DCS for TPC MPD: Integrating DIM and MasterSCADA 4D

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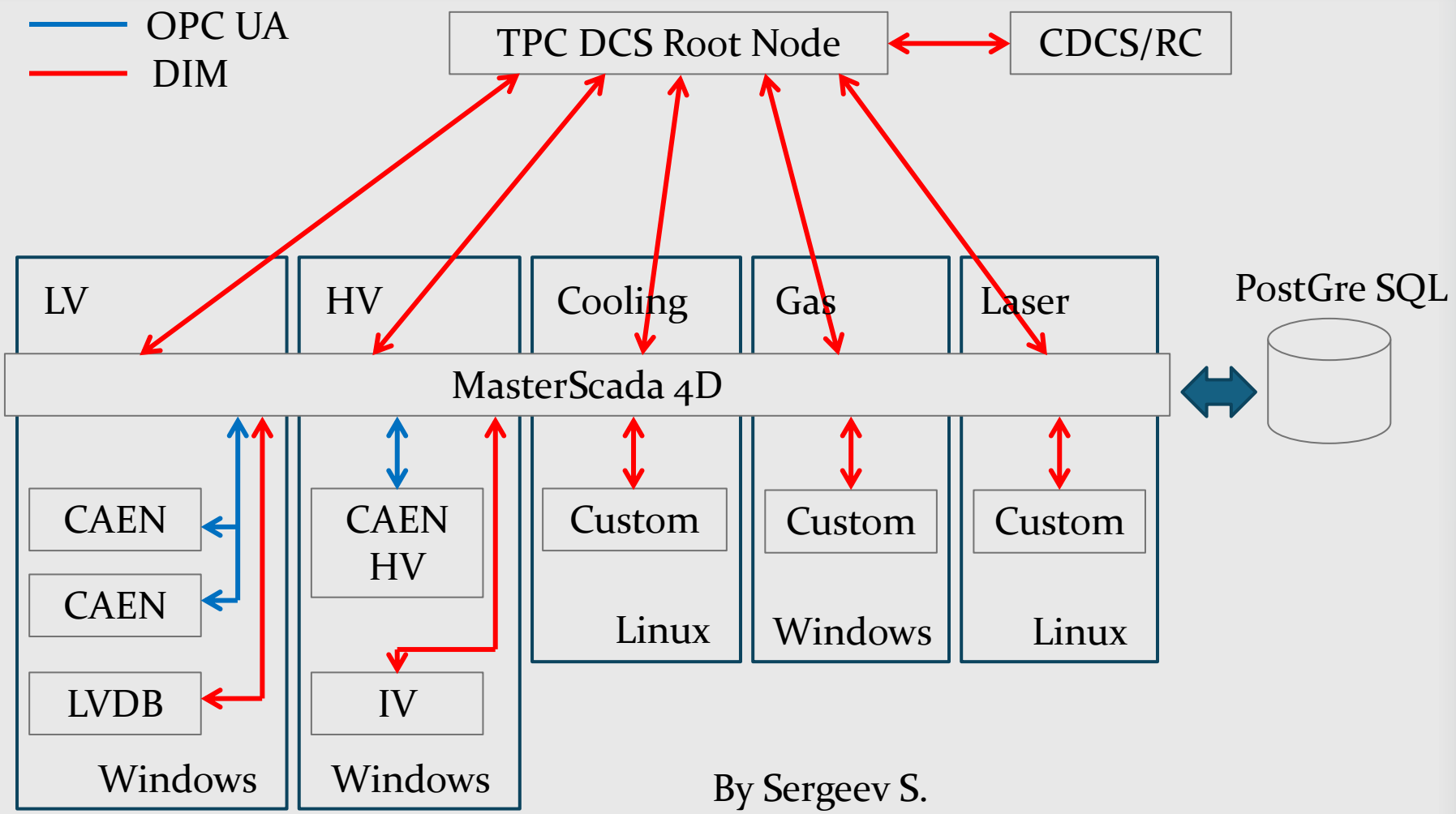
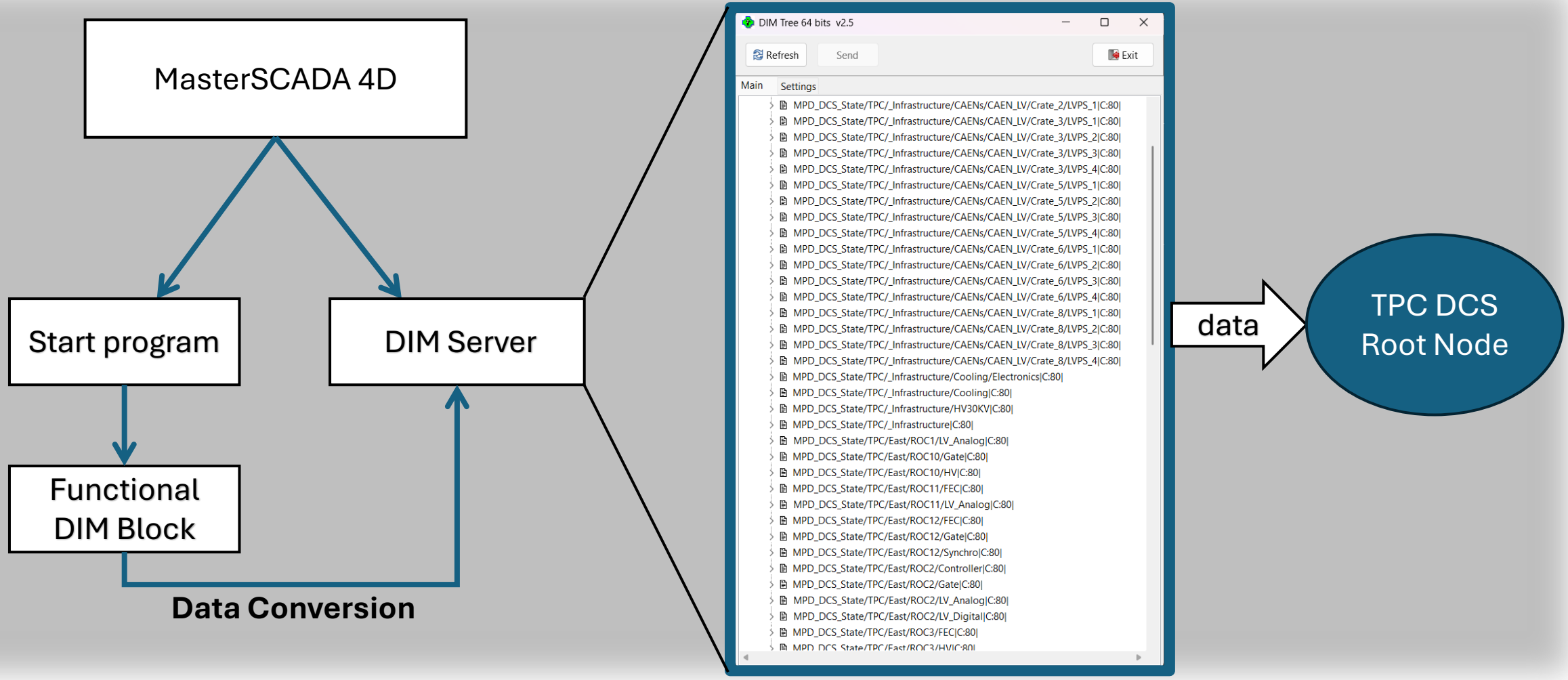
Introduction

- **The main parts of the TPC low level Hardware Control are realized in MasterSCADA 4D,** and this system should communicate with the MPD Central DCS (Detector Control System) via protocol **DIM (Distributed Information Management System)**.
- This is an **integration challenge** between two different systems.
- Our solution: A **custom C++ Functional Block** embedded within MasterSCADA 4D.
  - ✓ It runs a **DIM server** to publish TPC status data.
  - ✓ It processes **DIM commands** and passes them to MasterSCADA's control logic.
- This provides a seamless, robust, and efficient **two-way communication link.**

TPC DCS


OPC UA
DIM
TPC DCS Root Node
CDCS/RC
LV
HV
Cooling
Gas
Laser
PostGre SQL
MasterScada 4D
CAEN
CAEN
LVDB
Windows
CAEN HV
IV
Windows
Custom
Linux
Custom
Windows
Custom
Linux
By Sergeev S.

Functional DIM block



How DIM FB works

1. **Initialization and Binding to SCADA Variables**
2. **Data Conversion to DIM Format**
3. **Data Publishing via the DIM Server**
4. **Processing Incoming Commands**
5. **Bidirectional Synchronization**

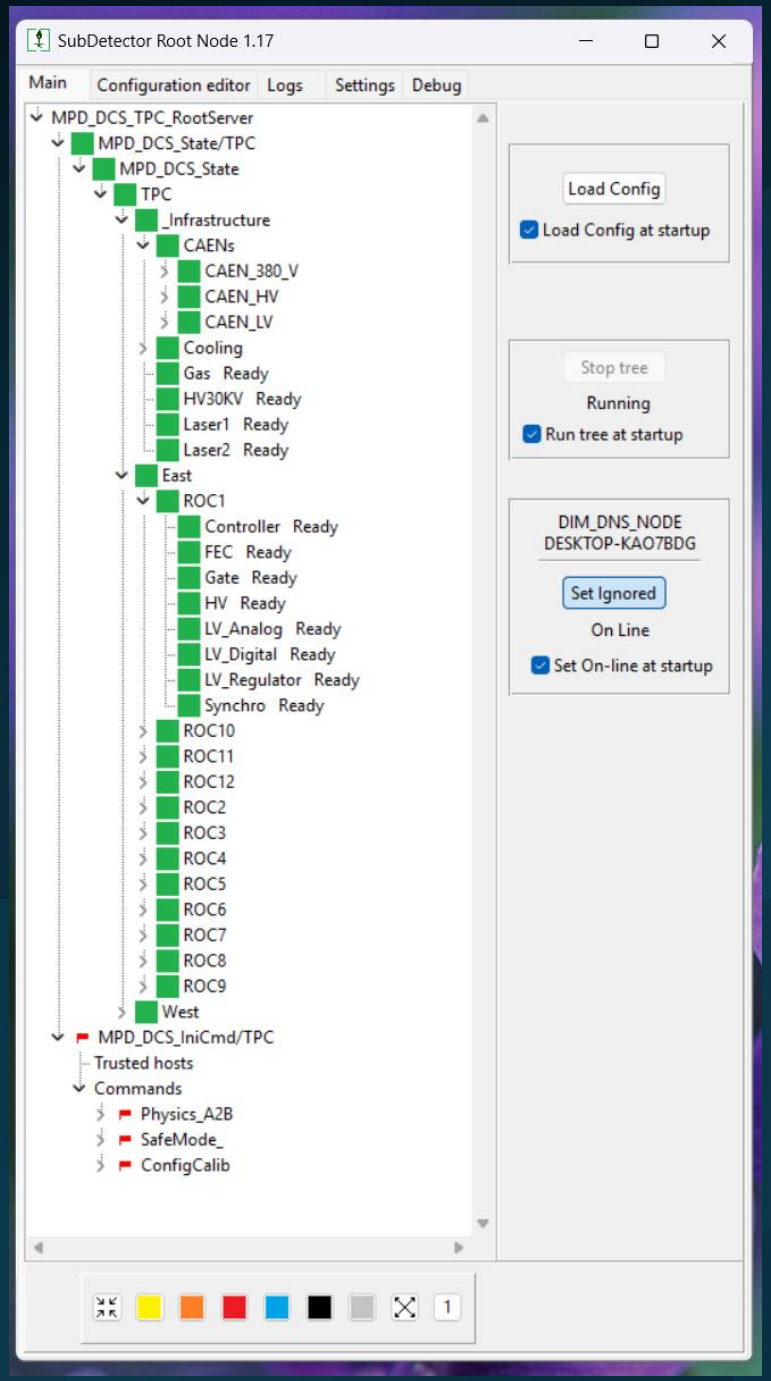
- **MPLC_DECLARE_PROPERTIES** mechanism.
- The variables include:
  - HV/LV system statuses (On/Off, errors, modes)
  - Channel parameter arrays (24 channels: 12 eastern + 12 western)
  - Control flags and state variables

The C++ code performs conversion into the standardized DCS format: **{state}_{message}**

- Specialized DIM services (**DimService**)
- Unique names
- Data refresh period inside the MasterSCADA 4D is **100 ms** and DIM Info Services are modified on data change.

Commands are received via the **DIMCommand.**

Continuous state synchronization between SCADA variables and DIM services.

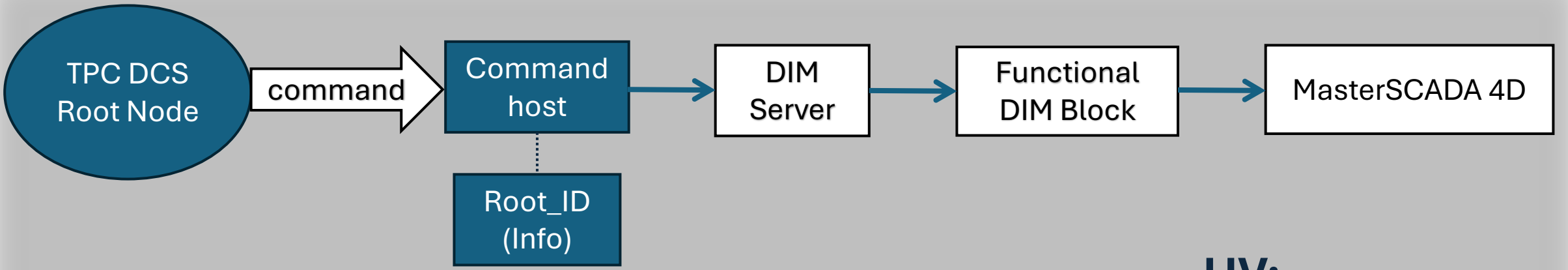


Format: **{State}_{Message}**

MasterSCADA 4D variables → DIM

- State=-1, Item does not have a state, no color to be displayed
- State=0, OFF - any of sub-elements does not respond
- State=1, StdBy – any of sub-elements is in stand-by mode
- State=2, NotRdy – any of element is in transition state
- State=3, Ready – all elements are OK
- State=4, Wrng – any of elements is in Warning state
- State=5, Error – any of elements is in Error state
- State=6, Ignrd – node in Partitioned state

Commands



When external management is enabled, commands change the state of the corresponding SCADA variables.

- Commands are sent via the **DIMClient and DIM Command Service**.

HV:

- hv_all_on
- hv_all_off
- hv_use_standby_presets
- hv_use_job_presets
- hv_use_laser_presets

Conclusions & goals

- ✅ A robust and efficient **integration bridge** between MasterScada 4D and the DIM system has been successfully developed and tested.
- ✅ The solution enables **real-time monitoring and control** of TPC systems through the unified MPD DCS interface.
- ✅ The architecture of the functional block is scalable and adaptable, proving its effectiveness for the assigned task.

Future Goals:

- **Short-term:** Finalize integration and deploy the solution for **all TPC subsystems** (HV, LV, cooling, gas, slow control).
- **Mid-term: Generalize the framework** to create a template functional block for easy adoption by other MPD subdetectors (e.g., ECAL, FFD, FHCAL).
- **Long-term:** Establish this solution as a **standardized approach** for detector control within the NICA/MPD experiment, ensuring uniformity and simplifying maintenance.

Thank you for attention!