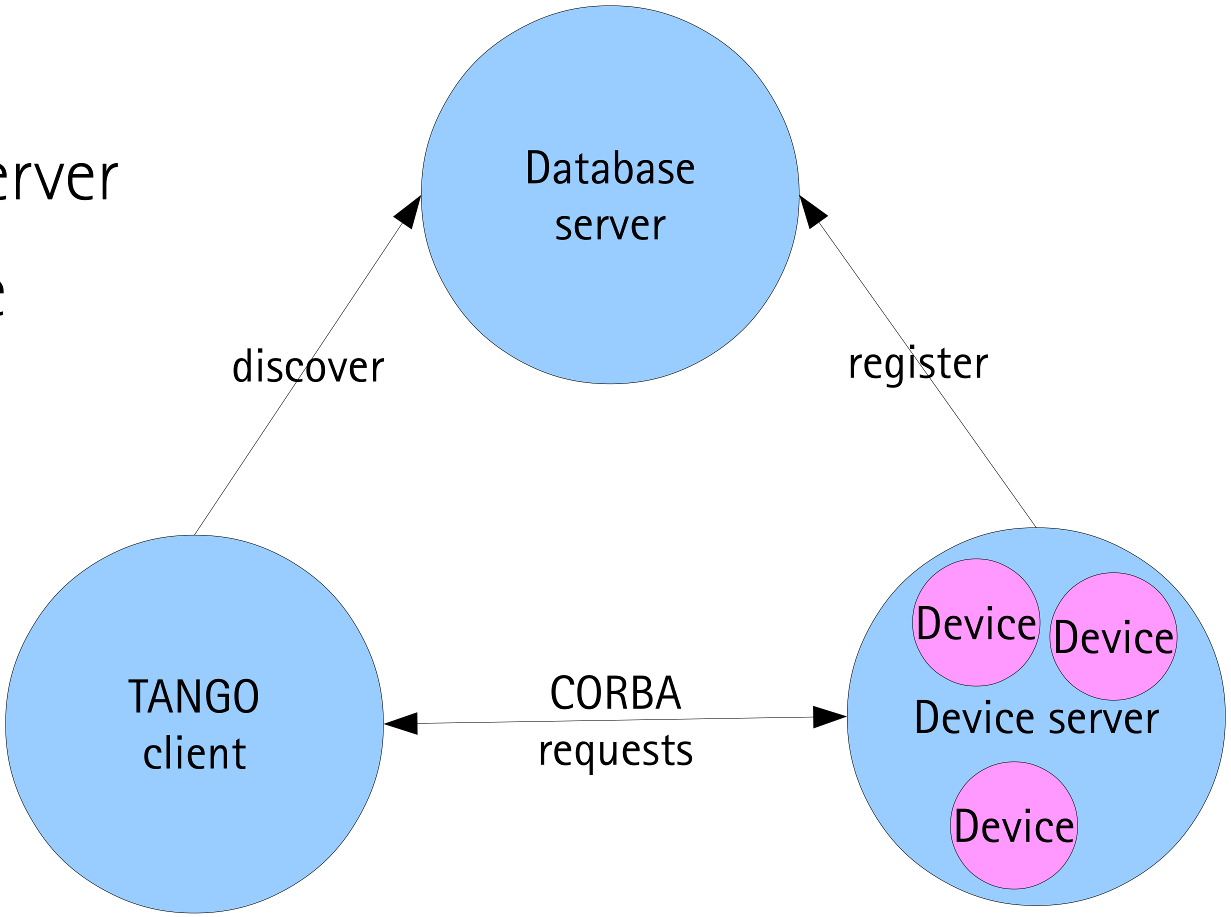
Forschungs-Neutronenquelle Heinz Maier-Leibnitz (FRM II)

How TANGO Collaboration works

- Two collaboration meetings per year
- One TANGO coordinator per site
- A mailing list (tango@esrf.fr)
- Project Web Site http://www.tango-controls.org
- Open Source Software (OSS) hosted on SourceForge
  - Change requests
  - Patches
  - Bugreports

TANGO concepts

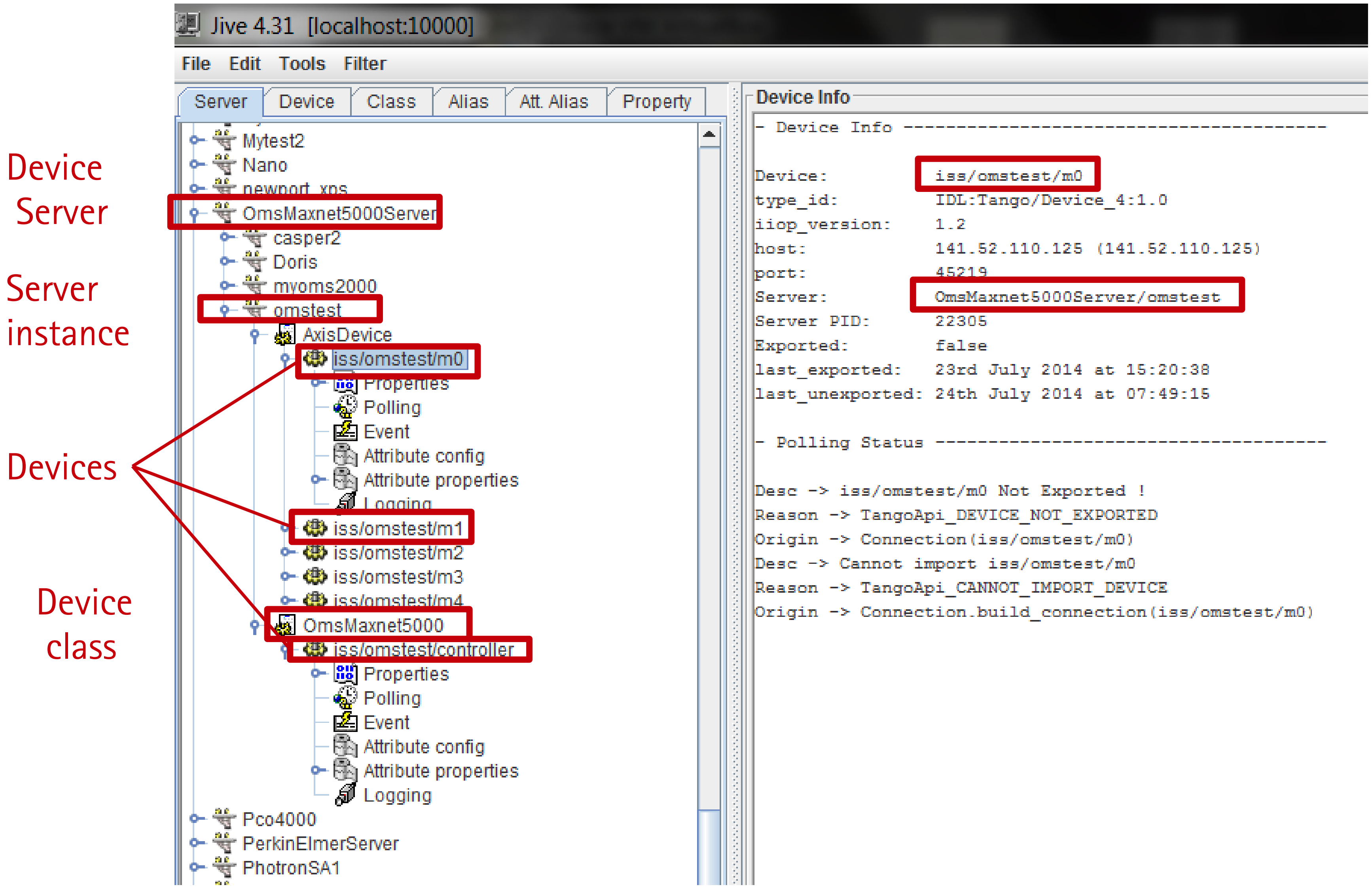
- Three major building blocks
  - TANGO device
  - TANGO device server
  - TANGO database
- TANGO client API



TANGO database

- Database server is a TANGO server with a device itself
- MySQL-backend for storing configuration
  - Register device servers and devices
  - Remember device properties
  - Memorize device attributes (optional)
- Communicate device end points (IOR) for p2p-communication

TANGO database via Jive

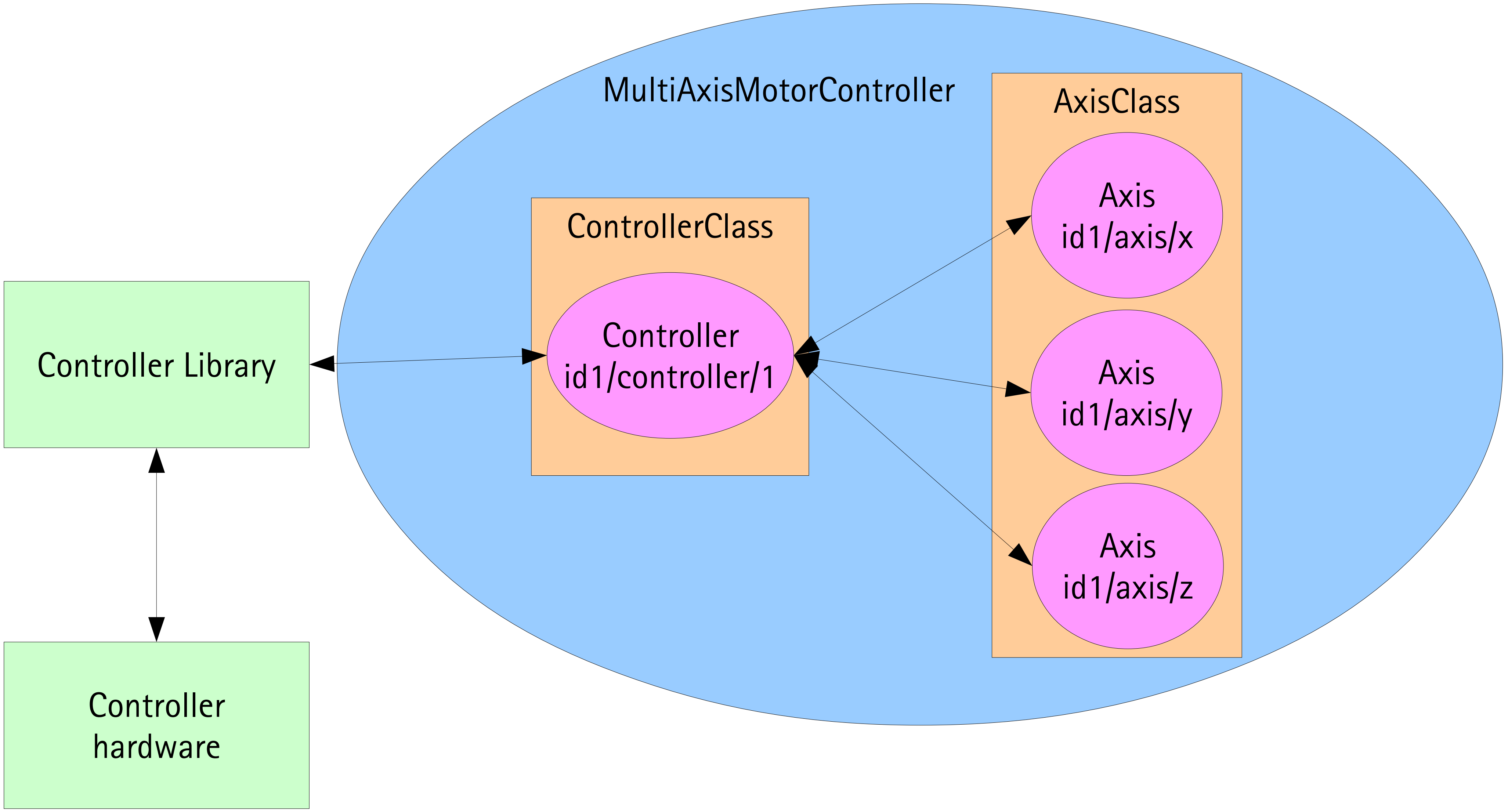


```
- Device Info ----------------------------------------

Device:          iss/omstest/m0
type_id:         IDL:Tango/Device_4:1.0
iiop_version:    1.2
host:            141.52.110.125 (141.52.110.125)
port:            45219
Server:          OmsMaxnet5000Server/omstest
Server PID:      22305
Exported:        false
last_exported:   23rd July 2014 at 15:20:38
last_unexported: 24th July 2014 at 07:49:15

- Polling Status -------------------------------------

Desc -> iss/omstest/m0 Not Exported !
Reason -> TangoApi_DEVICE_NOT_EXPORTED
Origin -> Connection(iss/omstest/m0)
Desc -> Cannot import iss/omstest/m0
Reason -> TangoApi_CANNOT_IMPORT_DEVICE
Origin -> Connection.build_connection(iss/omstest/m0)
```

TANGO device server

- Runnable piece of software containing TANGO devices
  - Device classes are defined in the code
  - Device instances are defined in the TANGO database
- Server instances are registered at the TANGO database
  - Identified by executable name + instance name
- Creates devices specified in database on startup
- Can be written in C++, Java or Python

Typical Device Server



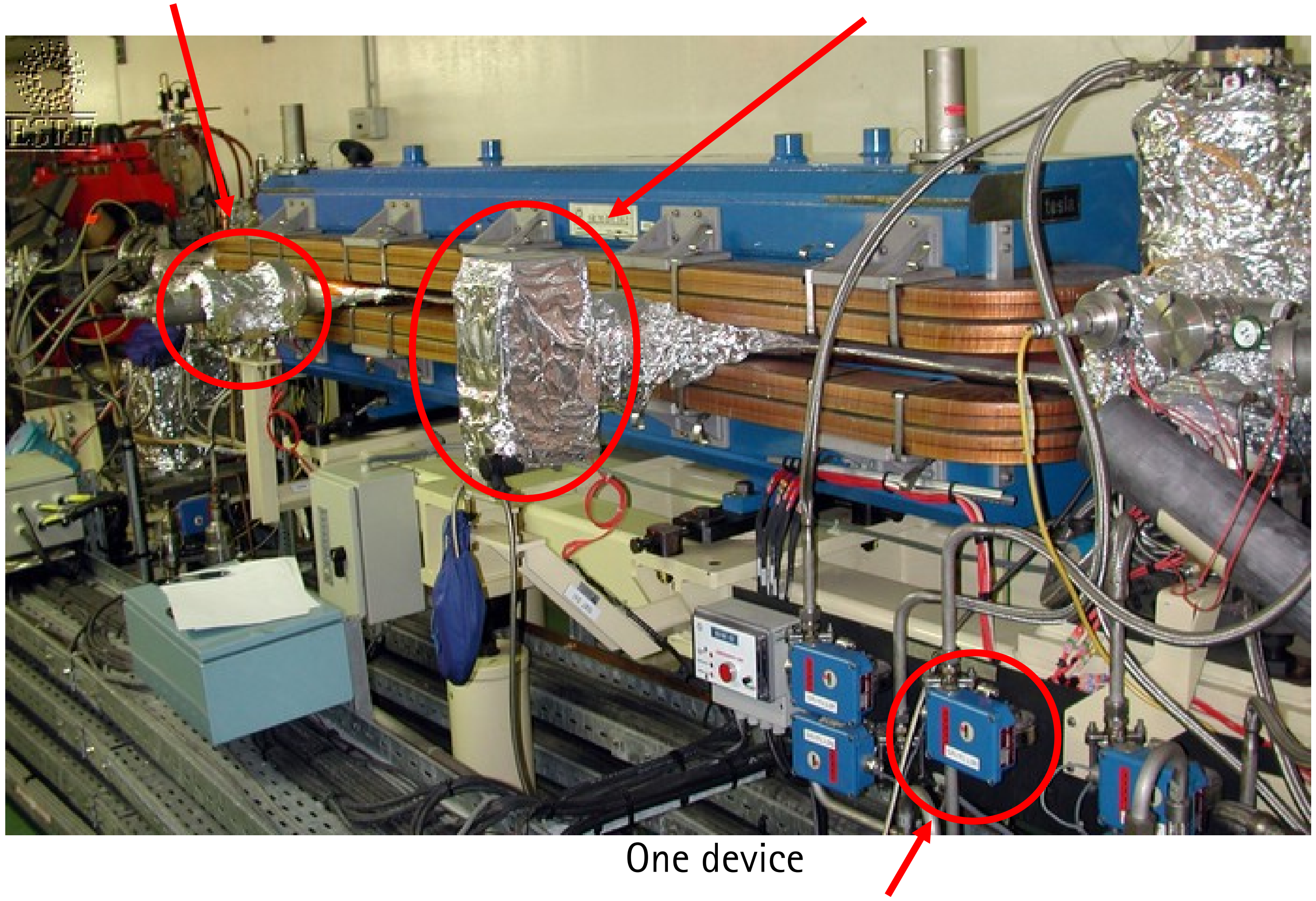
TANGO device

- Fundamental element of interaction
- Interface to existing hardware or logical devices
- Identified by a three field name „domain/family/member“
- Every device belongs to a TANGO class
- Configured by device properties
- Exposes attributes and commands

Real world devices

One device

One device



One device

A closer look at TANGO devices

- **Commands**: perform an action on a device
- **Attributes**: represent physical values
- **Properties**: configuration used at initialisation
  - e.g. IP adress, default shutter time
- **State and Status**: indicators for current device state

TANGO Device via POGO

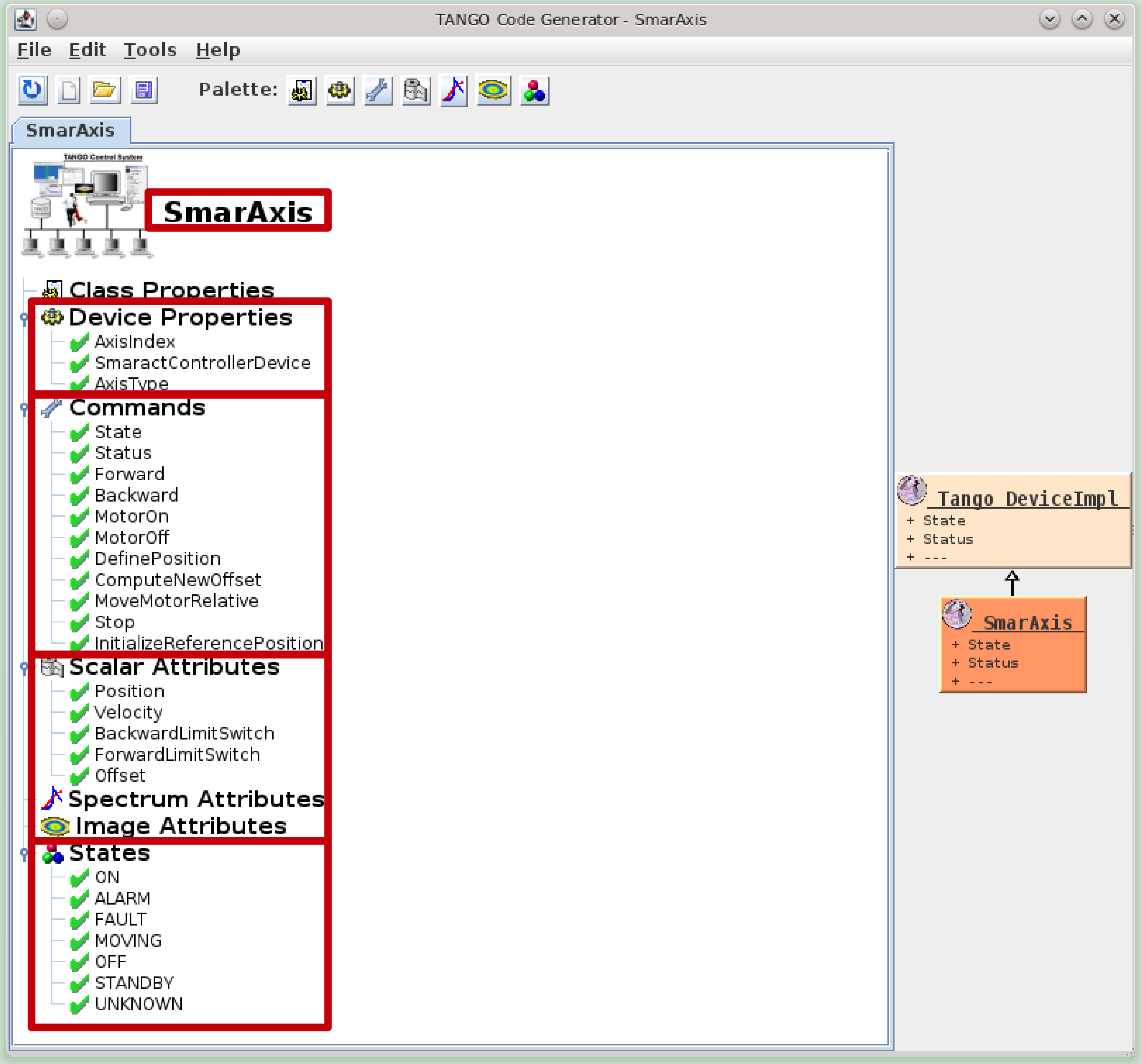
Device class

Device propterties

Commands

Attributes

Device states



SmarAxis

- Class Properties
- Device Properties
  - AxisIndex
  - SmaractControllerDevice
  - AxisType
- Commands
  - State
  - Status
  - Forward
  - Backward
  - MotorOn
  - MotorOff
  - DefinePosition
  - ComputeNewOffset
  - MoveMotorRelative
  - Stop
  - InitializeReferencePosition
- Scalar Attributes
  - Position
  - Velocity
  - BackwardLimitSwitch
  - ForwardLimitSwitch
  - Offset
- Spectrum Attributes
- Image Attributes
- States
  - ON
  - ALARM
  - FAULT
  - MOVING
  - OFF
  - STANDBY
  - UNKNOWN

Commands

- May have one input parameter and a return value
  - Only limited set of data types
  - But also arrays
- For example: PowerOn(), Stop(axisNumber), StopAll()

Attributes

- Self-describing data via attribute properties
  - e.g Description, Unit, data_type, min/max, alarm values
- May be read-only, write-only or read-write
- All typical primitive data types like boolean, integer, double, string etc.
- Three data formats
  - Scalar (one value)
  - Spectrum (one-dimensional array)
  - Image (two-dimensional array)

Properties

- Properties are stored in the TANGO database
- Manage using the tool Jive
- Can be defined at class, device and attribute level
- Basic data types as scalar or array values

State

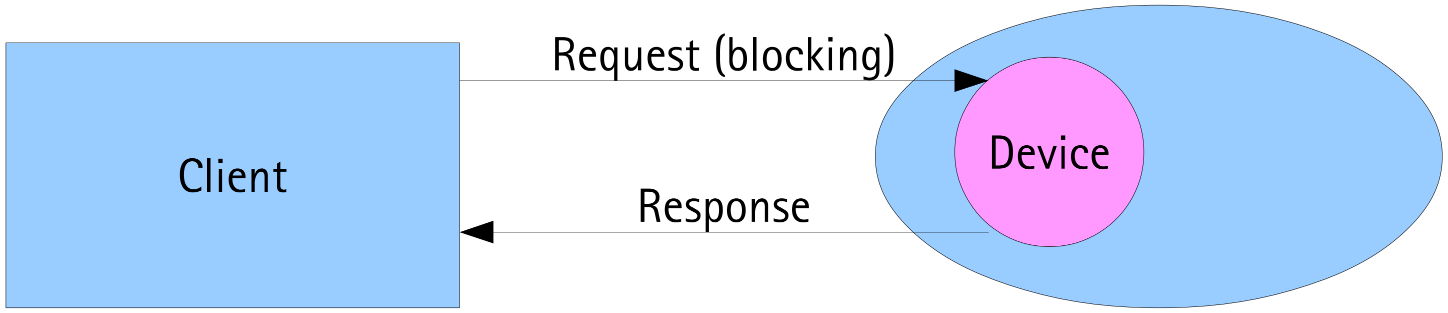
- State management is essential so clients can rely on it
- 14 defined states are available
  - e.g ON, OPEN, MOVING, FAULT, ALARM etc.
- Explanatory message available as Status attribute/command
- Support through „state machine“ and „allowed states“

TANGO clients

- Can be written in C++, Java, Python
- Implementations for many tools exist
  - e.g. Matlab, LabView, IgorPro, concert
- Different communication mechanisms
  - Synchronous calls
  - Asynchronous calls
  - Events
  - Group Calls

Synchronous Calls

- Network transparency etc. using DeviceProxy
- Easy to use calls like command_inout(), read_attribute()
- Result objects can contain data and metadata
- Exceptions are of type DevFailed



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Asynchronous Calls

- Non-blocking request to a device
- Device notifies clients via callback
- No changes on the server side required
- Supported for
  - command_inout
  - read_attribute(s)
  - write_attribute(s)

Events

- Different communication paradigm
  - No polling from the clients
  - Devices notify clients about „interesting“ changes
  - Only available for attributes
- Clients need to subscribe to events and are notified using callbacks
- Different types like Periodic, Change, Data ready etc.

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TANGO tools

- Jive
  - Database management
- POGO
  - Device generation
- Astor
  - Device server control
- AtkPanel
  - Ad-hoc device gui

Questions?

- Thank you for your attention!
- Feel free to ask questions

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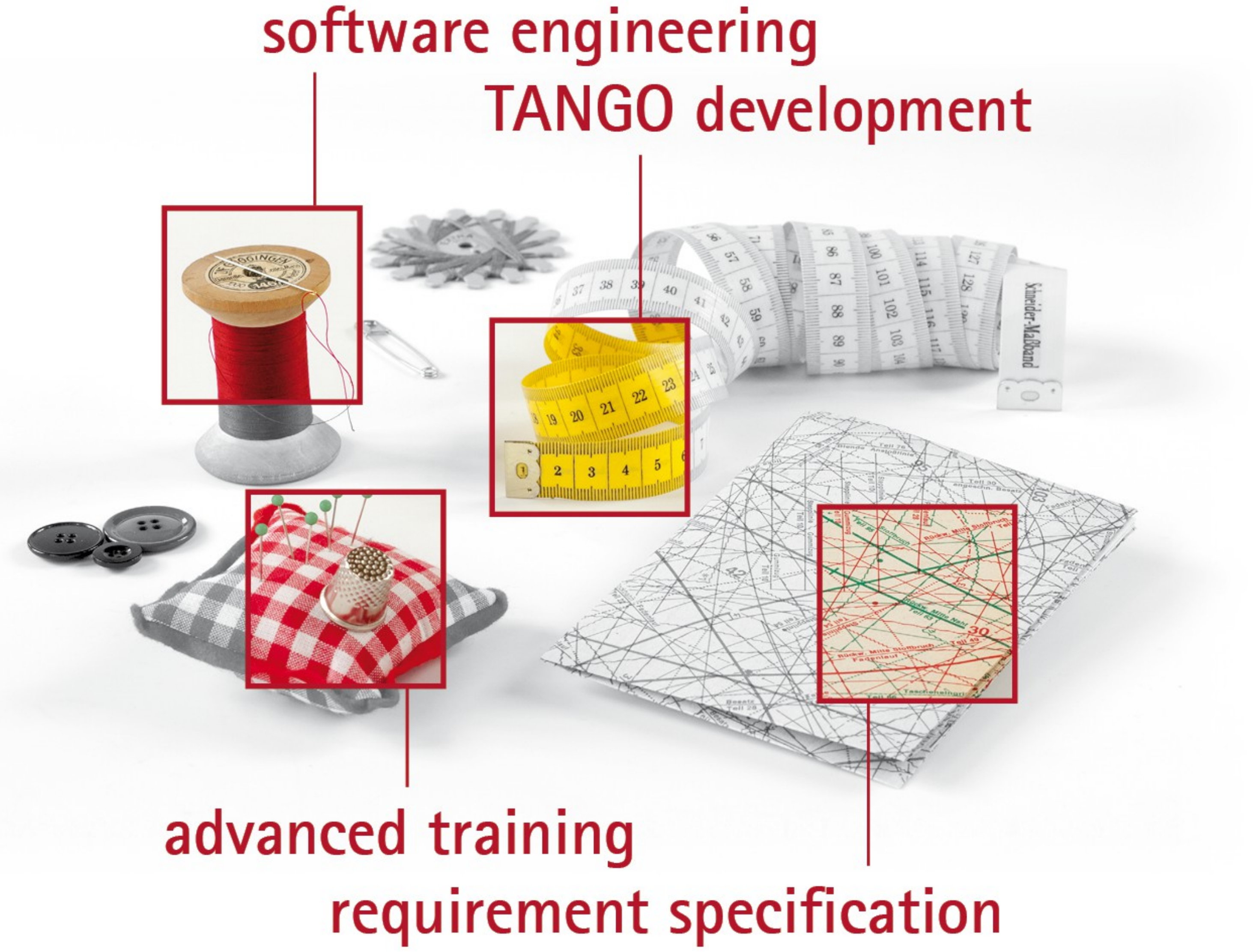

APIs and Frameworks

- JTango for Java
- PyTango for Python
- GUI-Toolkits
  - ATK for Java/Swing
  - Taurus for Python/Qt4
  - Qtango for C++/Qt4
- Jddd
- Sardana