Possibilities for communication between EPICS and TRBnet/DIM

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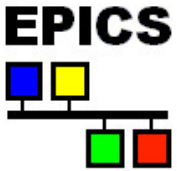
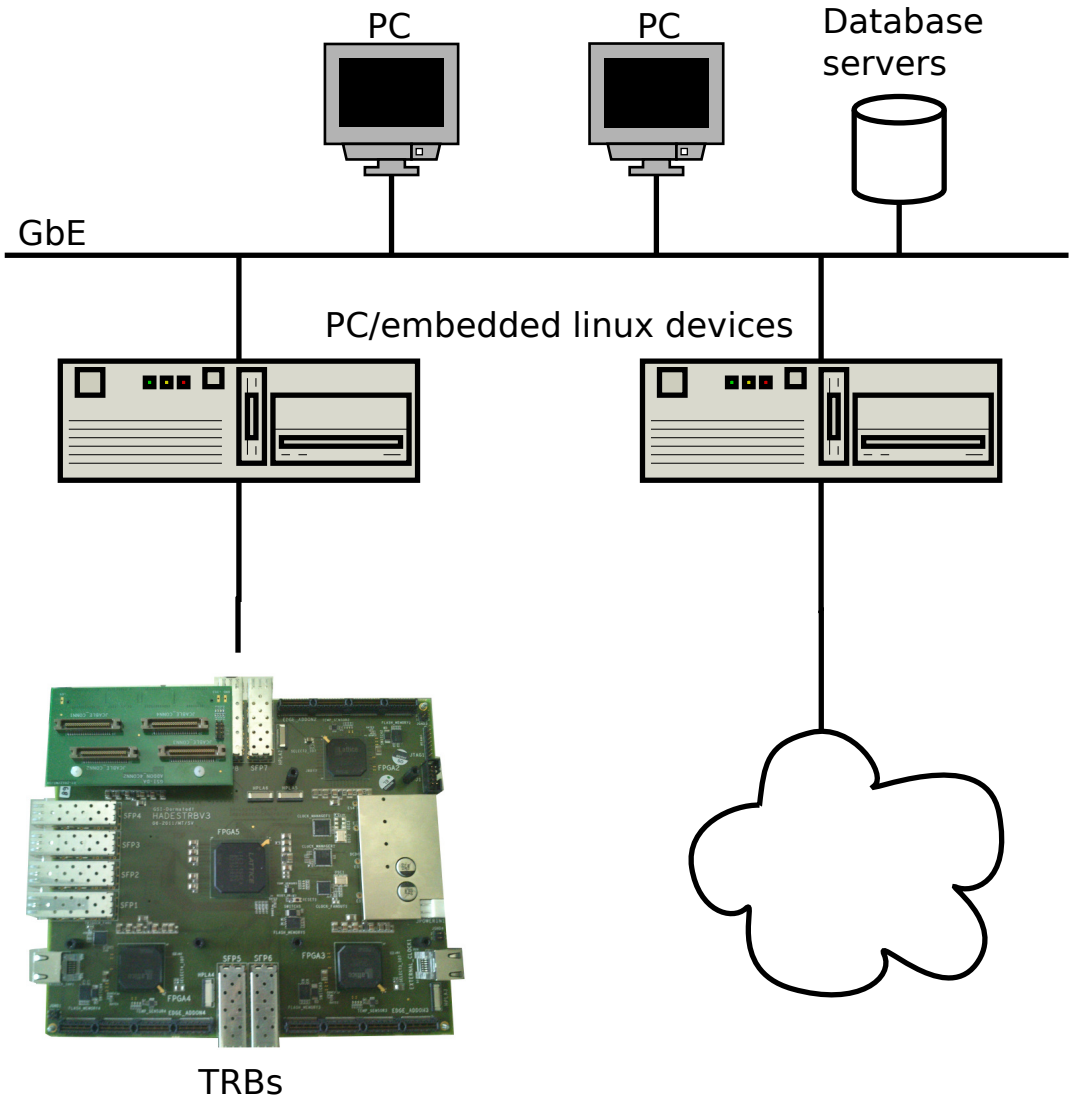
What is EPICS?



The Experimental Physics and Industrial Control System (EPICS) is:

- A Collaboration
  - A world wide collaboration that shares designs, software tools, and expertise for implementing large-scale control systems
- A Control System Architecture
  - A client/server model with an efficient communication protocol (Channel Access) for passing data
  - A distributed real-time database of machine values
- A Software Toolkit
  - A collection of software tools collaboratively developed which can be integrated to provide a comprehensive and scalable control system

Canonical Form of an EPICS Control System



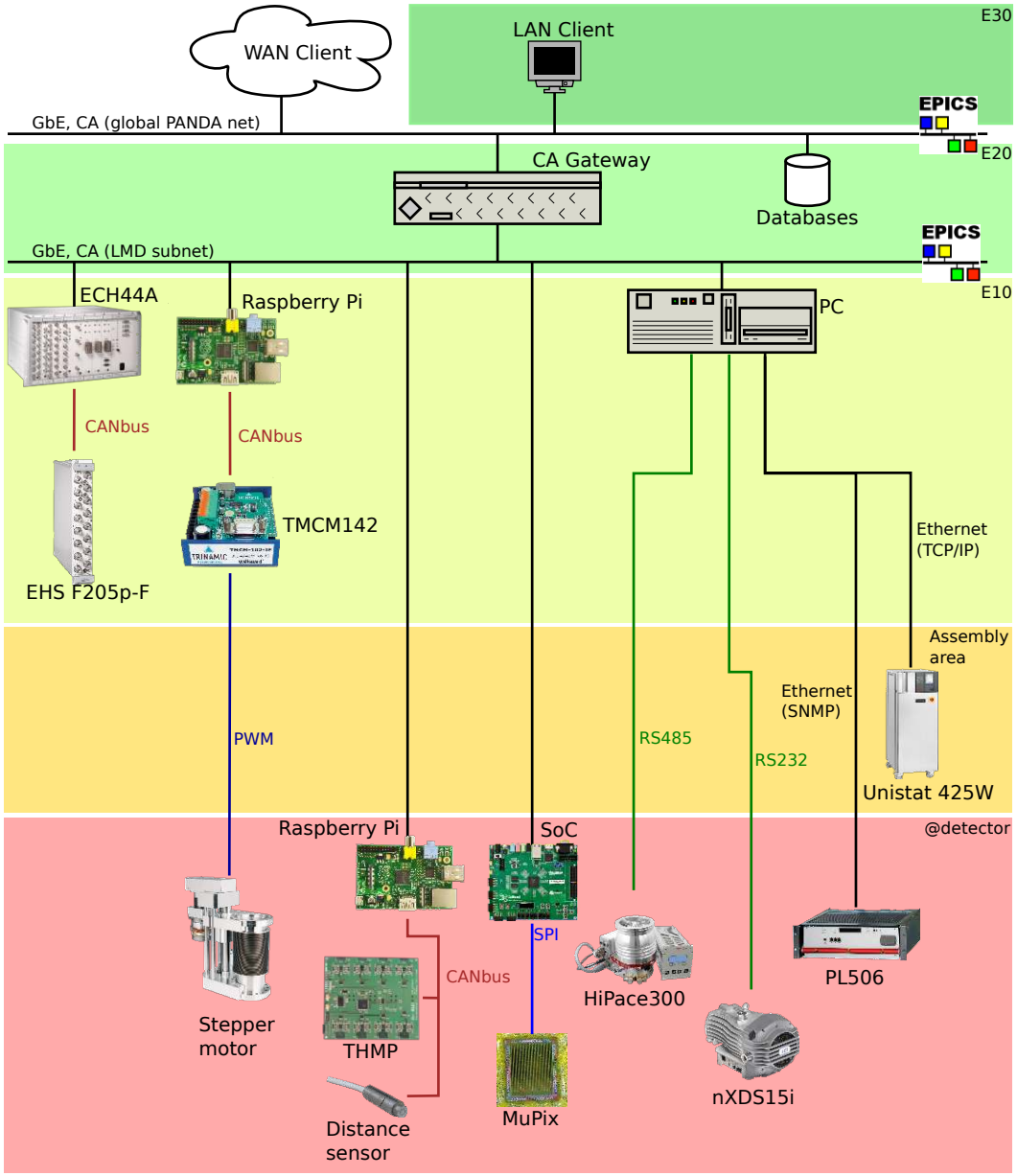
PCs running CA Clients
(Archiver, GUIs, AlarmHandling)

Channel Access

PCs running IOCs / CA Servers,
Sequencer Programs

Devices controlled/
monitored by DCS

Example: PANDA LMD



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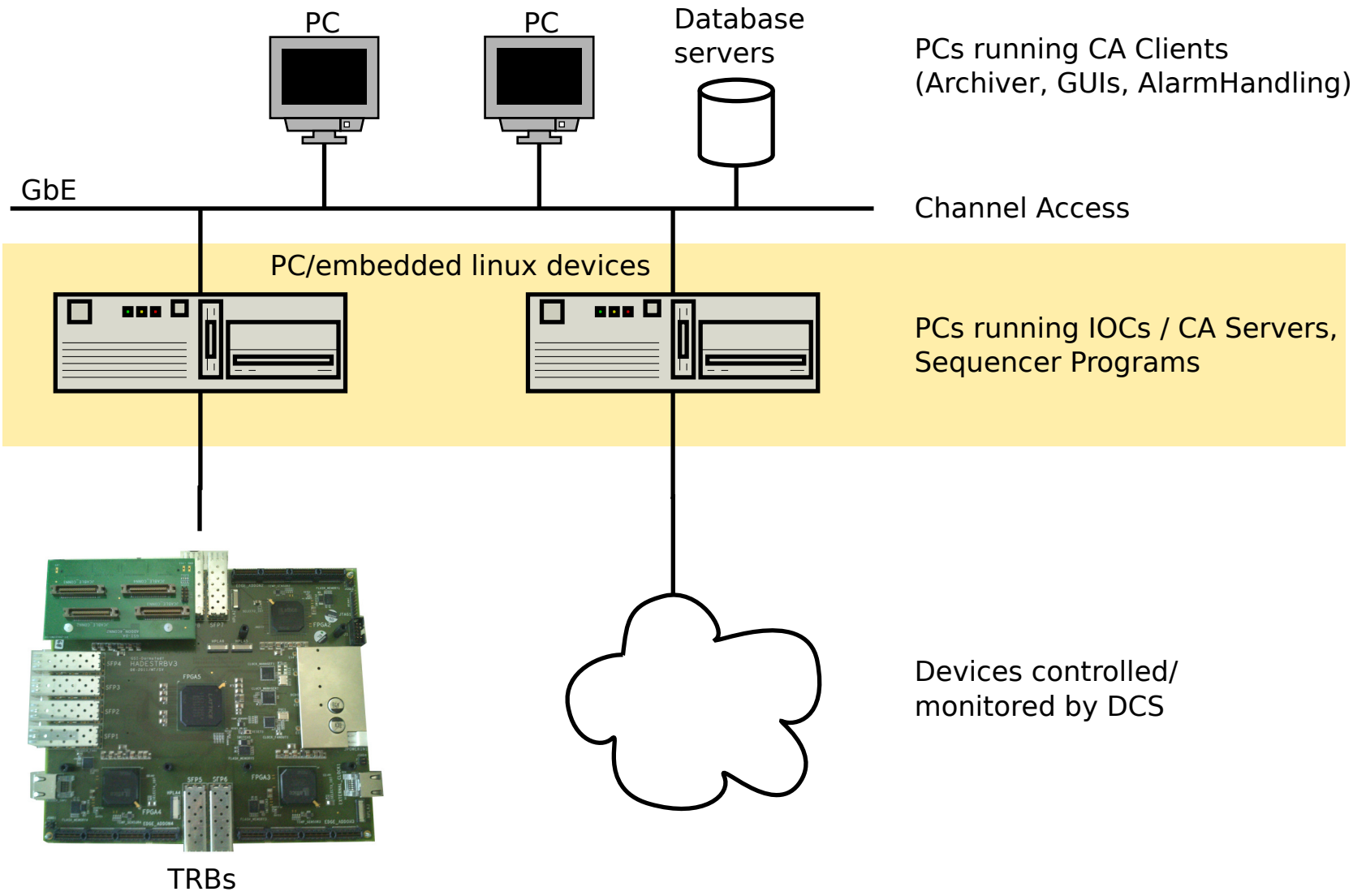
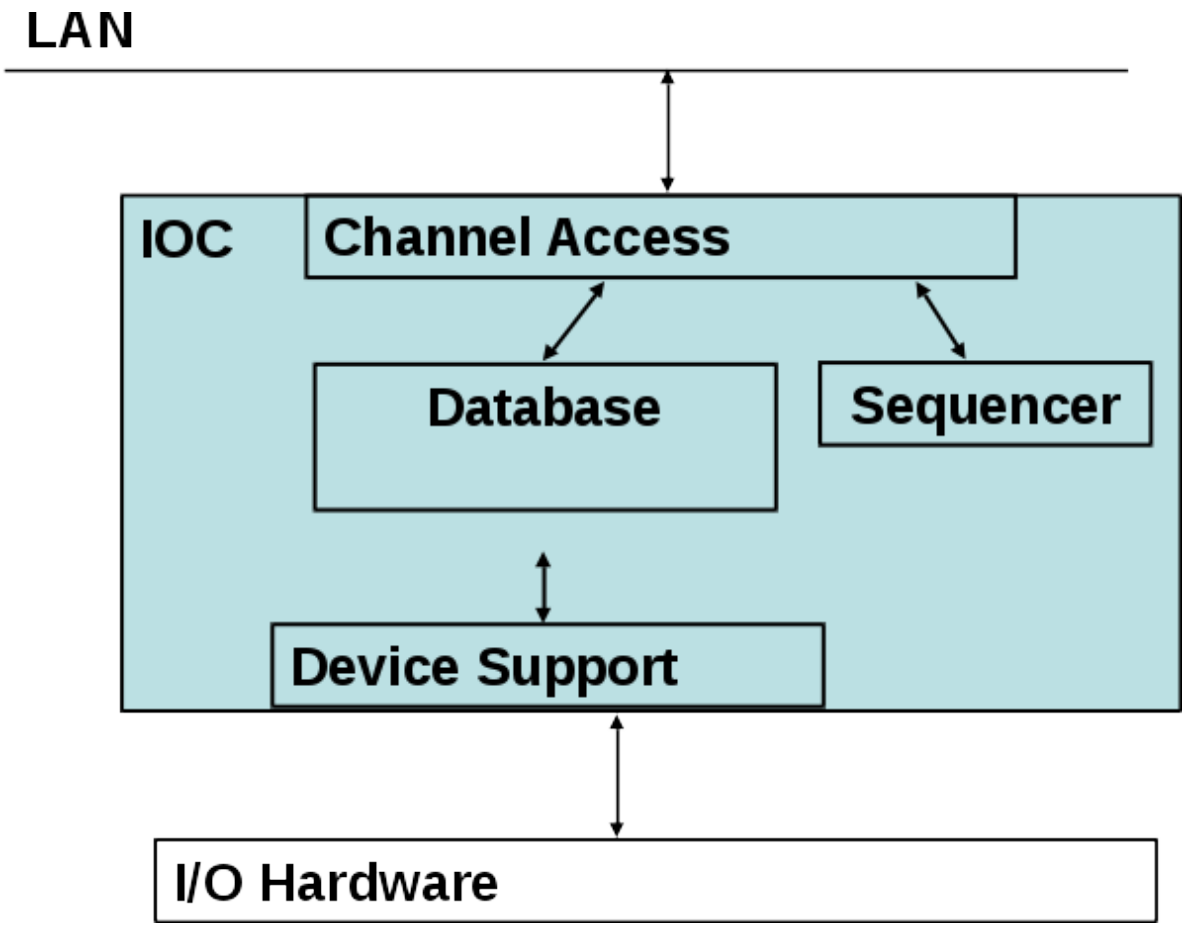


Key Feautures of IOC software

- Two primary application specific components:
  - The real-time database of records (required)
  - State Notation Language programs used to implement state oriented programs (finite-state machine, optional)
- Machine status, information and control parameters are defined as *records* in the application specific *database*.

Inside an IOC

The major software components of an IOC (IOC Core)



EPICS Records

- A record is an object with...
  - A **unique** name
    e.g. "PANDA:LMD:MUPIX:TEMP:H1:P2:M0:S1:D0:2:Tmom"
    (Temperature of MuPix sensor H1:P2:M0:S1:D0:2)
  - Controllable properties (fields) e.g. "EGU" (Engineering Unit)
  - A behavior - defined by its record type
  - Optional associated hardware I/O ($\Rightarrow$ device support)
  - Links to other records
- Records have some functionality associated with them (scaling, filtering, alarm detection, calculations, etc). Different record types have different functions and uses.
- *A record does nothing until it is processed!*
- Records can be processed periodically or event driven (Hardware interrupt, CAput, ...)

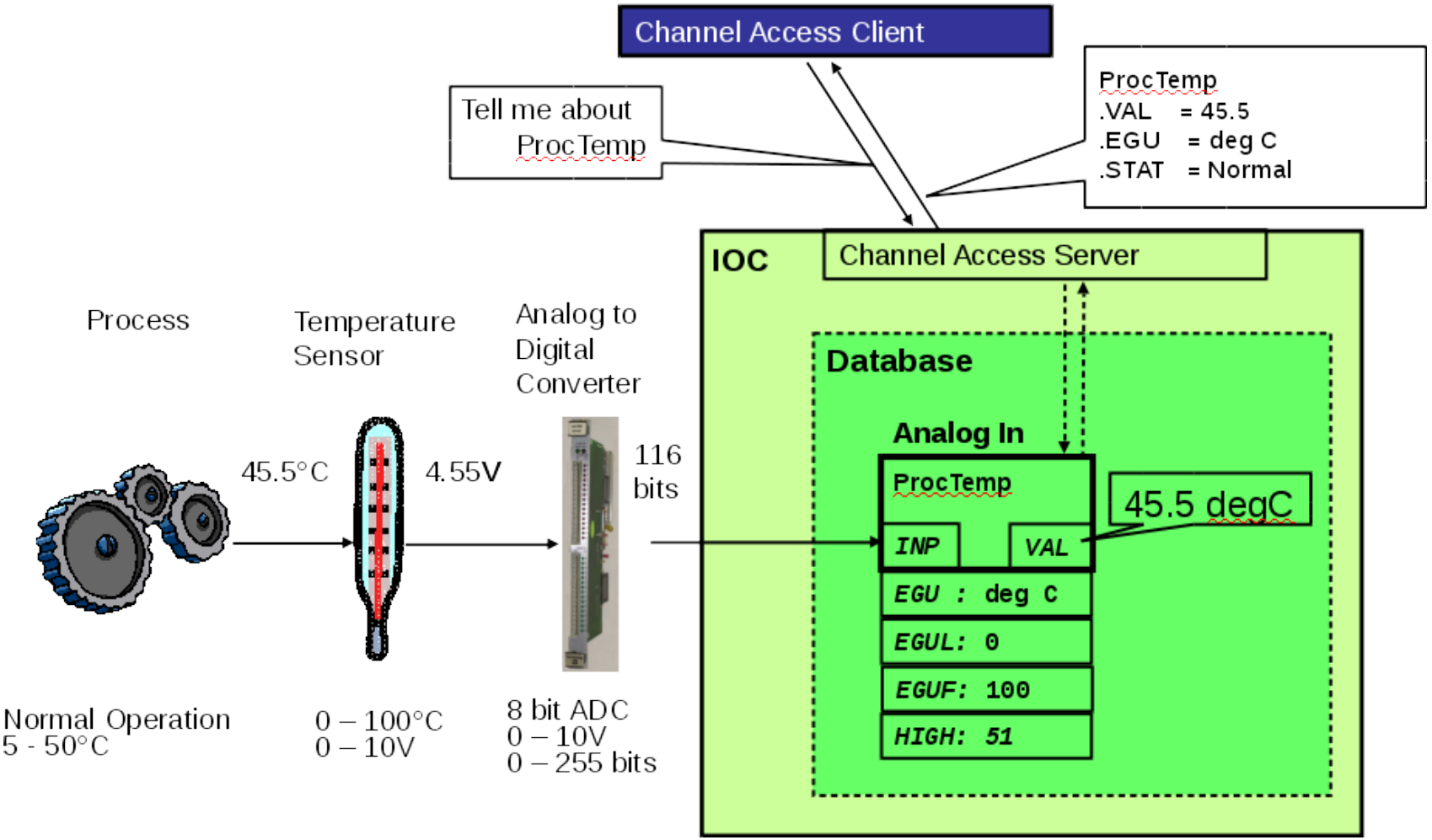
EPICS Records II

- Each field can be accessed individually by name
- A record name and field name combined give the name of a *process variable (PV)*
  e.g. "PANDA:LMD:MUPIX:TEMP:H1:P2:M0:S1:D0:2:Tmom.EGU"
- PV is named piece of data (with attributes)
- Examples for attributes: timestamp, status, alarm severity, ...
- CA uses PV names to access data

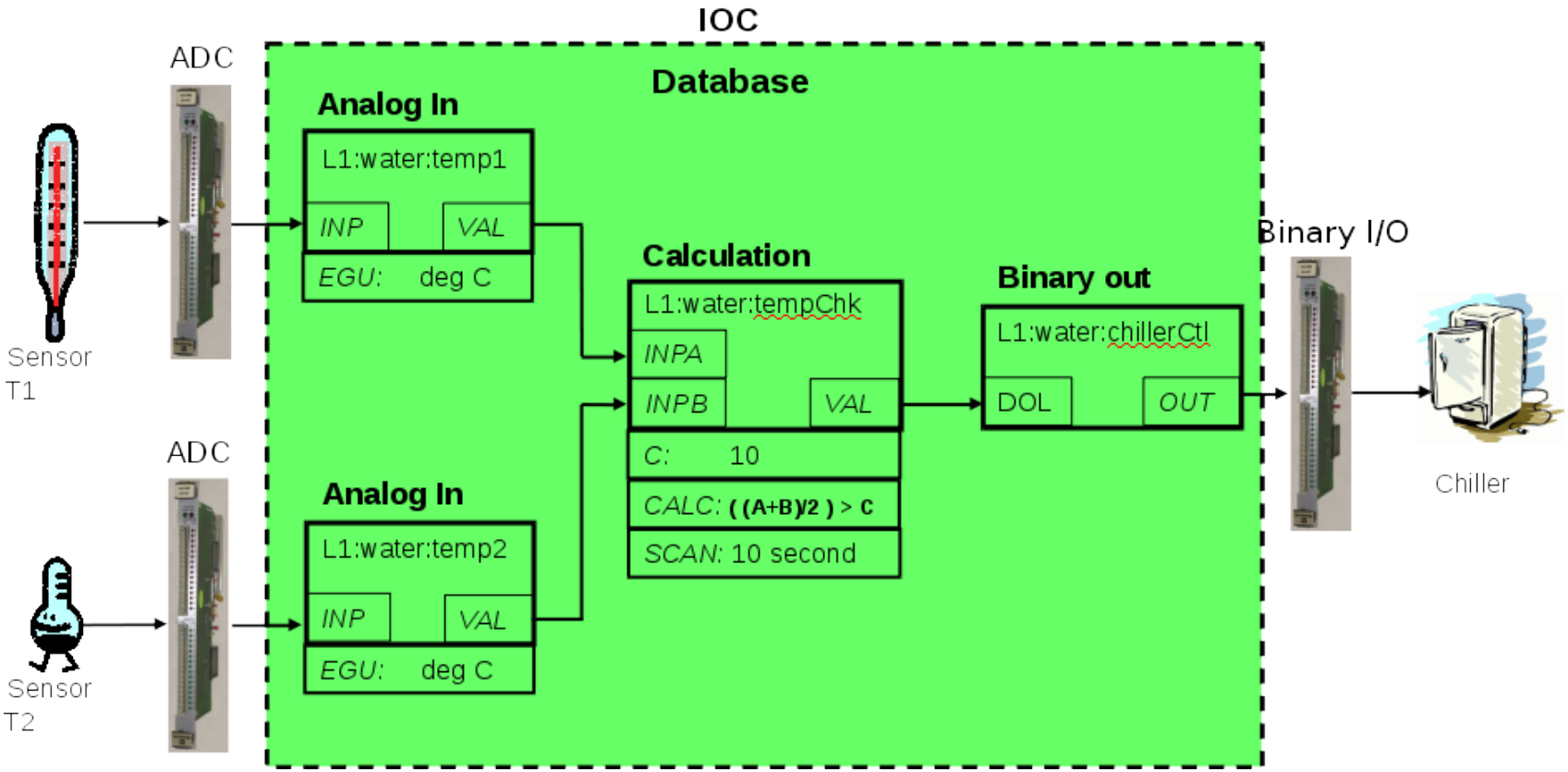
EPICS Database

- A collection of one or more EPICS records of various types
- Records can be interconnected and are used as building blocks to create applications
- A data file that's loaded into IOC memory at boot time
- Channel access talks to IOC's memory copy of database

A Simple Database



Database Processing



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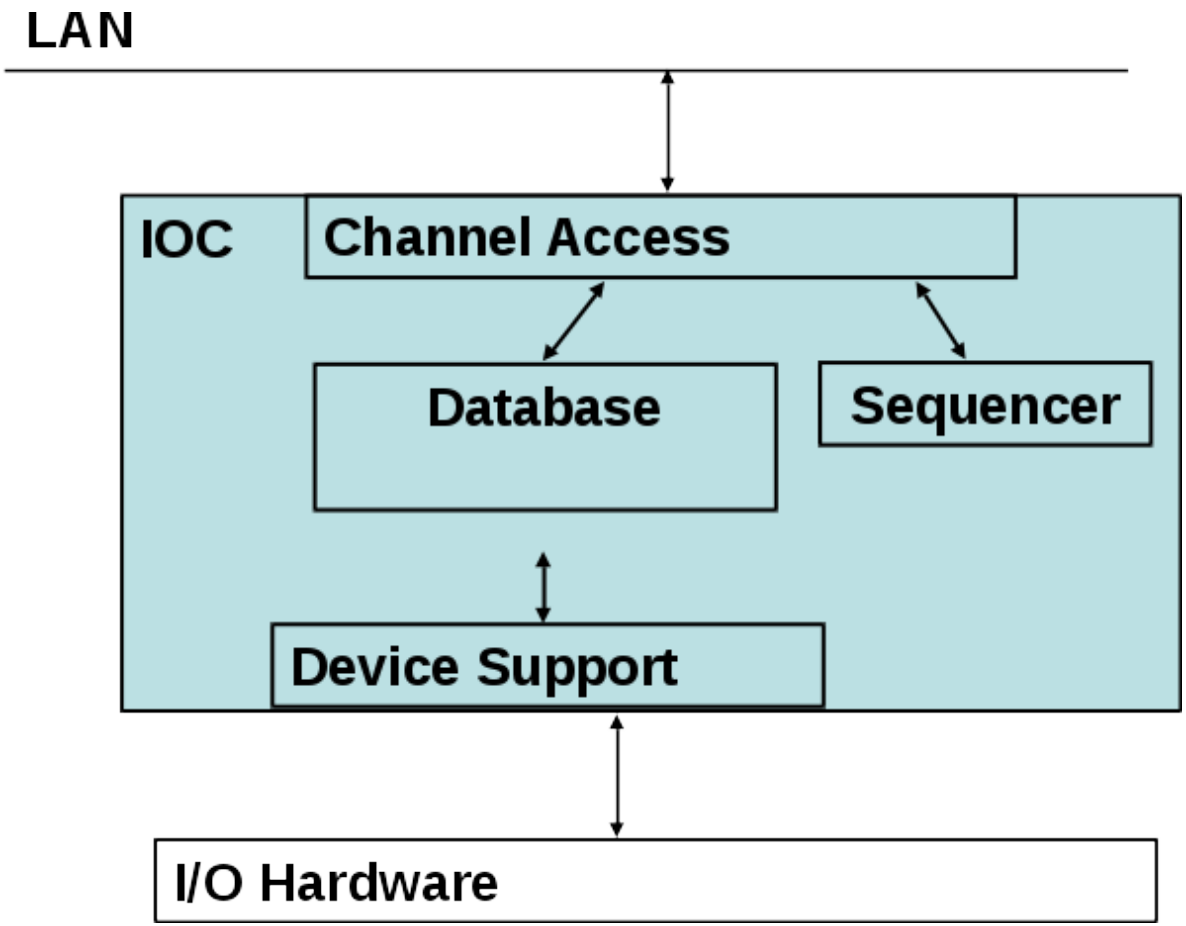

Device support

- Defines hardware I/O for a record type
- Simple *C* interface:
  init (global, per record instance), read/write, I/O interrupt handling
- Functions need to be implemented for each record type used
- Device Support uses underlaying API to hardware
  $\Rightarrow$ libtrbnet/DIM

- Device Support for DIM available:
  `https://github.com/zumbruch/EPICS-DIM`
  written by Peter Zumbruch (GSI)
  EPICS IOC can act as DIM server and DIM client

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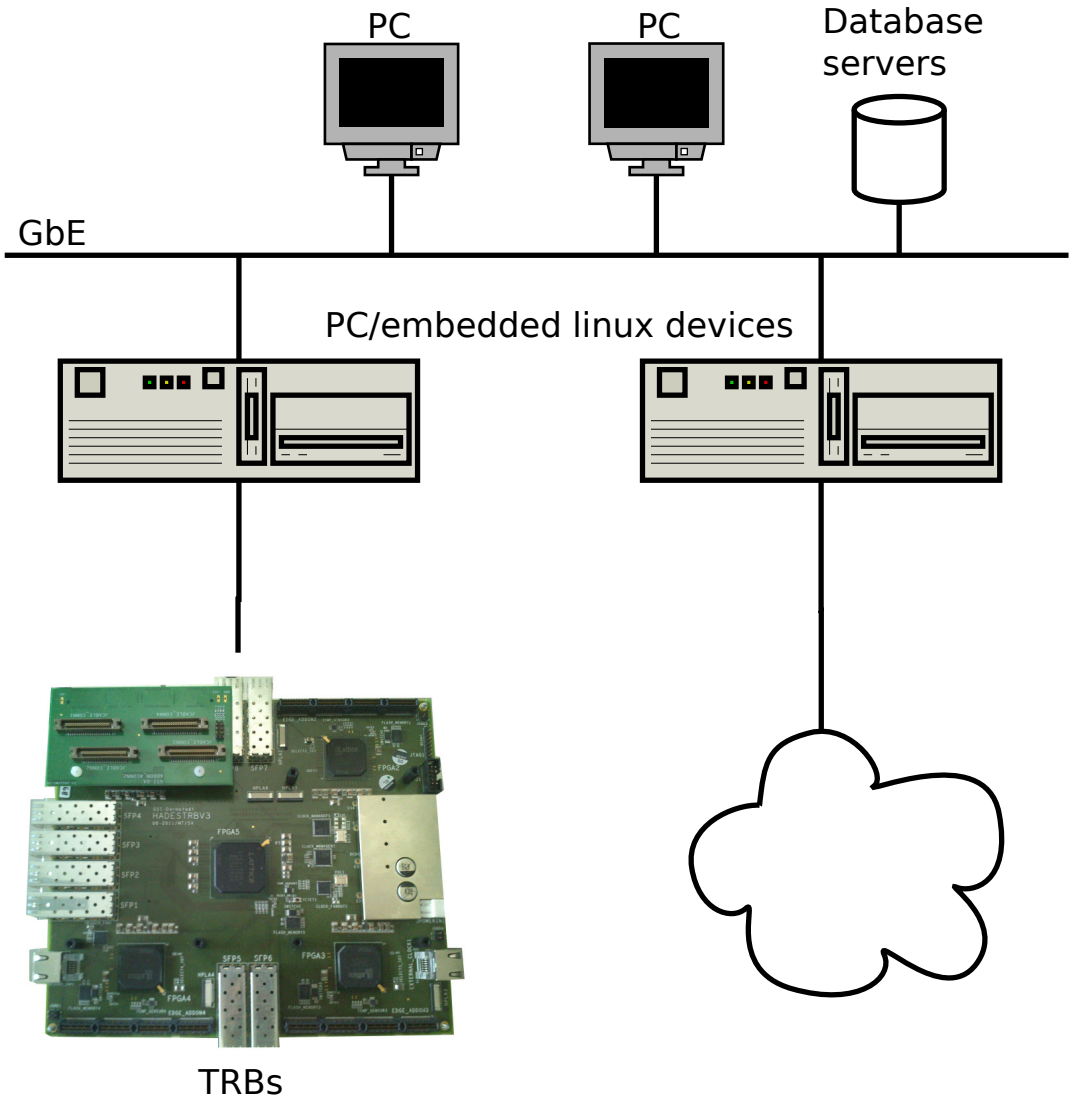

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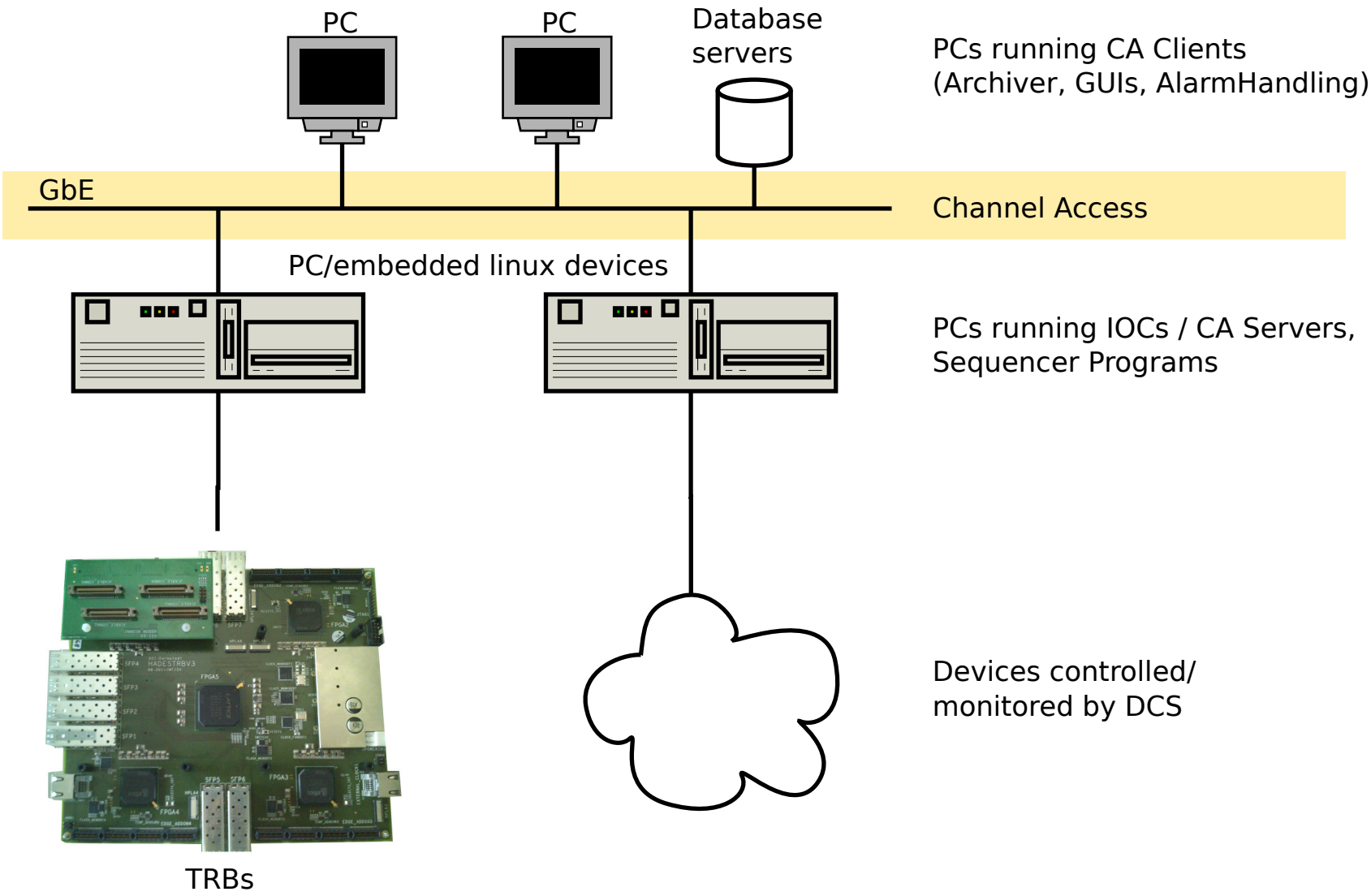
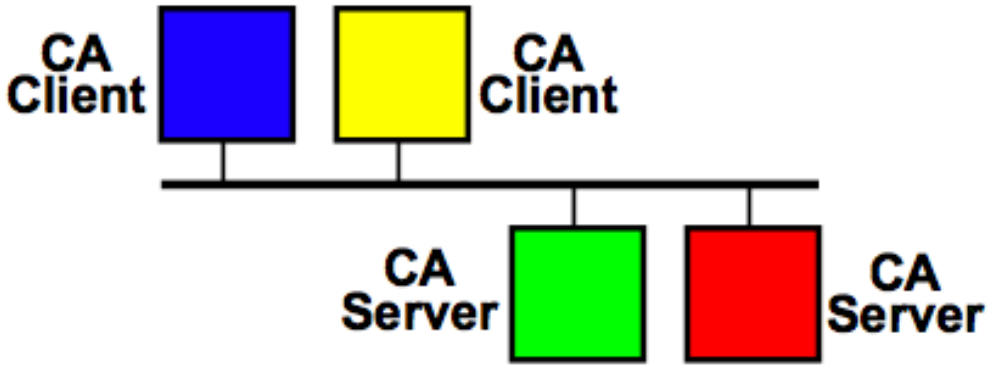


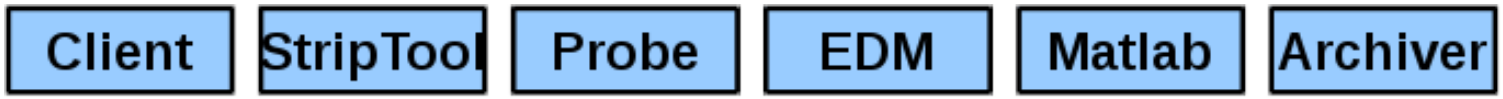
Channel Access Protocol

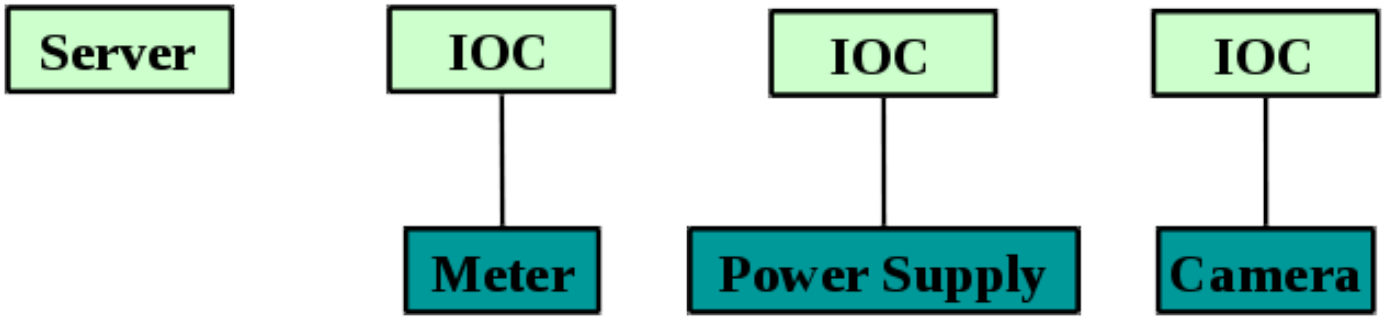
- Network-based "client/server" model
  Also known as "publish/subscribe"



- Channel Access (CA) is the protocol that connects clients and servers (virtual bus)
  - Very efficient (high troughput, low latency, no polling)
  - Robust (partial degradation, incremental recovery)
  - Self-configuring (uses "discovery" protocol)
  - Scalable (100s of elements, 100000s of connections)
  - Simple API: "set", "get", "monitor"

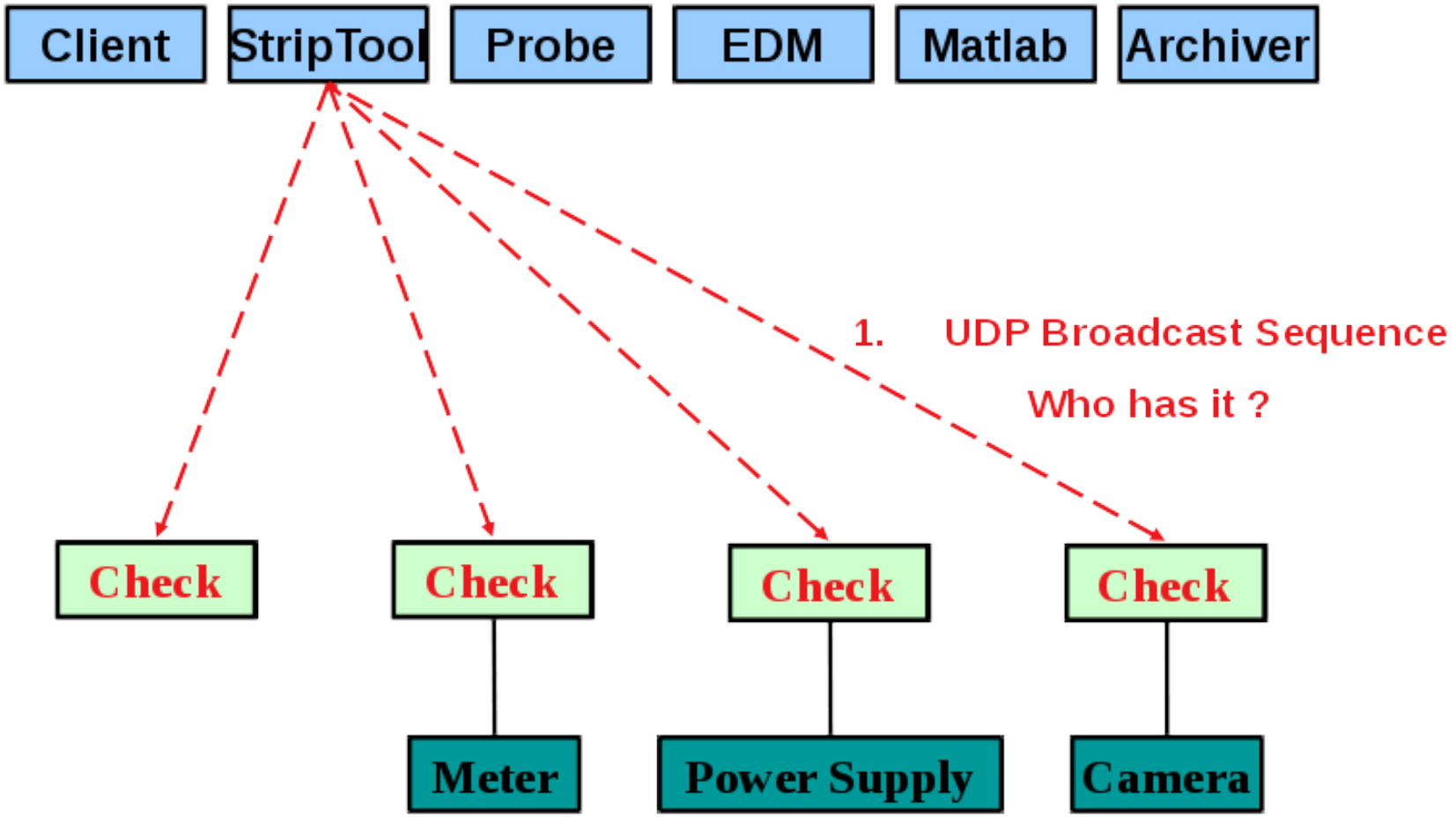
CA Search and Connect Procedure





Based On Getting Started with EPICS Lecture Series "Introduction to Channel Access Clients"
Kenneth Evans, Jr.

CA Search and Connect Procedure



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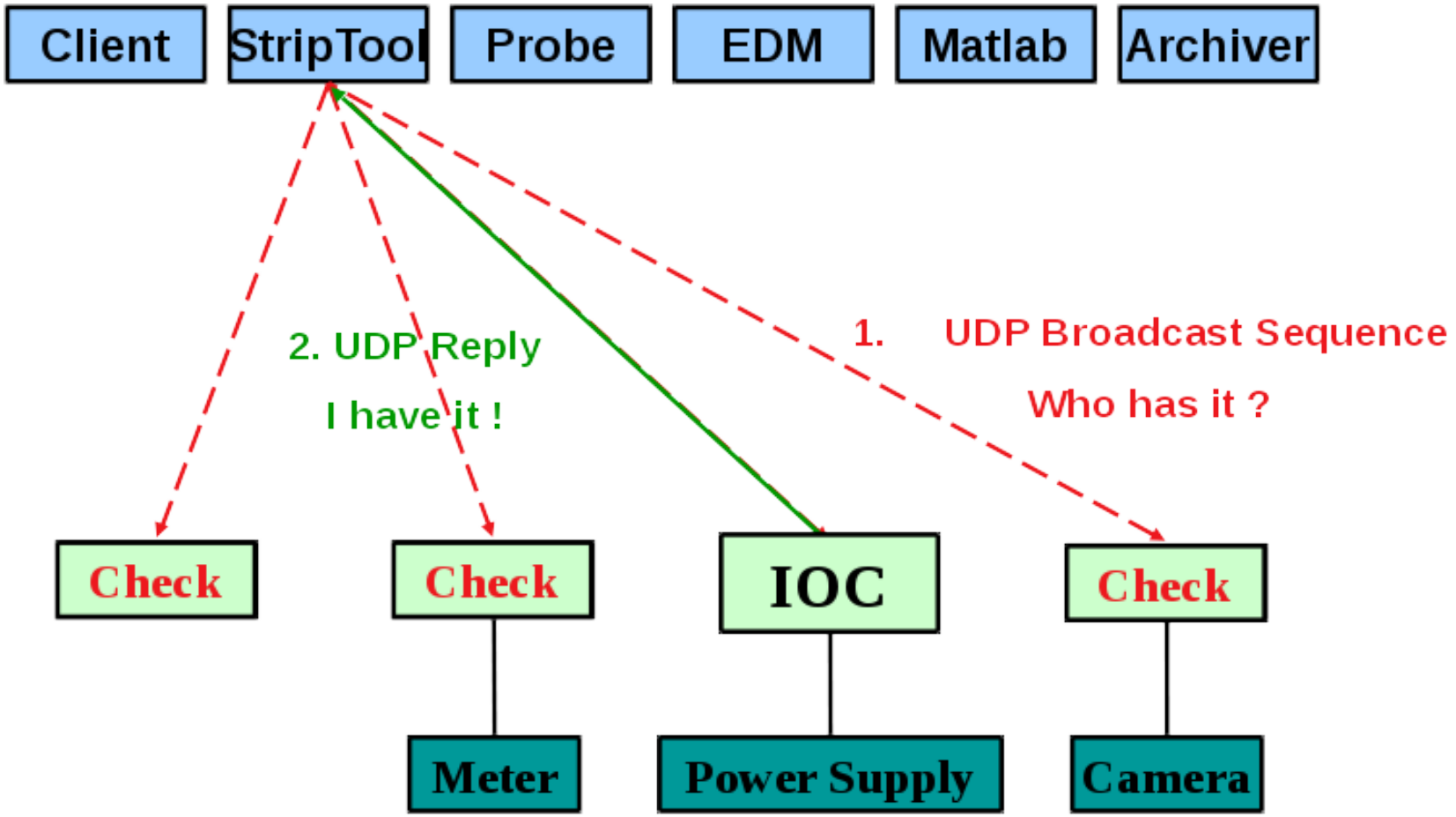

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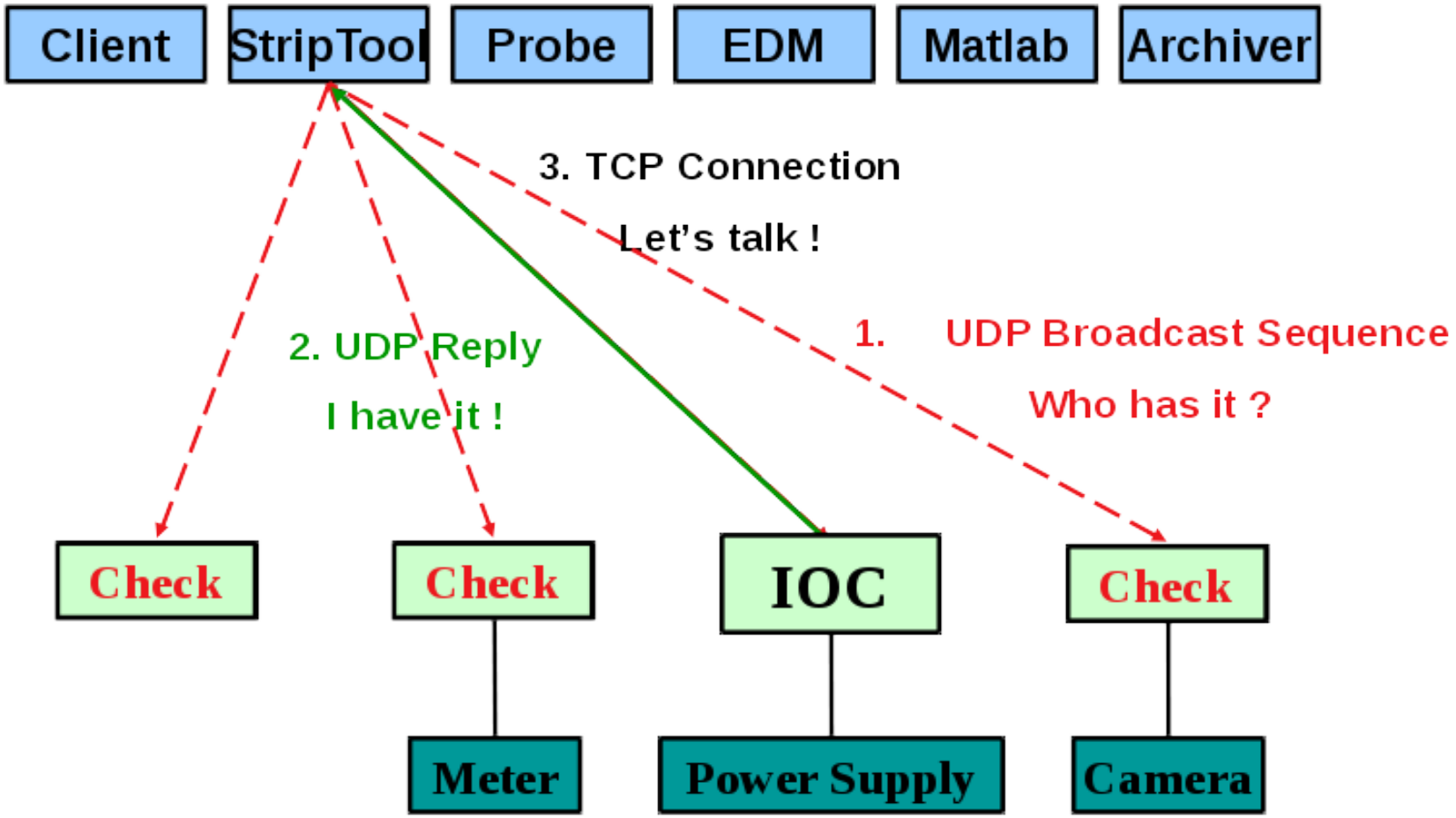

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Channel Access Client

- Alternative method to connect TRBnet/DIM with EPICS:
- Write stand-alone program for communication with TRB
- Interaction with EPICS via Channel Access (CA)
- CA implementation available for different programming languages: C, Perl, Python, Tck/TI, Java, ...
- CA is very efficient with a simple API
  BUT! Bad programming can easily kill network due to high traffic (overhead)

Conclusion

- Two possibilities to let EPICS talk with TRB:
  Device Support or Channel Access Client
- Need to think about requirements and goals!
- What do we want to do on the TRB/Front ends using EPICS?
  - Check Status of front end?
  - Monitor supply voltages?
  - Check firmware version?
  - Configure front end?
  - . . . ?