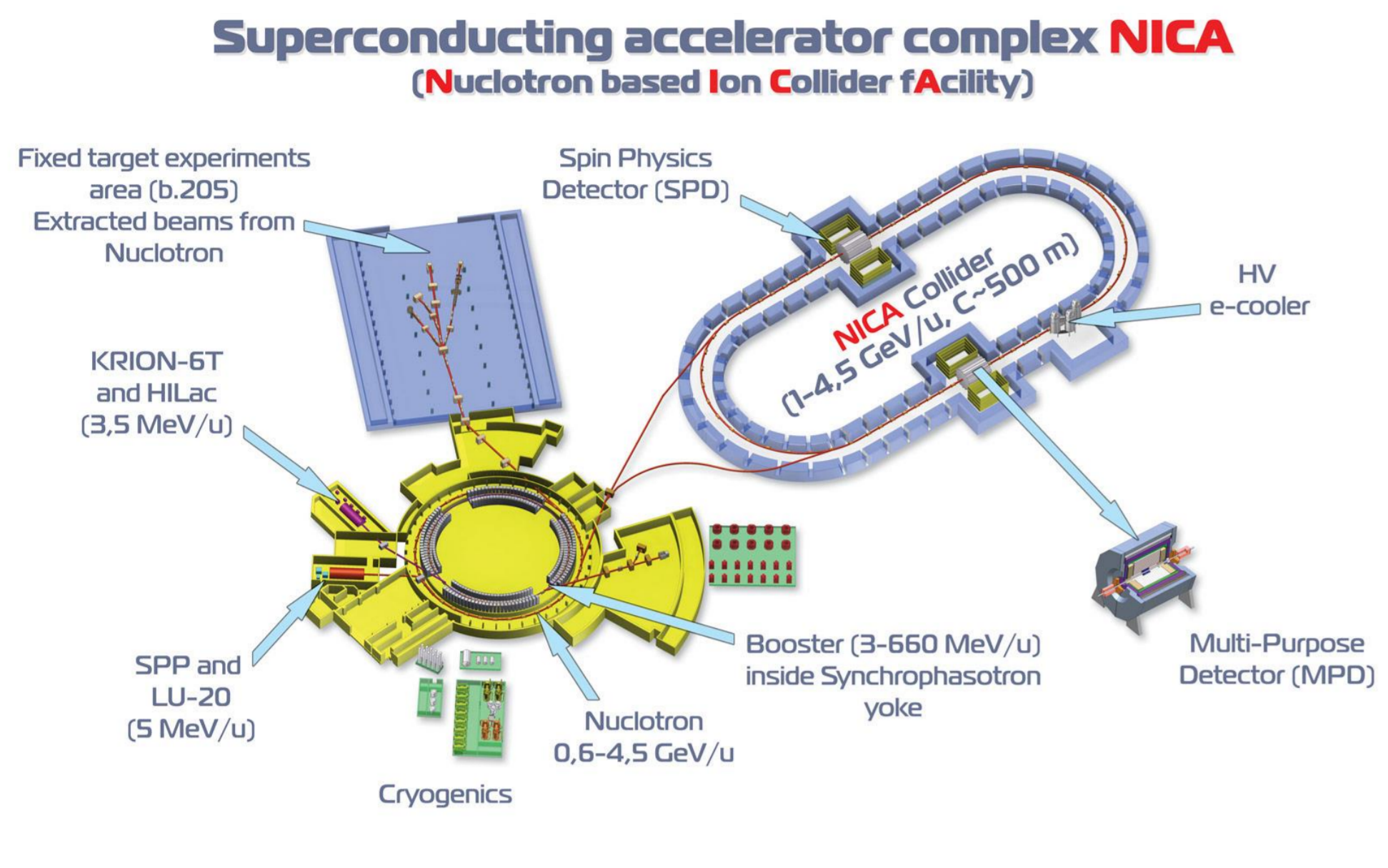


E. Gorbachev, V. Andreev, A. Kirichenko, D. Monakhov, S. Romanov, T. Rukoyatkina, G. Sedykh, V. Volkov
JINR, Dubna, Russia

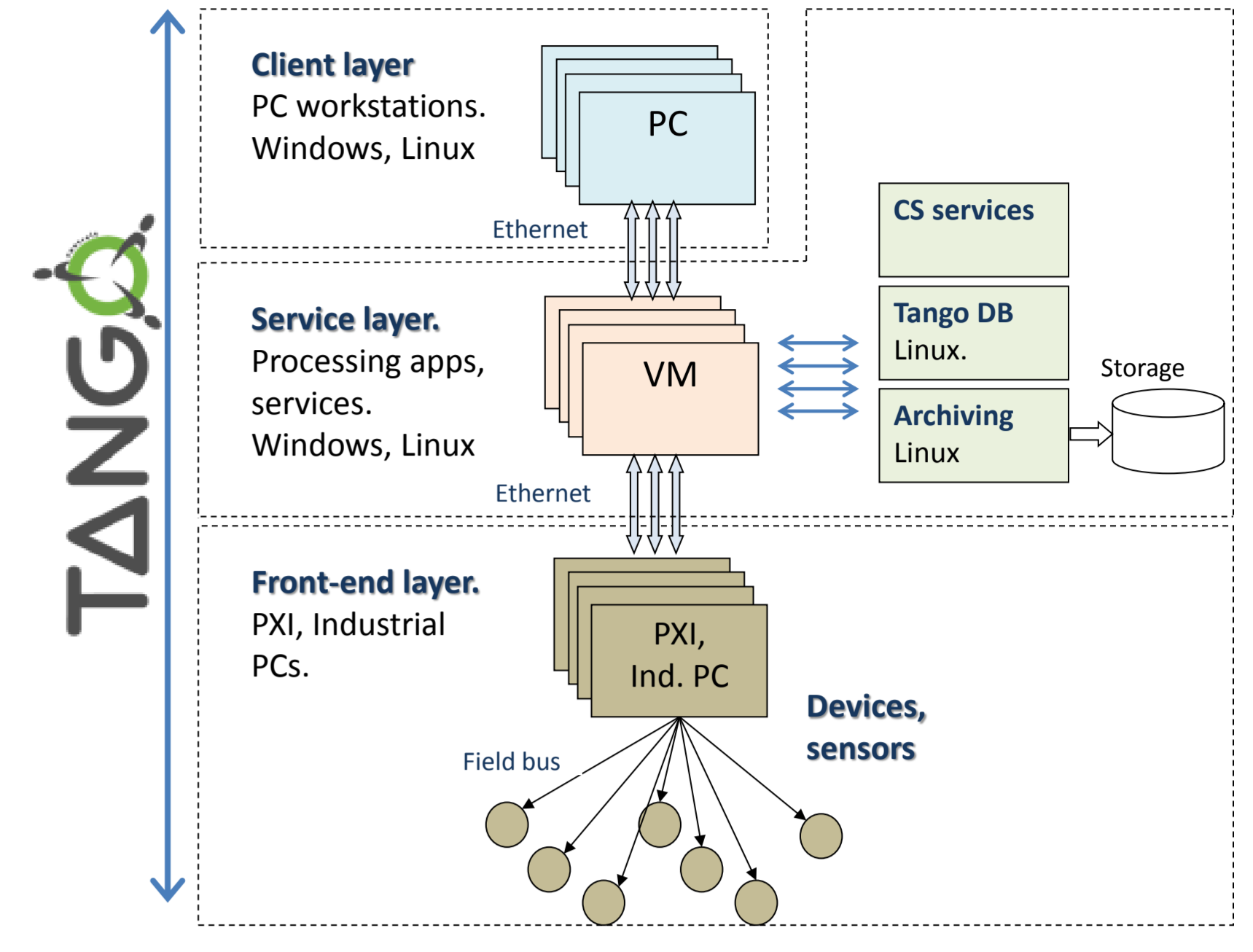
NICA accelerator complex is presently under construction at JINR, Dubna. It will consist of heavy ion and polarized particle sources, RFQ injector, heavy- and light-ion linear accelerators, superconducting booster synchrotron, existing Nuclotron synchrotron and two superconducting collider rings.



TANGO based control system is under development. Key points:

- **Centralized** administration and monitoring
- **Reliable** operation, quick recovery after failures.
- **Safe** operation, access restrictions.
- **Ease** of support, modification and scaling
- **Rapid** development and easy deployment

Three layers layout:
 Front-end layer – control equipment and acquire data from sensors
 Service layer - high level TANGO devices and CS services.
 Client layer - data visualization, operator interface.



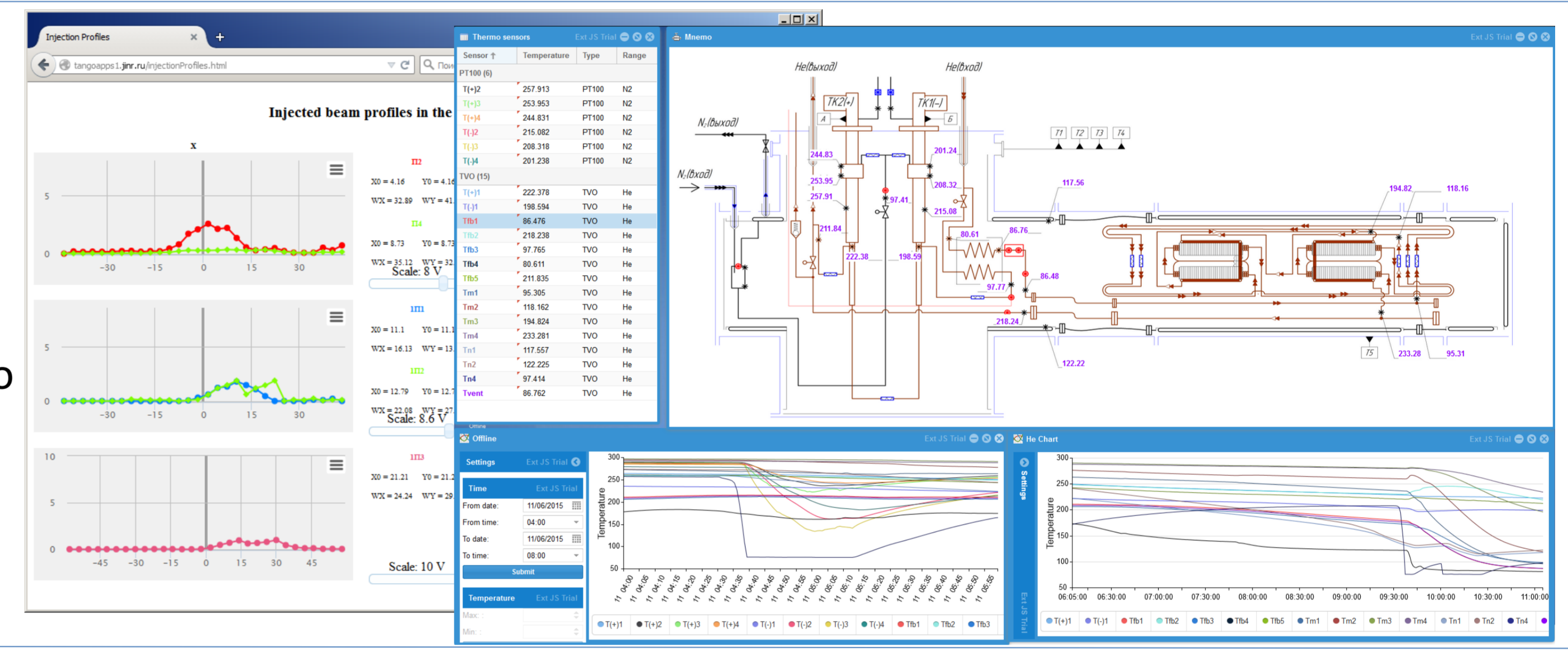
Front-end layer

- **PXI** modular platform for common acquisition tasks. 1500+ instruments available
 - FPGA based solutions for custom DSP, synchronization, signal generation:
 - **FlexRIO** – PXI and PXIe modules with Xilinx FPGA, onboard memory and standard or custom input modules.
 - **CompactRIO** - FPGA and processor (running RT OS) based platform with standard or custom I/O modules.
- Developed programming TANGO support for NI equipment:
- TANGO devices for many acquisition tasks: digital and analog I/O, timers, counters, digitizers, multimeters, RTD modules.
 - TANGO devices providing interface for NI FPGA solutions. Run on PXI or CompactRIO controllers.



Client layer - TANGO Web applications

- TANGO devices to simplify web client applications development:
- **RestDS** - REST protocol to access TANGO devices attributes and commands via HTTP:
http://host:port/tango/tango_domain/tango_class/tango_member/attribute_name
[http://host:port/tango/tango_domain/tango_class/tango_member/comand_name\(\)](http://host:port/tango/tango_domain/tango_class/tango_member/comand_name())
 - **WebSocketDS** – access to TANGO device attributes via WebSocket protocol.
 - **TangoWebAuth** performs authentication of users to restrict access of web applications to TANGO devices. The access rights are configured in database.
- Web applications are developed using **JavaScript** with help of **ExtJs** framework.



Service layer - High Availability cluster

- Service layer virtualized, run on cluster. **Supermicro** nodes running **Proxmox VE + Ceph**:
- **Data is replicated** with factor 3
 - **Thin** provisioning
 - **Snapshots** support
 - **No single point** of failure, self healing
 - **Scalability** - improves characteristics on scale
 - **KVM** stored on Ceph RBD + **OpenVZ** containers on local storage

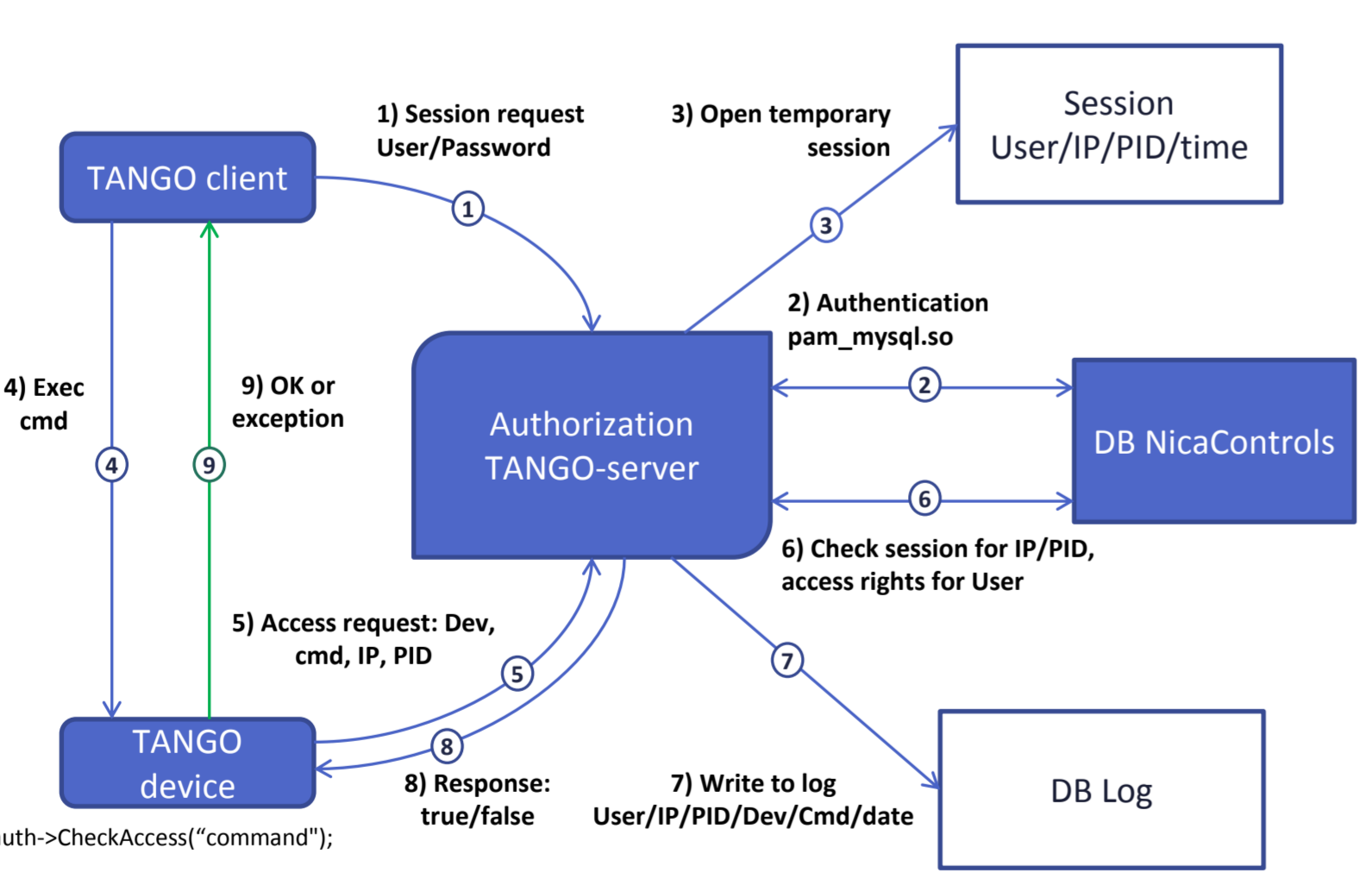


TANGO database

- **Master-master** semi-synchronous replication.
 - **HAProxy** routes MySQL traffic to primary/backup MySQL backend.
 - **MySQL** backends run on containers (**OpenVZ**) on local SSD for performance reasons.
 - **Hourly** MySQL dumps.
-

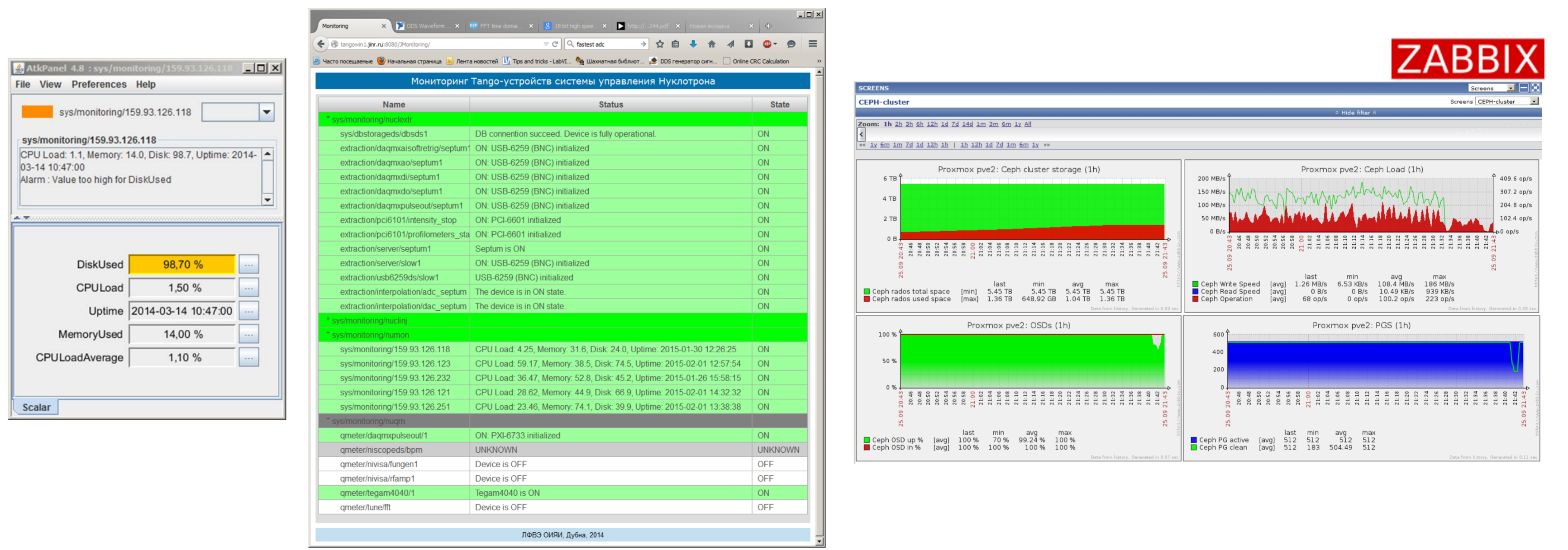
Control system administration

- **Astror/Starter** TANGO services for remote management of TANGO devices.
- **Additional** server-side authorization for more flexible access control.
- **Operator-expert** rights separation.



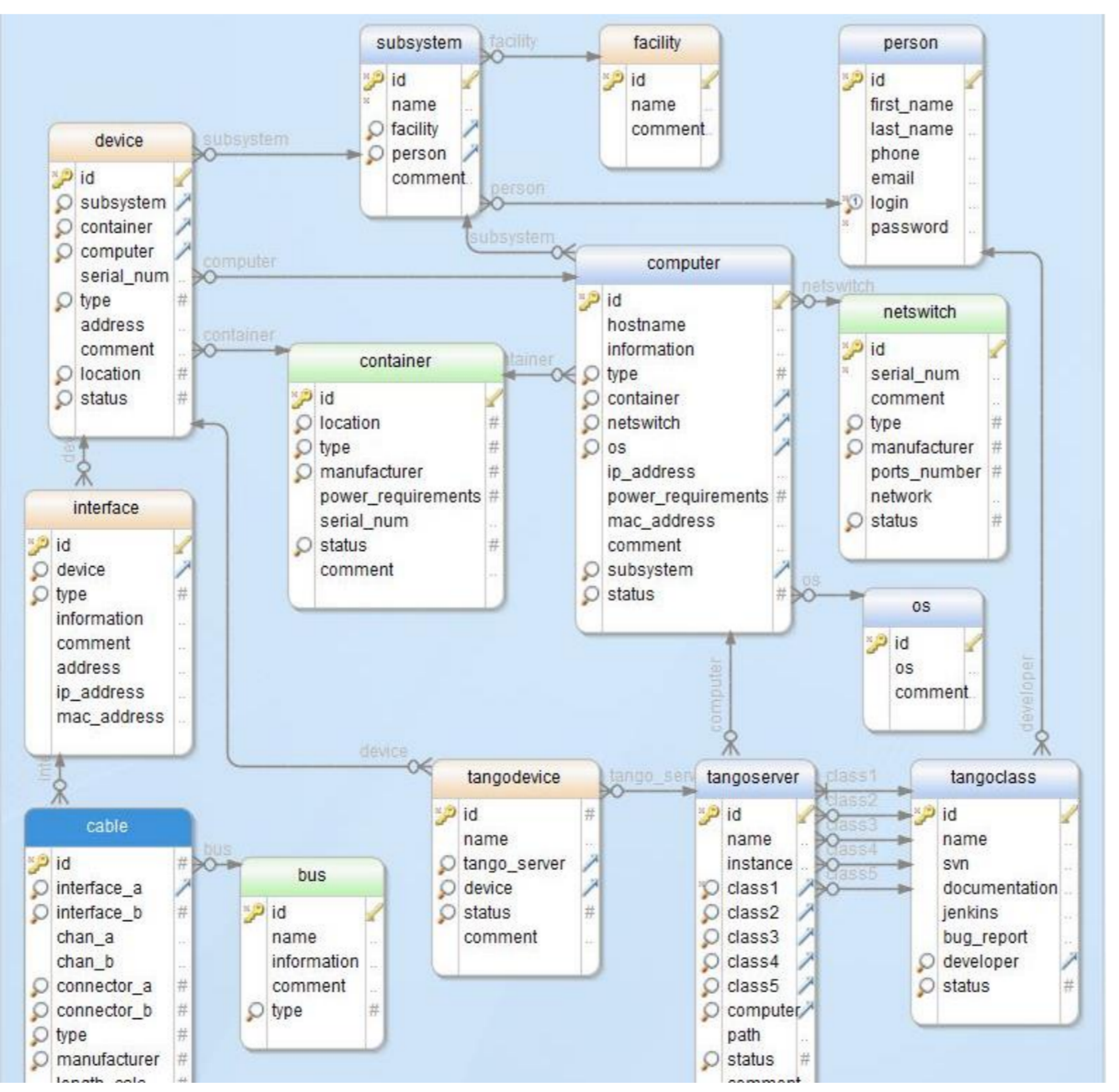
Control system monitoring

- **Custom** monitoring system to check computers and TANGO devices.
- **Zabbix** monitoring system to check Ceph, Proxmox cluster, MySQL databases.



Control system management

- NicaControls** hardware and software database stores and manages relations of NICA controls components, including:
- **Facilities** - accelerators, transfer lines.
 - **Subsystems** - RF, vacuum, beam diagnostics etc.
 - **Devices** - electronics, equipment.
 - **Computers**, networking devices.
 - **TANGO** software -TANGO devices, device servers, classes.
 - **People** – hardware and software developers.



NicaControls DB web manager:

- **Tree** view to display subsystems hierarchy.
- **Plain** tables output.
- **Sorting**, filtering, navigation.
- **Role-based** administration.

