

**ELI-ALPS Research Institute**  
TOWARDS THE SHARP END OF ATTOSCIENCE



# Configuration Management for the Integrated Control System Software of ELI-ALPS

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European Union  
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- Introduction
  - ELI-ALPS
  - Research areas
  - Research technology
- Control system configuration
  - Background
  - Requirements
  - Implementation
  - Toolkit
- Conclusions





# ELI-ALPS

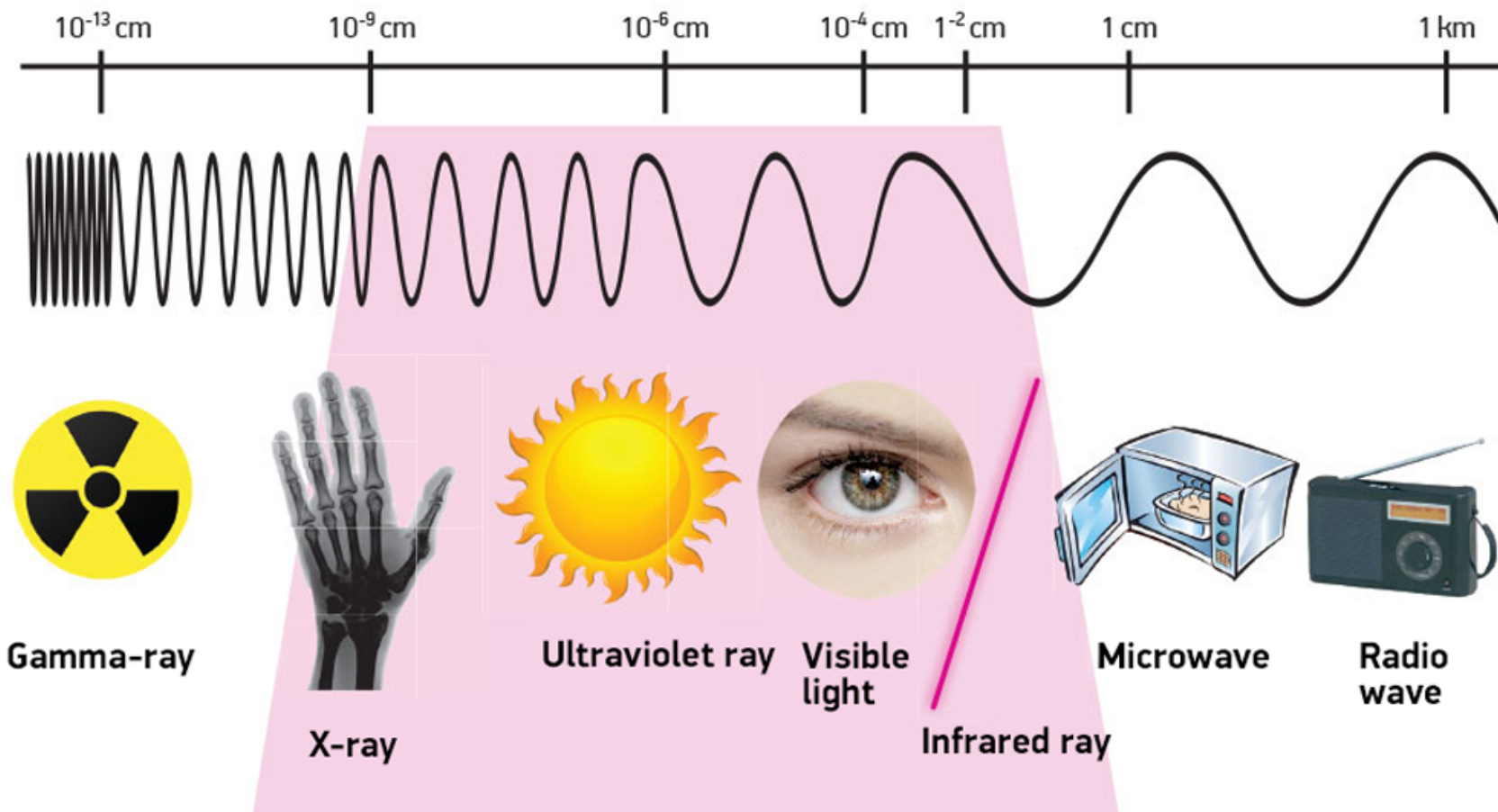




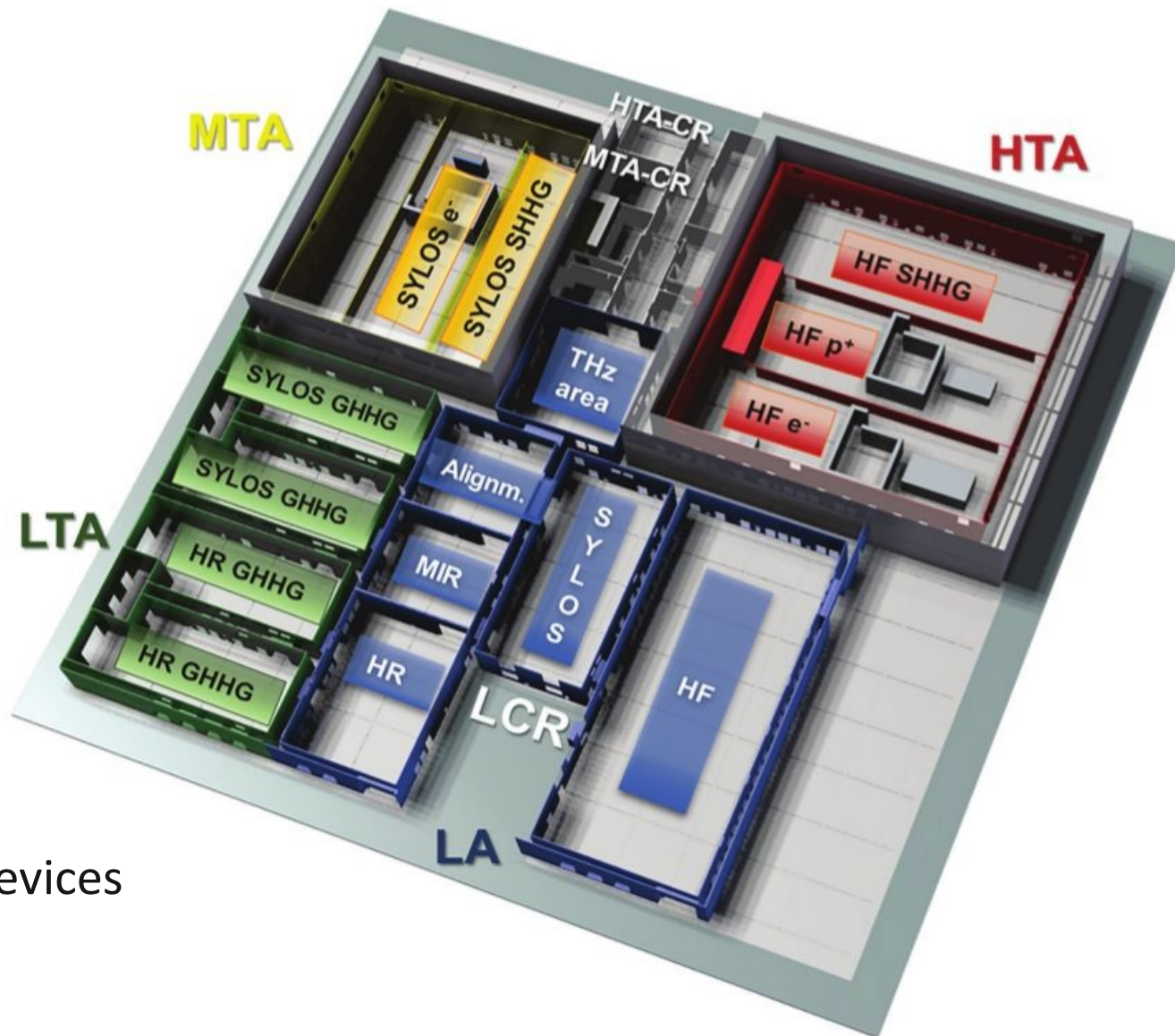
## ELI-ALPS

## Extreme Light Infrastructure – Attosecond Light Pulse Source

- Valence and core electron science
- 4D imaging
- Relativistic interactions
- Biological, medical applications



- Building infrastructure
- Laser systems
  - Primary laser sources
  - Beam transport
  - Secondary sources
  - End-stations
- Equipment
  - Vacuum devices
  - Optical configuration and alignment
  - Cameras, other detectors
- Control system is built on top of low level devices



## Background

- Some form of configuration is present in all control systems
- Contains one or more of:
  - Equipment (IT infrastructure, hardware devices)
  - Control system elements (drivers, logical devices, GUI components, ...)
  - Virtualization information (in case real equipment is unavailable)
- Supports various tasks during the control system lifecycle

## Lifespan of data used by the control system (NOT experimental data)

- **Transient:** runtime data, in memory
- **Persistent:** data saved to secondary storage for later use (survives restarts)
- **Permanent:** static data – tied to a particular version of the control system

## Content related

- Modeling physical reality
  - Space subdivision, locations
  - Hardware for executing the control system
  - Hardware to be controlled by the control system
- Control system software structure
  - High level software
  - Virtualization elements
- Connections between the above

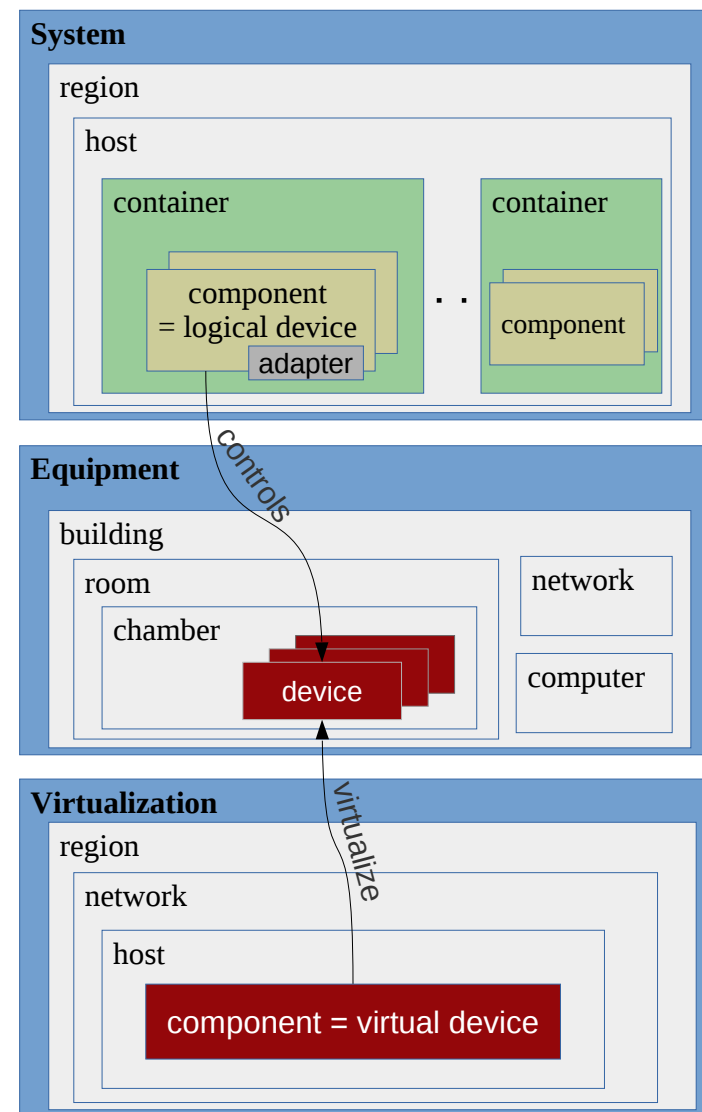
## Usage/process related

- Identifiers (unique, comprehensive)
- Data extraction: convenient API
- Integrity/consistency checking
- Storage in text based, human readable format
  - Support for version control
  - Manual editing
- Custom graphical editor



## Mapping content related requirements

- Physical reality
  - Space subdivision, locations
  - Hardware for executing the control system
  - Hardware to be controlled
- Control system structure
  - High level software
  - Virtualization elements
- Representation of connections

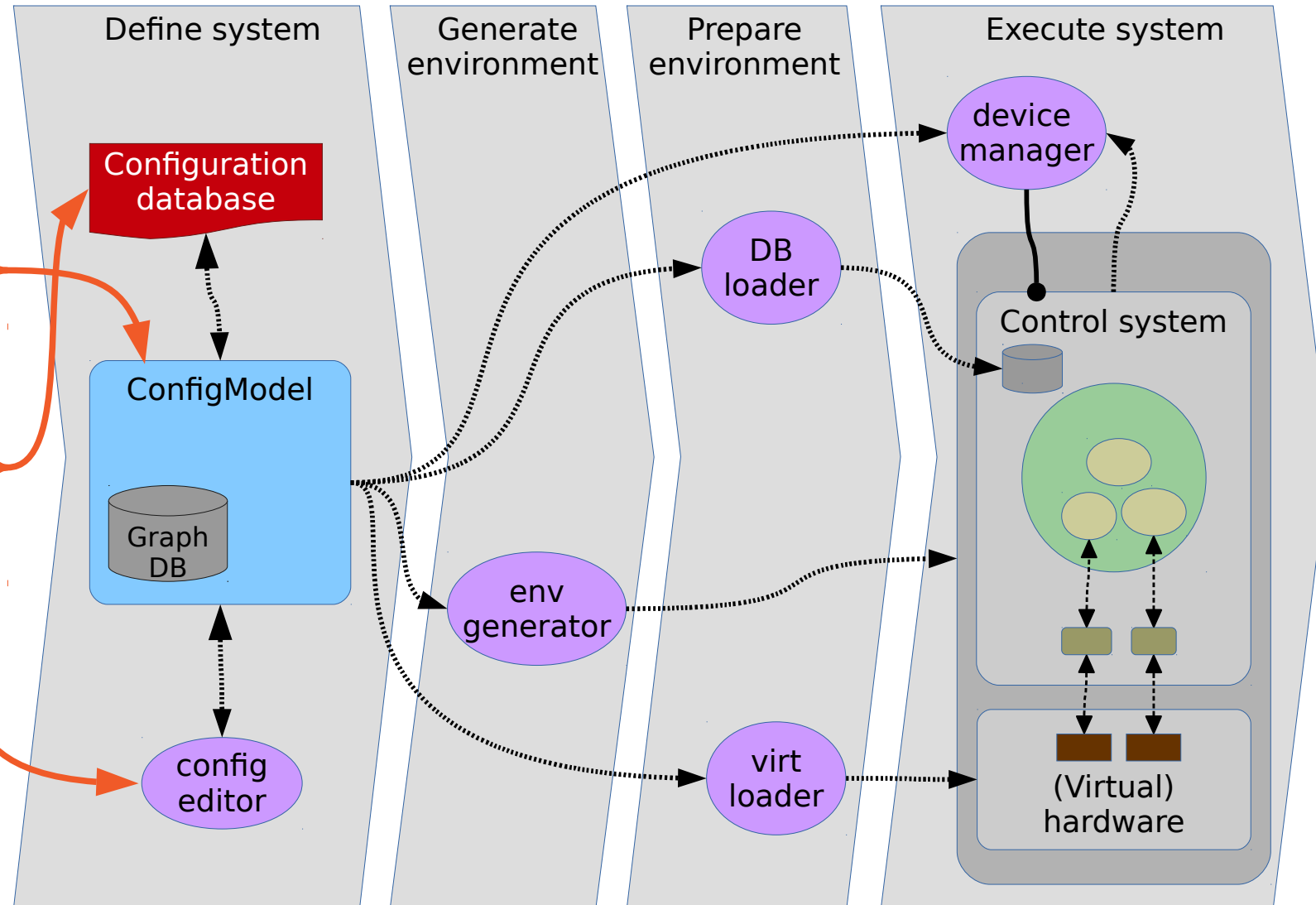




# Configuration model usage

## Usage related requirements

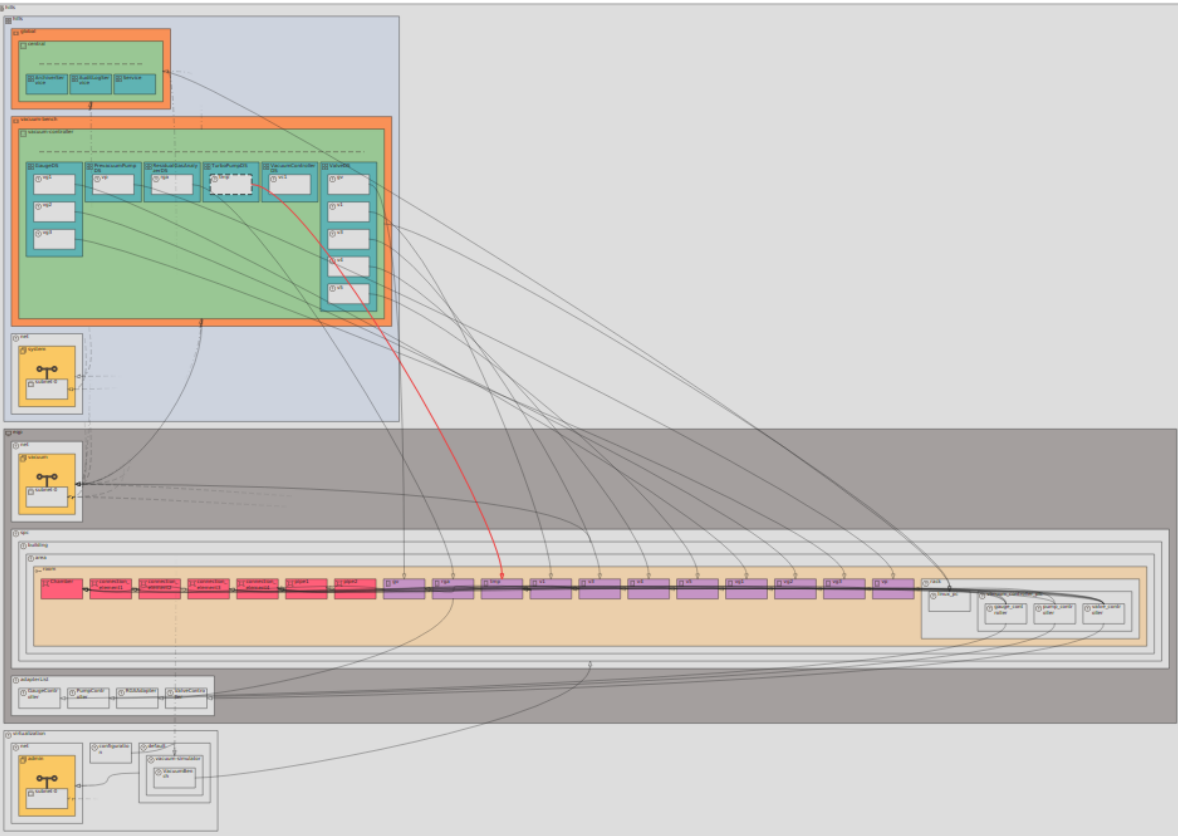
- Data extraction: convenient API
- Integrity/consistency checking
- Storage in text based, human readable format
  - Support for version control
  - Manual editing
- Custom graphical editor



Config Editor

File Edit View Tools

Connect to DB Reload Export Validate Delete Element Delete Connection Add Connection Zoom to Fit Change Layout Toggle Visibility Show Equipment Show Connections



eth0 (nic)  
eth1 (nic)  
GaugeDS (container)  
PrevacuumPumpDS (container)  
ResidualGasAnalyzerDS (container)  
TurboPumpDS (container)  
tmp (lowLevelComponent)  
VacuumControllerDS (container)  
ValveDS (container)  
net (networkConfiguration)  
eqp (equipment)

Attributes

Name	Value
local_id	tmp
tango_id	vacuum-bench/pumps/tmp

Connections

Elements Links

<input checked="" type="checkbox"/> adapter	<input checked="" type="checkbox"/> adapterList	<input checked="" type="checkbox"/> address
<input checked="" type="checkbox"/> area	<input checked="" type="checkbox"/> building	<input checked="" type="checkbox"/> chamber
<input checked="" type="checkbox"/> computer	<input checked="" type="checkbox"/> config	<input checked="" type="checkbox"/> container
<input checked="" type="checkbox"/> controller	<input checked="" type="checkbox"/> device	<input checked="" type="checkbox"/> equipment
<input checked="" type="checkbox"/> host	<input checked="" type="checkbox"/> lowLevelComponent	<input checked="" type="checkbox"/> network
<input checked="" type="checkbox"/> networkConfiguration	<input type="checkbox"/> nic	<input type="checkbox"/> property
<input checked="" type="checkbox"/> rack	<input checked="" type="checkbox"/> region	<input checked="" type="checkbox"/> room
<input checked="" type="checkbox"/> spatialConfiguration	<input checked="" type="checkbox"/> subController	<input checked="" type="checkbox"/> subnet
<input checked="" type="checkbox"/> system	<input type="checkbox"/> virt_config	<input checked="" type="checkbox"/> virtualization
<input checked="" type="checkbox"/> virtualizationConfig	<input checked="" type="checkbox"/> virtualization_host	<input checked="" type="checkbox"/> virtualization_region
<input checked="" type="checkbox"/> virtualizedSystem		

(lowLevelComponent:tmp)

## Device Manager

- Monitoring of a running system
- Managing of a running system
  - Start/stop devices (one-by-one or in groups)
  - Issue commands on devices
- API → GUI, CLI, custom managers
  - Full sequence control at system startup
- Compare the set of configured devices and running devices

PLAINS System Monitoring (PyTango Version: 9.2.0)

Actions

Component	State	Device Servers	Devices
plains	On	On (28)	On (4) / Running (37) / Off (36)
sylos	On	On (24)	Running (37) / Off (36)
beamtransport	On	On (13)	Running (24) / Off (27)
bt-controller	On	On (13)	Running (24) / Off (27)
BeamLineDS/beamtransport	On	On (1)	Running (1)
bt/beamline/1	Running		Running (1)
BeamTransportService/beamtransport	On	On (1)	Running (1)
bt/beamline/service	Running		Running (1)
BT_Gauge/beamtransport	On	On (1)	Off (6)
bt/gauge/c0	Off		Off (1)
bt/gauge/c1	Off		Off (1)
bt/gauge/c2	Off		Off (1)
bt/gauge/c3	Off		Off (1)
bt/gauge/c4	Off		Off (1)
bt/gauge/c5	Off		Off (1)
BT_MotionController2D/beamtransport	On	On (1)	Running (5)
bt/c1t1/mc2d01	Running		Running (1)
bt/c2t1/mc2d01	Running		Running (1)
bt/c3t1/mc2d01	Running		Running (1)
bt/c4t1/mc2d01	Running		Running (1)
bt/c5t1/mc2d01	Running		Running (1)
BT_MultiMotor/beamtransport	On	On (1)	Running (2)
bt/c2t1/mc01	Running		Running (1)
bt/source/iris01	Running		Running (1)
BT_Pump/beamtransport	On	On (1)	Off (6)
bt/pump/c0	Off		Off (1)
bt/pump/c1	Off		Off (1)
bt/pump/c2	Off		Off (1)
bt/pump/c3	Off		Off (1)
bt/pump/c4	Off		Off (1)
bt/pump/c5	Off		Off (1)
BT_SimpleValve/beamtransport	On	On (1)	Running (2) / Off (3)
bt/valve/c3t1	Off		Off (1)
bt/valve/c4t1	Off		Off (1)
bt/valve/e1	Running		Running (1)
bt/valve/e2	Running		Running (1)
bt/valve/s1	Off		Off (1)
BT_TurboPump/beamtransport	On	On (1)	Off (6)
bt/turbo/c0	Off		Off (1)
bt/turbo/c1	Off		Off (1)
bt/turbo/c2	Off		Off (1)
bt/turbo/c3	Off		Off (1)
bt/turbo/c4	Off		Off (1)
bt/turbo/c5	Off		Off (1)
BT_Vent/beamtransport	On	On (1)	Off (6)
bt/vent/c0	Off		Off (1)
bt/vent/c1	Off		Off (1)
bt/vent/c2	Off		Off (1)
bt/vent/c3	Off		Off (1)
bt/vent/c4	Off		Off (1)
bt/vent/c5	Off		Off (1)
BT_Webcam/beamtransport	On	On (1)	Running (5)
bt/c1t1/ccd01	Running		Running (1)
bt/c2t1/ccd01	Running		Running (1)
bt/c3t1/ccd01	Running		Running (1)
bt/c4t1/ccd01	Running		Running (1)

No polling for device states



- Configuration is part of any control system
- We tried to give a clear definition of what configuration is – based on lifespan of data
- Formulated requirements for configuration model
- Implemented a system that satisfies the requirements
- We have experience with moderate sized systems so far
  - Vacuum test station
  - Optical test station
  - HR laser system with virtual devices
- So far the system performs well, further development is expected

# THANK YOU FOR YOUR ATTENTION!

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