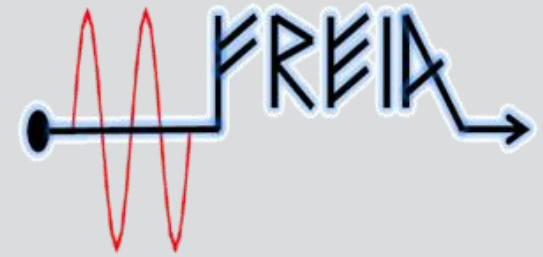




UPPSALA
UNIVERSITET

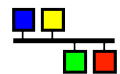


Diagnosics and Controls

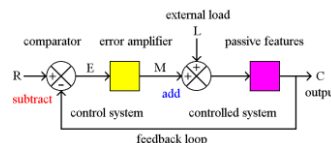
K. Gajewski

**ESS Spoke RF Source
Accelerator Internal Review**

EPICS



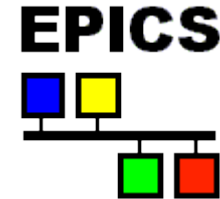
- EPICS
- Subsystems
 - Cryogenics
 - Vacuum
 - RF Power Supplies & Amplifiers
 - LLRF
 - Timing
 - Safety systems (MPS, PPS)
- Instrumentation
- Control System Studio
- Summary



Experimental Physics and Industrial Control System

Why EPICS?

- Has all features that we need at FREIA
- Mature, well maintained system
- Will be used at ESS
- EPICS drivers and device support for many commercial instrumentation
- Easy integration with PLCs
- Very wide users base and helpful community
- Scalable, suits well for both small and very large installations
- Ongoing projects on making EPICS easier to install, configure and maintain (CODAC at ITER, **I**ntegrated **C**ontrol **S**ystem at ESS)



- **Cryoplant**

- Will be delivered by Linde.
- Local controls based on Siemens Simatic S7-315 PLC
- Has interface to EPICS

- **Vacuum**

- Pumps
- Valves
- Vacuum gauges
- PLC controller



- **RF Power Supplies & Amplifiers**

- Anode PS
- Control Screen PS, Grid Screen PS
- Filament PS
- Solid State Amplifier

Controlled by Simatic PLC or/and via serial interfaces

- **LLRF**

- **Initial solution for tests on a dummy load**

- Function generator
 - Digital oscilloscope
 - Vector network analyzer
 - LabView

- **Final solution for the cavity tests**

- LLRF system supplied by ESS based on system developed at DESY

- **Backup solution**

- LIBERA - complete LLRF system from Instrumentation Technologies

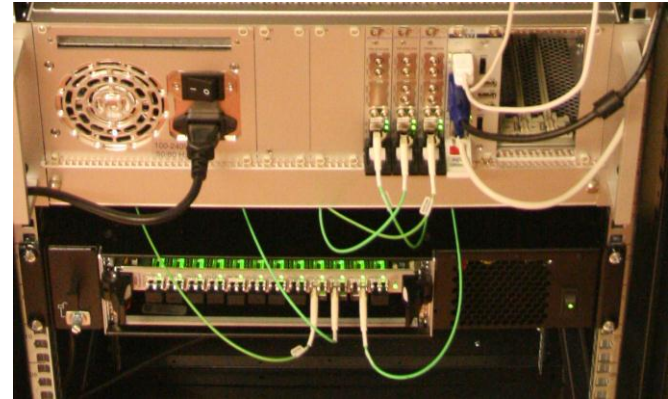


• Timing

Event generator

Micro-Research cPCI-EVG-230

- Front panel RF input and programmable divider /1, /2, /3, ..., /12, /14, ..., /20 to generate event clock
- Event clock rate 50 MHz to 125 MHz
- Front panel mains synchronization input
- 4 hardware inputs
- Optional side-by-side module for additional 6 inputs
- Up to 255 events
- Heart-beat
- Can be used for distribution of interlock signals



Event receiver

Micro-Research cPCI-EVR-230

- 2 front panel trigger inputs
- 2 universal I/O slots for four hardware outputs
- Optional side-by-side module for three additional universal I/O slots
- Jitter typically < 25 ps rms
- RF Clock 88.052500 MHz
- Event granularity ~110 ns

- **Machine Protection System**

- PLC for the "slow" interlocks – tenths of ms
- Fast interlocks implemented in hardware
- Interlock distribution possible on the timing system bus
- Post mortem data



- **Personnel Protection System**

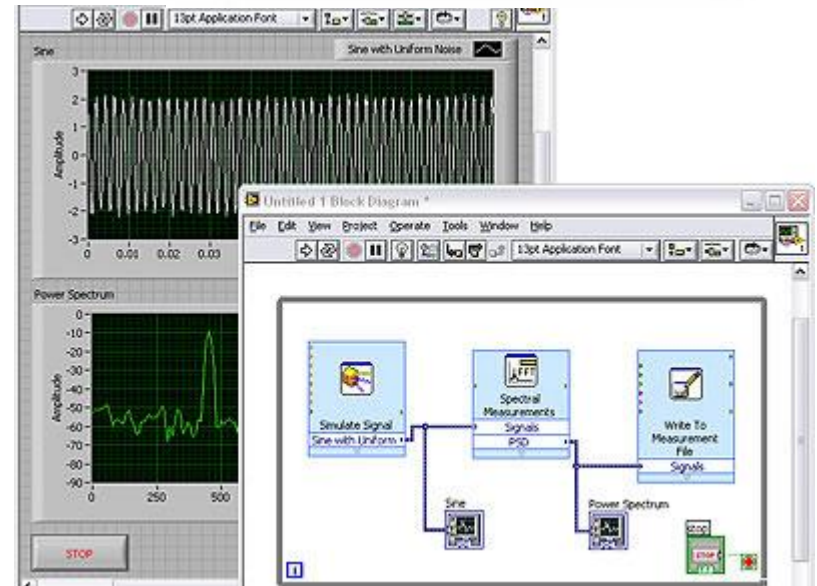
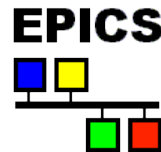
- Radiation protection system
- Access control
- RF leakage interlock



- Laboratory instruments
 - Digital oscilloscopes
 - Vector Network Analyzer with power measurement probes
 - Signal generators
- Programmed with LabVIEW

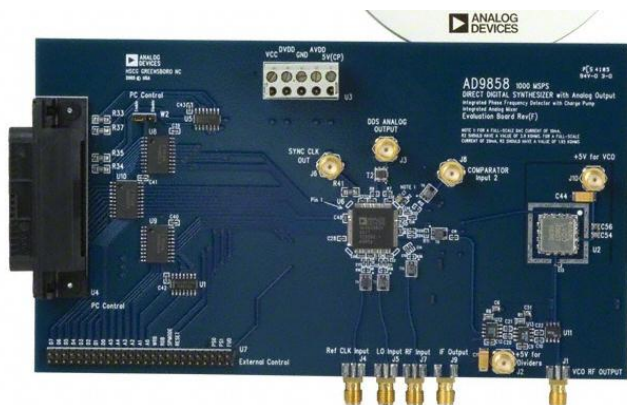
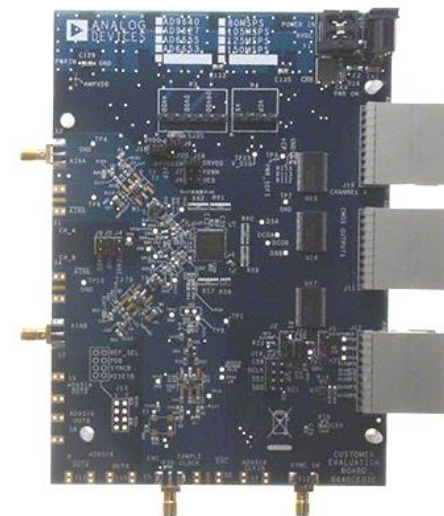


- Integrated with EPICS

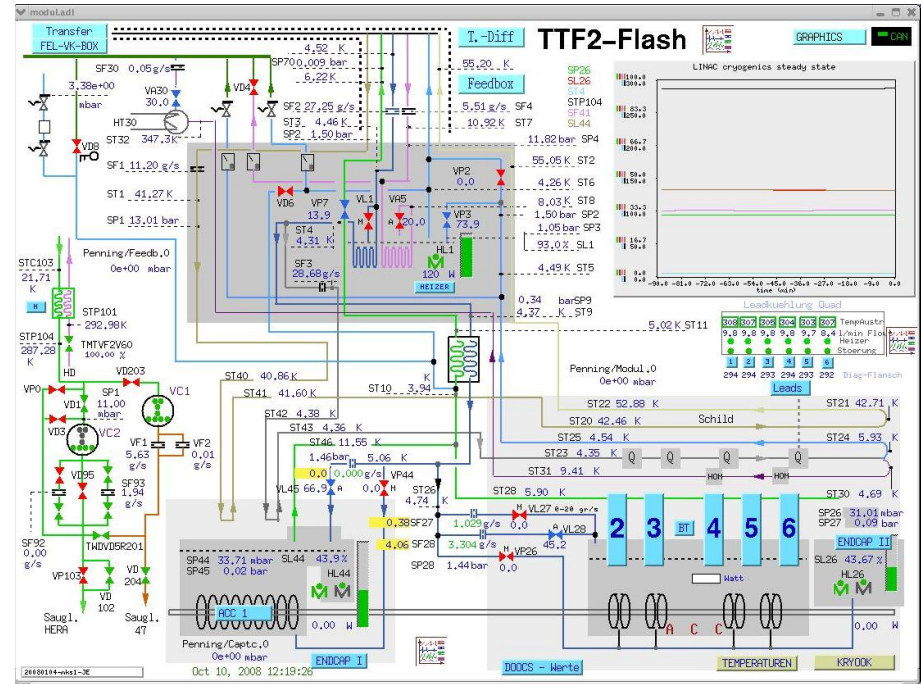


- Fast ADC for directly sampling the signals from the directional couplers and cavity antenna
 - sampling at 150 MSa/s, 14 bits,
 - input bandwidth > 400 MHz
 - no need for mixers
 - inexpensive system

- Direct digital synthesizer (DDS) for generating RF signal to the cavity



- Control System Studio (CSS)
 - GUI interface (BOY)
 - Alarm toolkit (BEAST)
 - Archiver (BEAUTY)
 - Set/Restore (PV Table)
 - Testing and Debugging Tools



Synchronize ba... Console Alarm Treeview Properties

- Plattenplatz
- Rechner-Räume
 - Geb- Send Acknowledgement
 - Geb- Run Alarm Display
 - Geb- Run Display
 - Systems Open Strip Chart
 - TTF Show Help Guidance
 - BATTERIE Open Help Page
 - Helium_Ki Delete
 - Pumpenh Create Record
 - GLYK Create Subcomponent
 - HAUF
 - Kuehlturmkreis
 - TT:K:WK:T1:PrDlu | mbbi

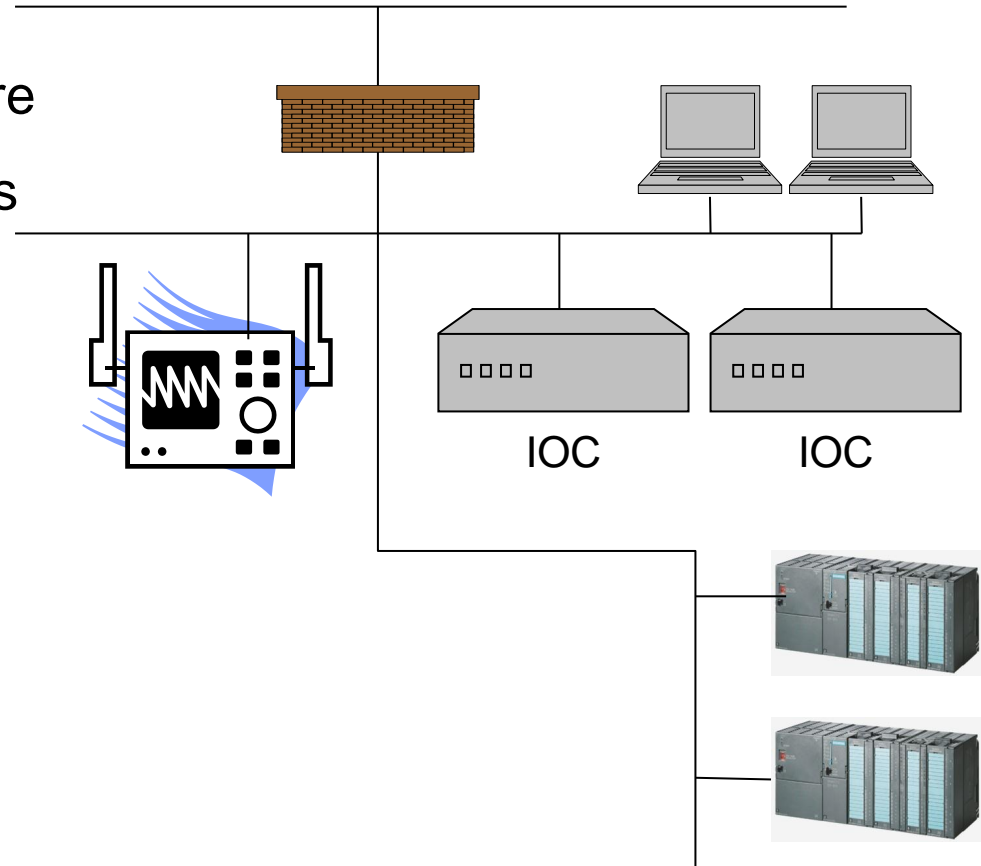
| Property | Value |
|---------------|---|
| alarm display | /CSS/SDS/hera/klima/klima54+55.css-sds |
| display | /CSS/SDS/hera/klima/klima54+55.css-sds |
| help guidance | Zur Zeit gibt es keine Überwachung der Kaltwassersaetze durch die Kontrolltechniker! |
| help page | http://elogbook.desy.de:8080/eLogbook/index.html |
| name | Rechner-Räume |
| object class | epicsComponent |
| strip chart | /CSS/DataBrowser/Rechnersysteme/Rechnerraume-Temperaturen.css-plt |

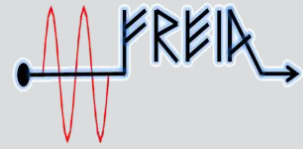
Done so far:

- Chosen the system architecture
- Identified the main subsystems and the way to integrate them
- Set-up EPICS test system
- Connection to Siemens PLC
- Tested Control System Studio

In the pipeline:

- LabVIEW \leftrightarrow EPICS
- Set-up an IOC (Control Box) for the timing system and I/O modules

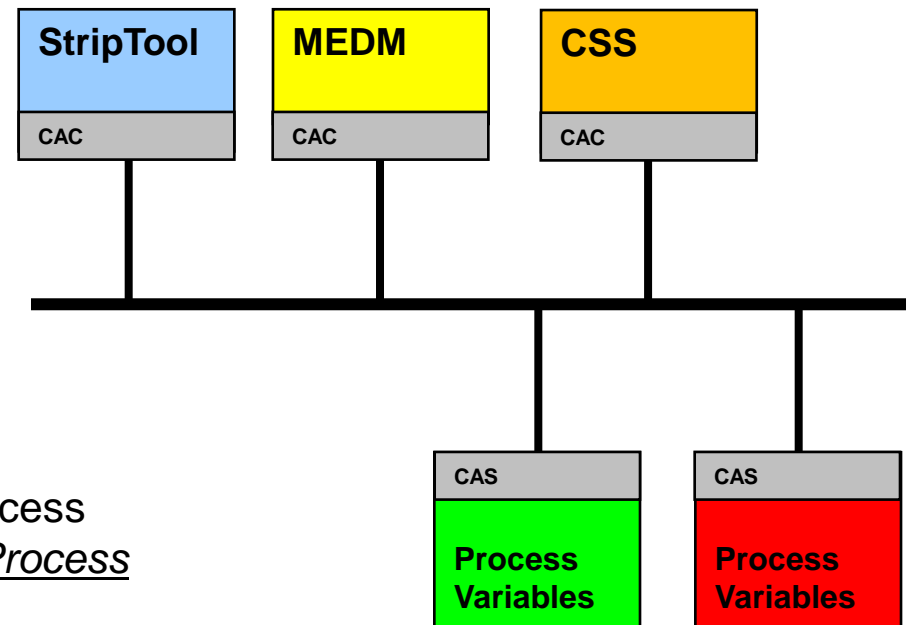




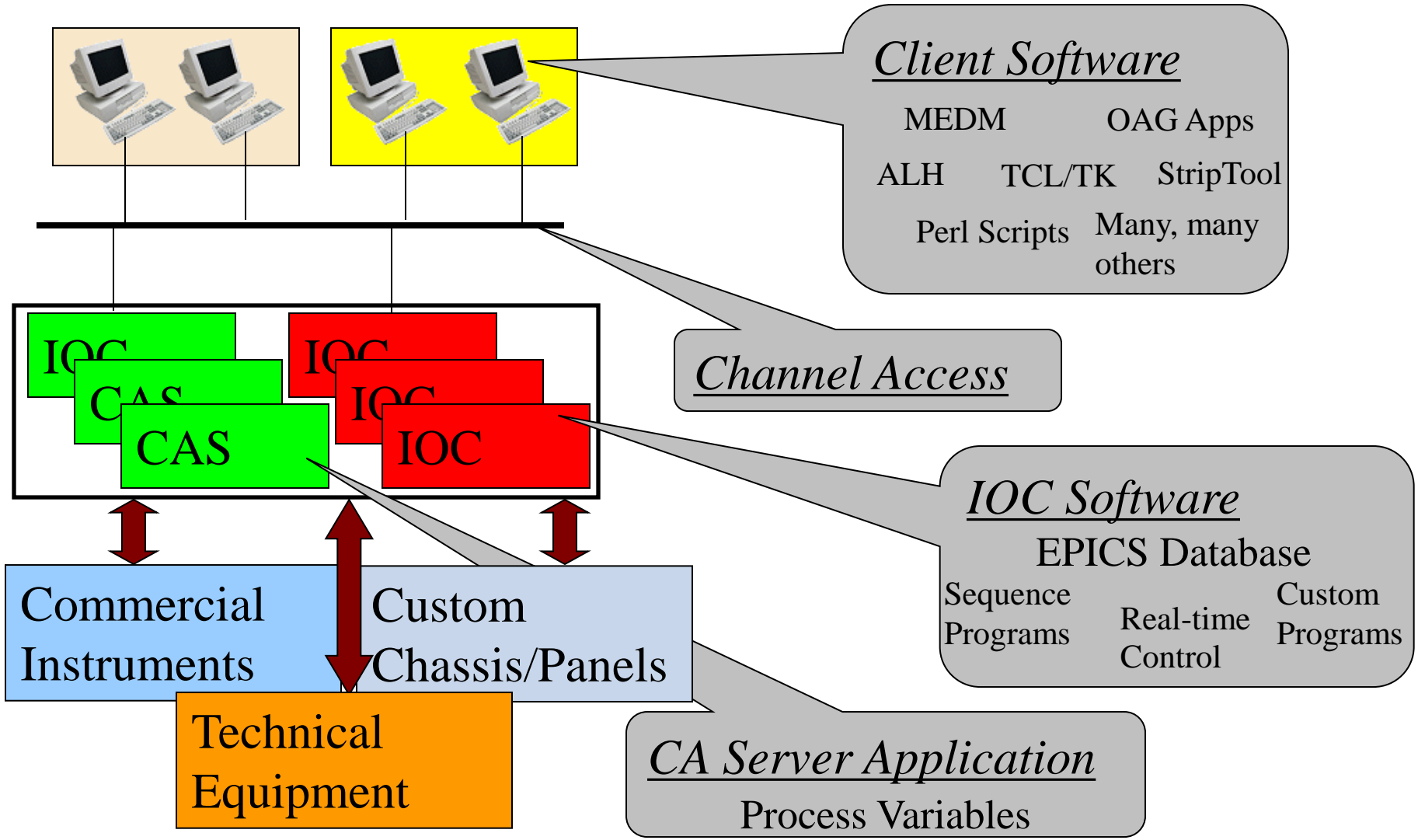
- Extra slides (not to be shown if not requested)

- A Collaboration
- A Control System Architecture

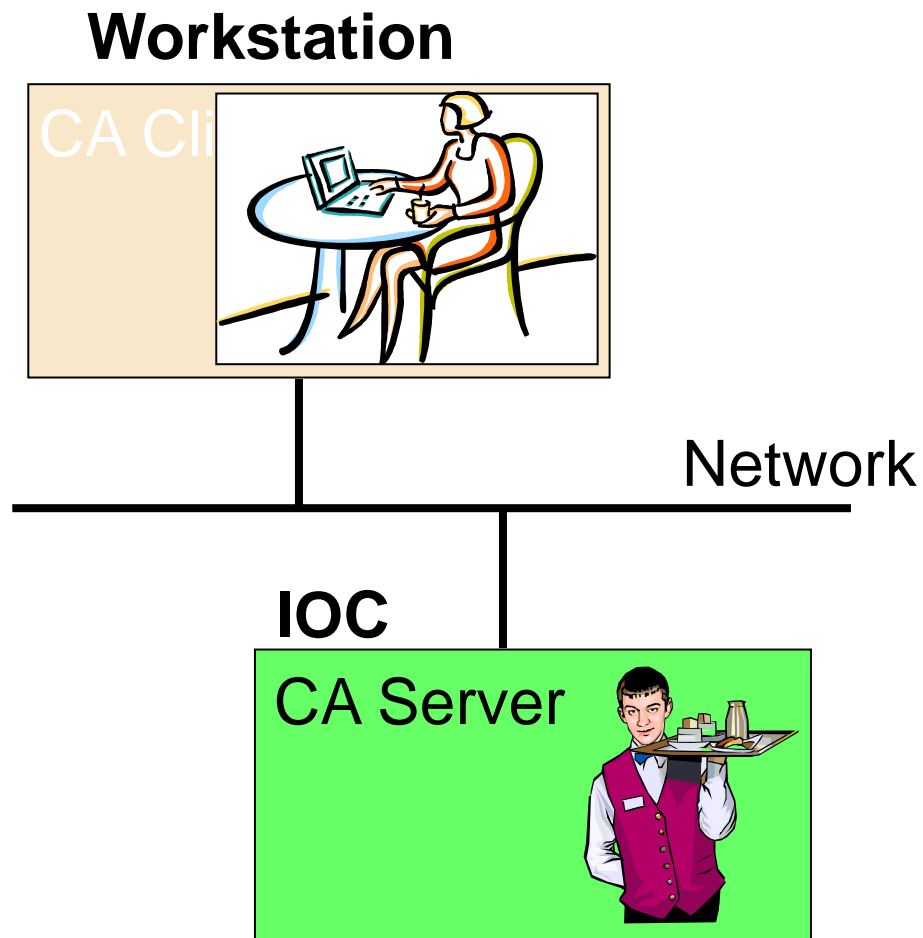
Channel Access *clients* are programs that require access to Process Variables to carry out their purpose



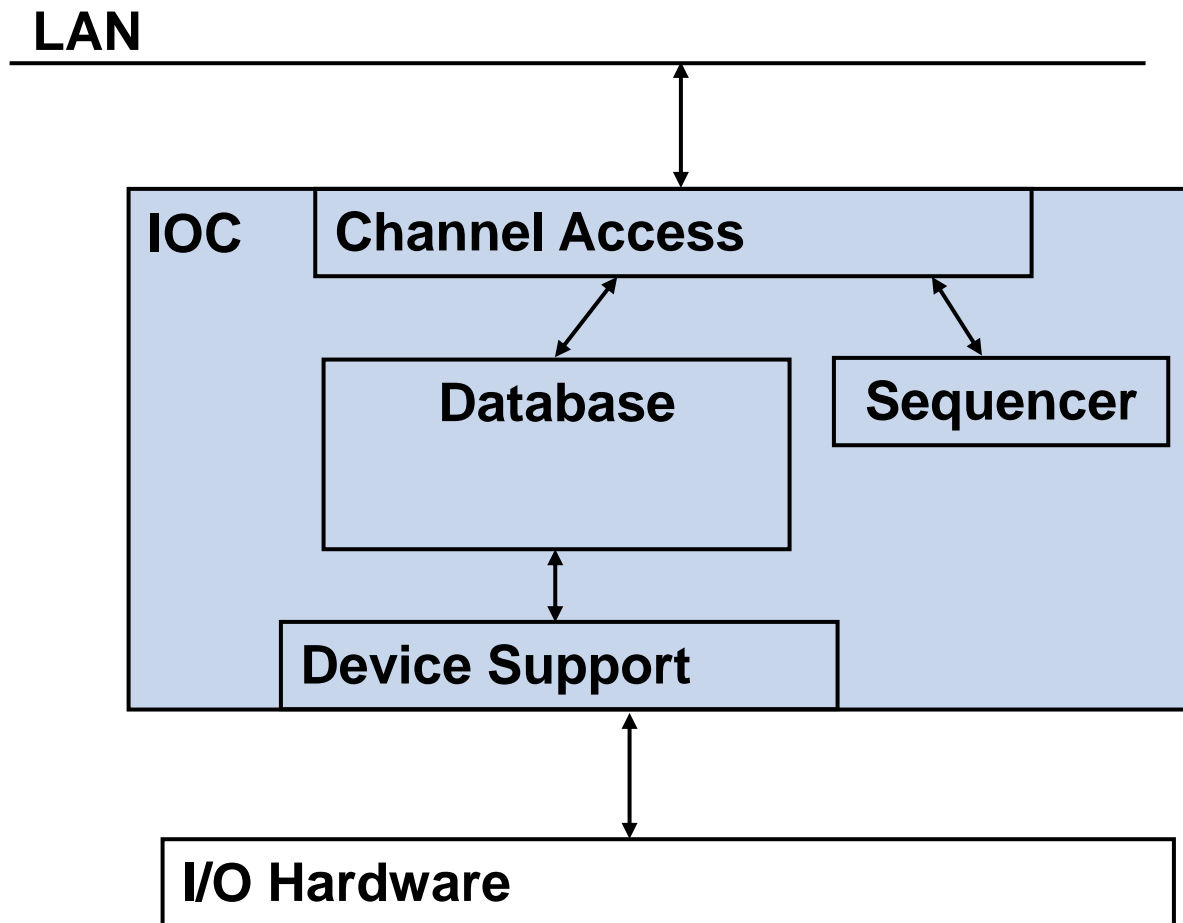
The “service” that a Channel Access server provides is access to a Process Variable*



- Allows other programs (CA Clients) to see and change values of Process Variables in an IOC (CA Server)
- CA Clients may
 - Put (write)
 - Get (read)
 - Monitor data of Process Variables
- IOCs are both CA clients and CA servers. They can interact with data in other IOCs
- A CA Client can connect to many servers
- A CA Server may serve many clients
- A very efficient and reliable protocol



The major software components of an IOC (IOC Core)



- Supported hardware:
- **ADLINK cPCI-3965(4HP) (CPU Core2 Duo, 2.2 GHz, VGA, 2 GigE, 2 USB)**
http://www.adlinktech.com/PD/marketing/Datasheet/cPCI-3965/cPCI-3965_Datasheet_en_1.pdf
- **ADLINK cPCI-9116 (64-ch 16-bit 250 kS/s, 1 timer/counter, 8 DI, 8 DO DAQ)**
http://www.adlinktech.com/PD/marketing/Datasheet/cPCI-9116+R/cPCI-9116+R_Datasheet_1.pdf
- **ADLINK cPCI-6216v (16-ch 16-bit D/A, bipolar outputs, 4 DI, 4 DO)**
http://www.adlinktech.com/PD/marketing/Datasheet/cPCI-6208+6216Series/cPCI-6208+6216Series_Datasheet_en_1.pdf
- **ADLINK cPCI-7230 (isolated 16 DI & 16 DO, 2 ext. interrupt sources)**
http://www.adlinktech.com/PD/marketing/Datasheet/cPCI-7230/cPCI-7230_Datasheet_en_1.pdf
- **Micro-Research cPCI-EVG-230 (event generator)**
- **Micro-Research cPCI-EVR-230 (event receiver)**
- areaDetector module provides support for Allied Vision Technologies (formerly Prosilica). It interfaces their GigE and Firewire interfaces
<http://www.alliedvisiontec.com/emea/products/cameras/gigabit-ethernet/manta.html>
- **Siemens PLC (via TCP/IP using s7plc driver)**

