



Agenda

Adaptation of existing
open-source control systems
from compact accelerators
to *large scale* facilities

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Your **TRUSTED** Control System Partner



- ❑ What is a Control System?
 - Definition
 - Components
 - Middleware (software bus) – EPICS, TANGO, FESA, TINE, etc.
- ❑ EPICS
 - Architecture
 - Software toolkit
 - What can it do?
- ❑ CODAC (used @ ITER, ESS, ELI, ...)
 - I&C architecture
 - Development cycle
 - Hardware support
- ❑ DCDB-tool
- ❑ Maintenance / technical support

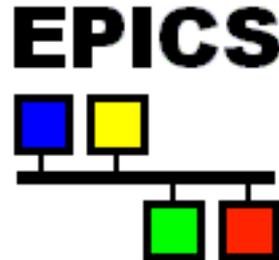
What is a CS?

- ❑ A tool that allows to operate the complexity of the accelerator from a single location
 - convert analog signals to digital values
 - transfer digital values over network
 - Access remotely each single device
 - Execute complex processes (injection, ramping, tuning, feedback systems, safety, etc.)
 - Log and archive data
 - Handle and respond to alarms

- Allow physicists to „run“ the accelerator with Matlab 😊

EPICS, TANGO, CMW/FESA,
TINE, DOOCS, PVSS,...

- Are they really different?
 - **Yes** in terms of technical implementation
 - **Probably yes** in terms of performance
 - **No** in terms of what they provide for the CS



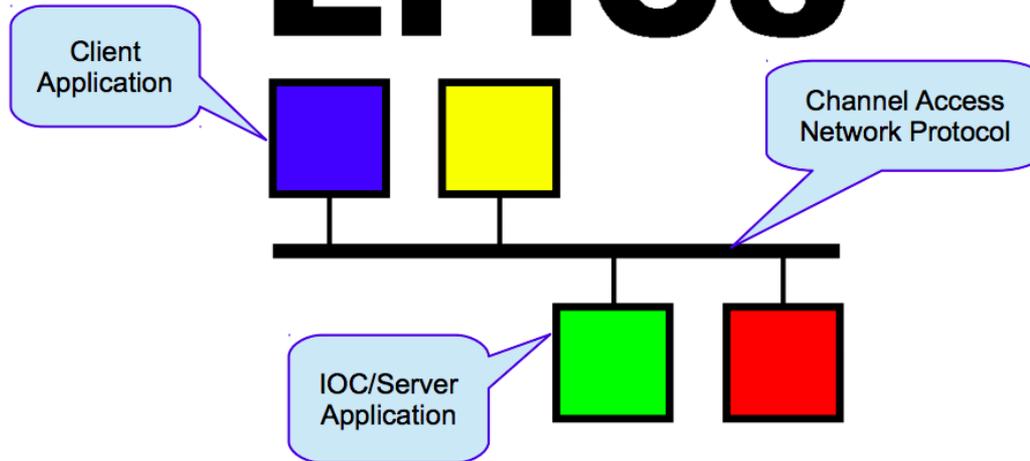
What is EPICS?



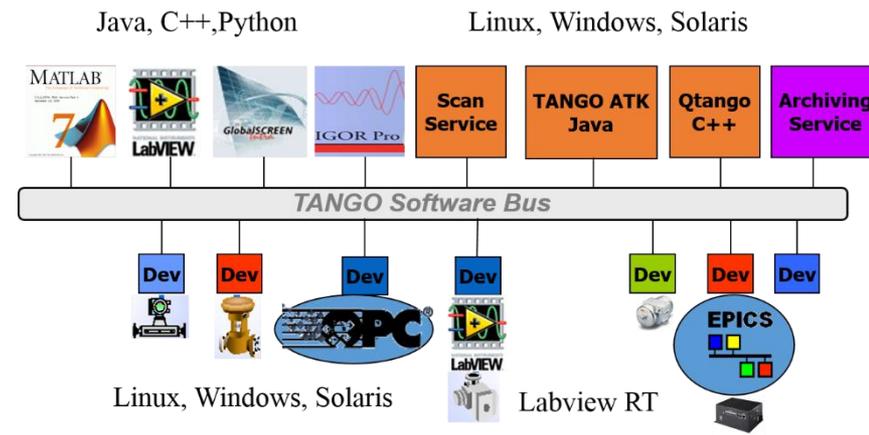
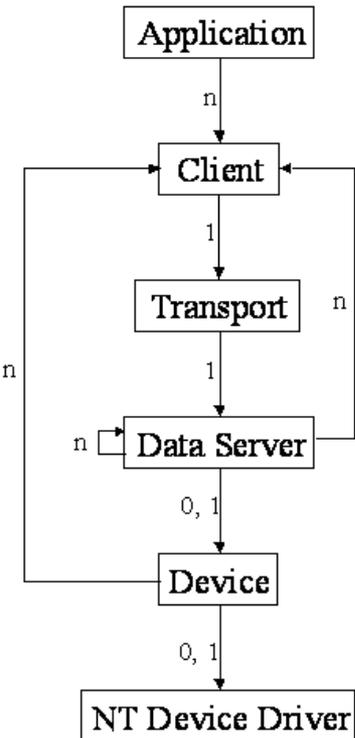
- ❑ A Collaboration
- ❑ A Control System Architecture
- ❑ A Software Toolkit



EPICS



ConSys

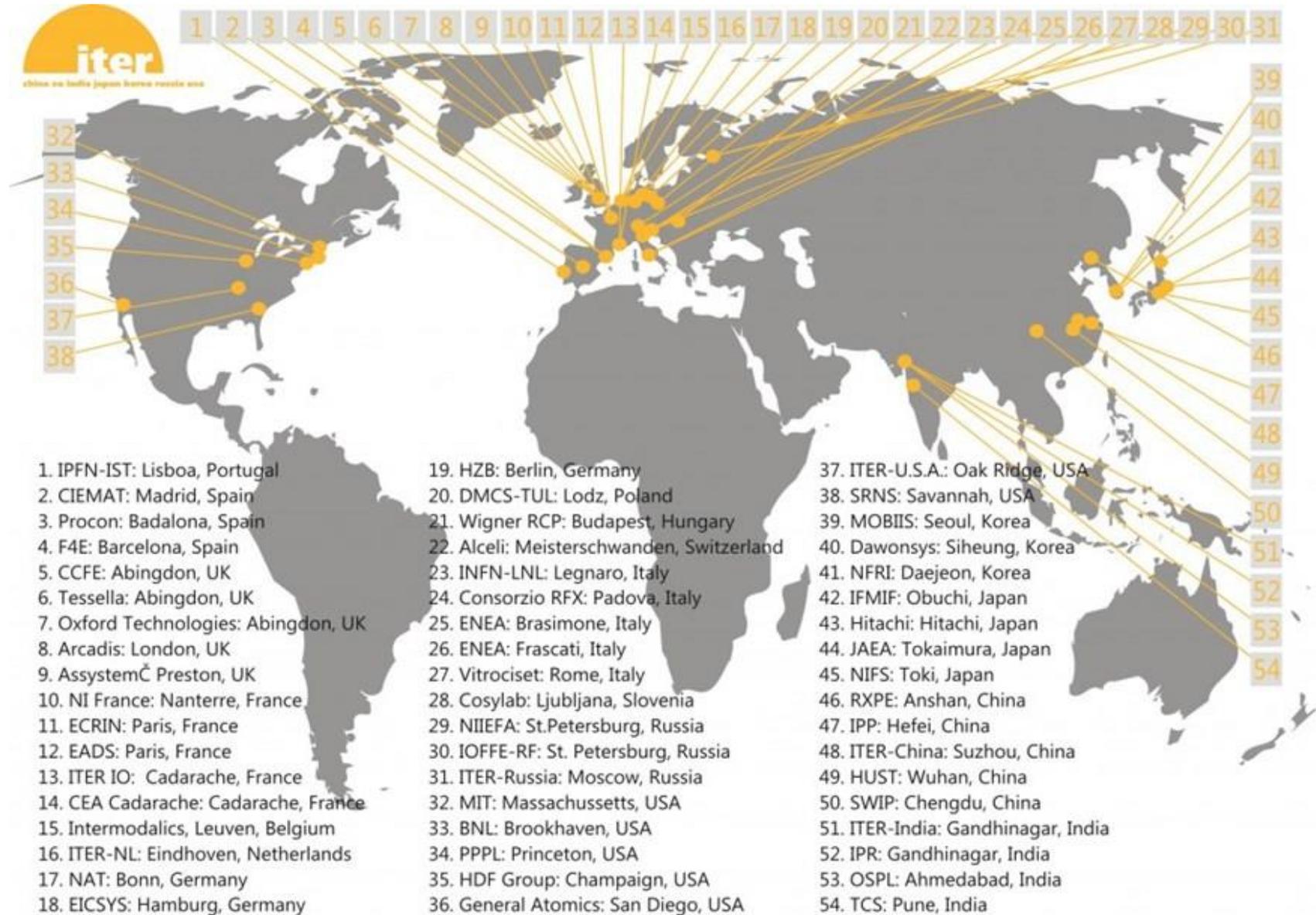


- ❑ 'Installing EPICS' does not create a control system
- ❑ The EPICS SW toolkit consists of hundreds of pieces of software
 - individual programs for performing specific tasks
 - GUIs, archiving, alarms, etc.
 - code libraries for monitoring/controlling HW:
 - IOC device and driver support for COTS equipment (PLC, scopes etc)
 - allow programming languages to interface with EPICS:
 - C/C++, Perl, Python, Java, Matlab/Octave, C#, LabView etc
- ❑ Almost all EPICS code is Open Source (freely usable & modifiable)
- ❑ *An EPICS control system can be made by choosing and **configuring** existing software*

What can EPICS do?



- ❑ Almost any typical Distributed Control System function
 - Remote control & monitoring of technical equipment
 - Data conversions and filtering
 - Closed loop control, both slow and fast
 - Access security
 - Alarm detection, reporting and logging
 - Data trending, archiving, retrieval and plotting
 - Automatic sequencing of operations
 - Data acquisition including image data
 - Data analysis

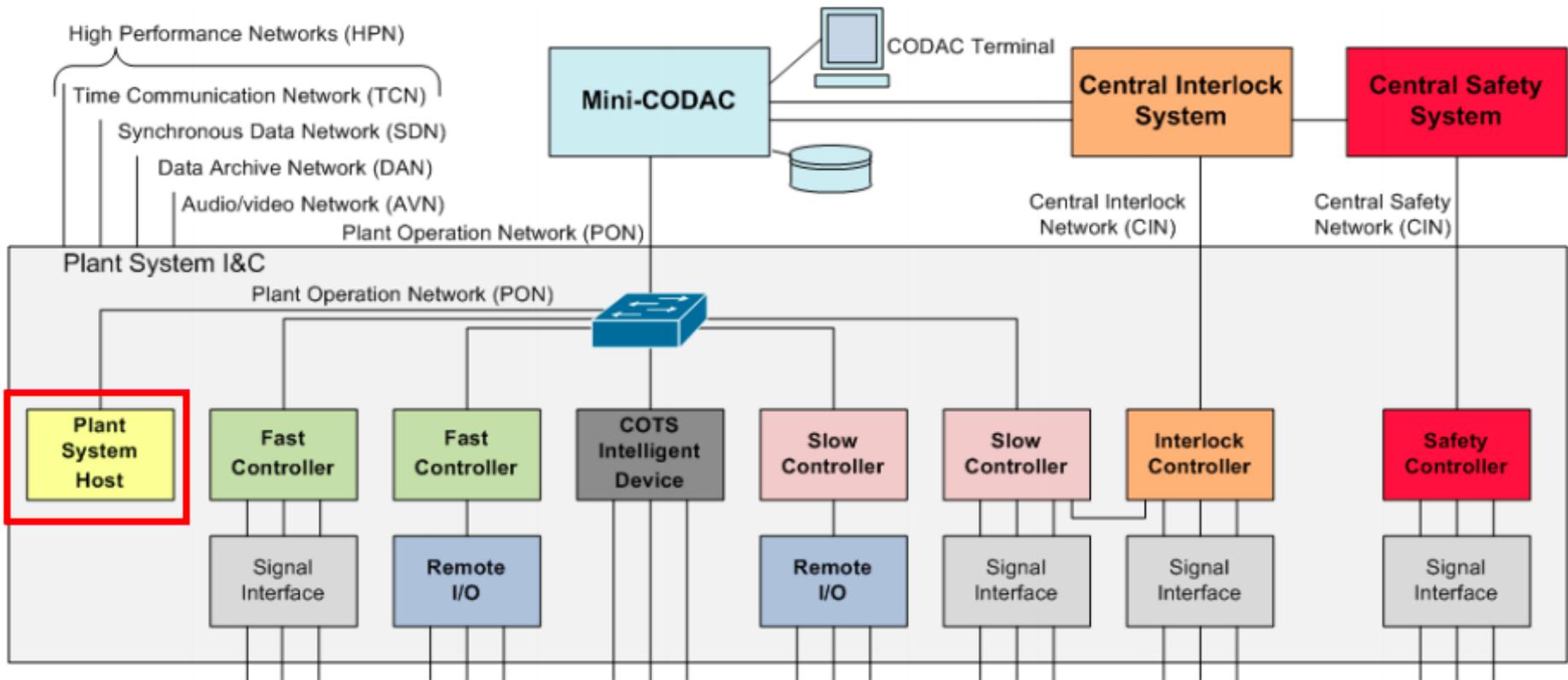


CODAC Core System

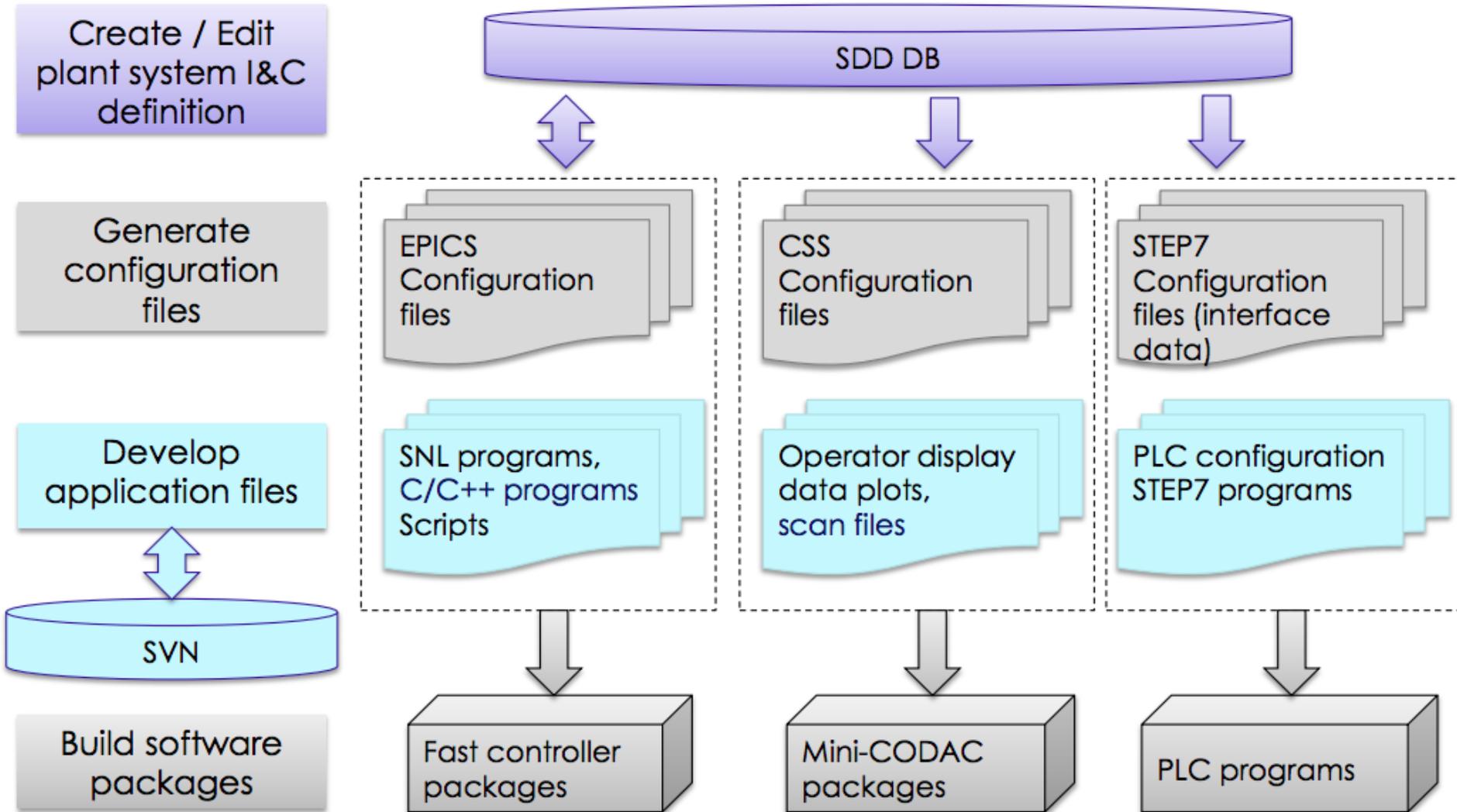


- ❑ Is a collection of EPICS tools and more:
 - RHEL 6 (MRG-Realtime), linux-x86_64
 - EPICS base 3.14.12 (v4 comes with CODAC 5.0)
 - PostgreSQL RDB
 - SDD (CS configuration tool):
 - SDD Editor, Translator, Sync, Parser
 - Operator interface (Control System Studio)
 - Alarm handling (BEAST)
 - Data archiving (BEAUTY)
 - **Development tools** (Maven, Eclipse, EPICS, etc.)
 - Device support, drivers for I/O, PLC, Fast controllers

CODAC I&C architecture



Development workflow



Standard Hardware support



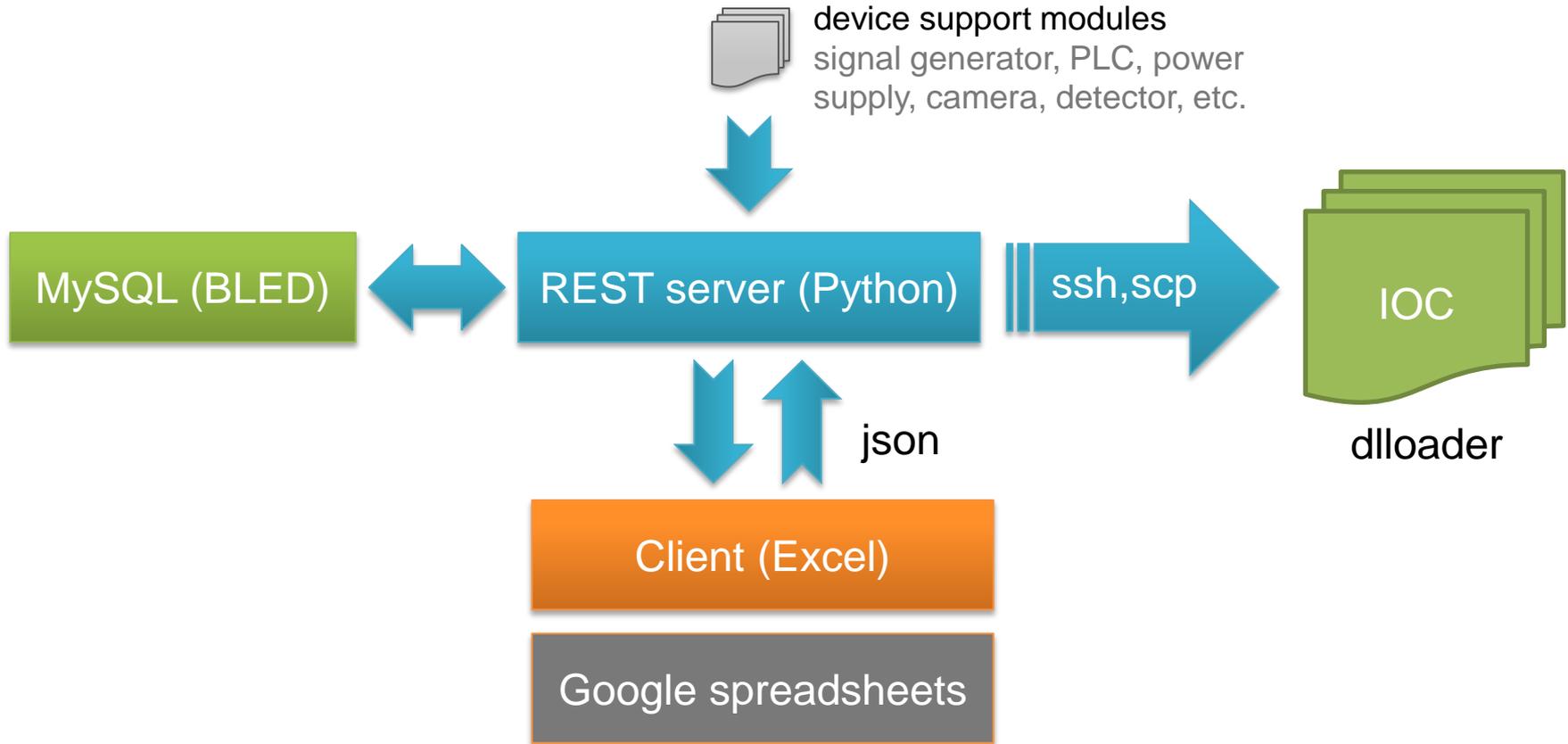
- ❑ CODAC Core System includes the software for ITER standard I/O board:
 - Linux driver
 - EPICS integration (EPICS device support)
- ❑ Supported I/O boards:
 - N.I. PXI-6682/PXI-6683H : Synchronization and timing
 - N.I. PXI-6259: multi-function DAQ
 - N.I. PXI-6368 (X-series boards)
 - N.I. PXI-6528 : Digital I/O
 - N.I. PXIe FlexRIO: Flexible I/O with FPGA
- ❑ PLC support
 - Siemens S7 PLC (S7-300, 400)

❑ *DCDB tool*

is a control system configuration tool, which provides an easy-to-use interface for quick configuration of the whole accelerator in just a few clicks.



- ❑ IOC/Alarms/archive configuration
- ❑ Start/stop/restart IOC
- ❑ Change IOC parameters on the fly
- ❑ S7 PLC support
- ❑ Supports *dlloader*
- ❑ Compliant with CODAC



Configuration tool (Excel)

Book1 - E

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW DCDB TEAM

Settings Modules IOCs Support modules st.cmd Restart PLCs Blocks UDT Generate Update Commit

Setup Overview Configuration Generate IOC PLC Commit/update

E16

	C	D	E	F	G	H	I
1							
2							
3	Delete	Name	Ip	SSH User	SSH Private Key	Description	Needs Restarting
4	-	ioc1	10.5.3.93	bled	/home/bled/.ssh/id_rsa.pub	sample ioc1	TRUE
5	-	ioc2	10.5.3.94	bled	/home/bled/.ssh/id_rsa.pub	sample ioc2	TRUE
6	-	ioc3	10.5.3.95	bled	/home/bled/.ssh/id_rsa.pub	sample ioc3	TRUE
7	-	ioc4	10.5.3.96	bled	/home/bled/.ssh/id_rsa.pub	sample ioc4	TRUE
8	-	ioc5	10.5.3.97	bled	/home/bled/.ssh/id_rsa.pub	sample ioc5	TRUE
9	-	ioc6	10.5.3.98	bled	/home/bled/.ssh/id_rsa.pub	sample ioc6	TRUE
10	-	ioc7	10.5.3.99	bled	/home/bled/.ssh/id_rsa.pub	sample ioc7	TRUE
11	-	ioc8	10.5.3.100	bled	/home/bled/.ssh/id_rsa.pub	sample ioc8	TRUE
12	-	ioc9	10.5.3.101	bled	/home/bled/.ssh/id_rsa.pub	sample ioc9	TRUE

- ❑ Open source vs. proprietary software
 - SW components vs Turnkey CS
- ❑ Stages
 - System design
 - Development
 - Integration
 - **Maintenance / technical support**



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Summary



- ❑ You can pick any CS (EPICS, Tango, PVSS, ConSys?)
- ❑ Installing EPICS doesn't mean you install a CS
 - You need to *configure* it!
 - You need to *maintain* it!
- ❑ The main challenge is the integration challenge
 - how to integrate everything in the CS in-time, on-budget and with a low risk by using an increasingly large number of COTS components

THANK YOU!

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