Improving Reliability: Redundant IOC for ATCA and automation of EPICS system tests

Accelerator Reliability Workshop
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Artem Kazakov, KEK/SOKENDAI

How to improve Reliability of a Control System:

- Design with high availability in mind
- Use better Software
- Implement redundancy for critical parts
- Etc...

Outline: Redundant EPICS IOC for ATCA

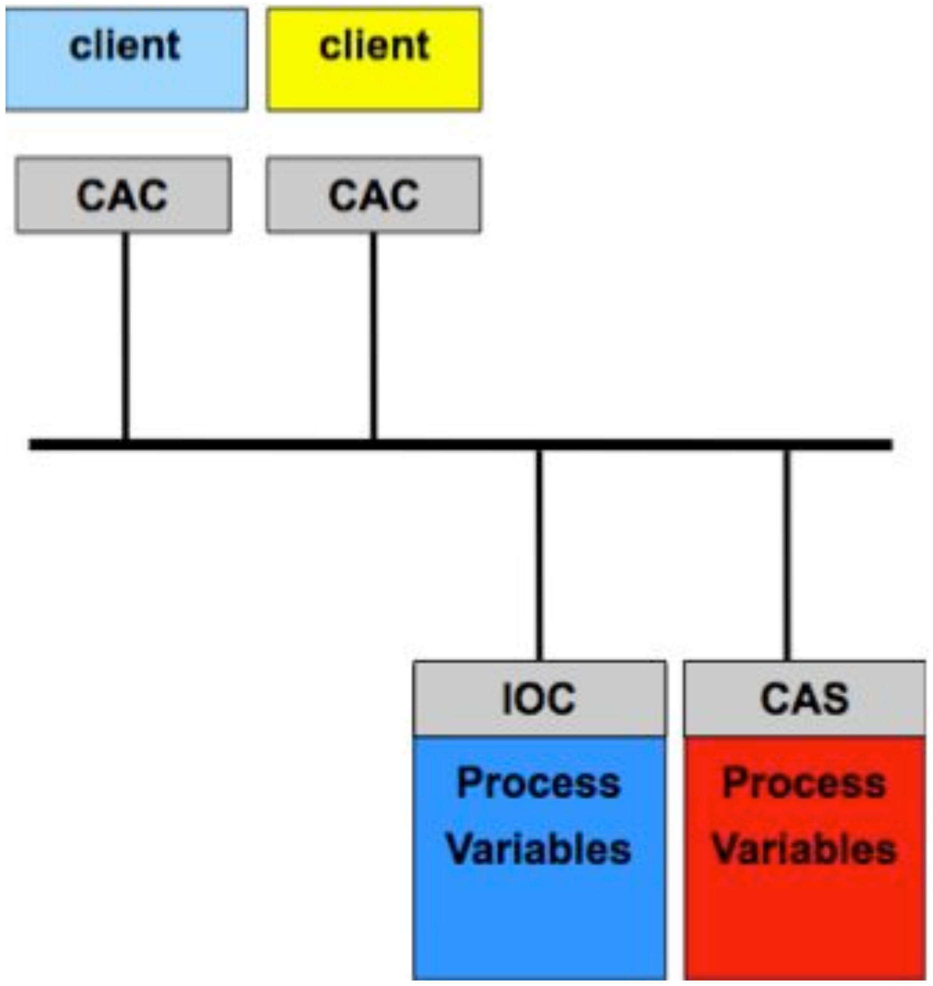
- Brief introduction of EPICS, IOC, RIOC
- What is ATCA and why do we want it?
- RIOC + ATCA features and benefits
- Conclusion

EPICS: Experimental Physics and Industrial Control System

- EPICS is a set of software tools and applications which provide a software infrastructure for use in building distributed control systems
- It is used to operate Particle Accelerators, Large Experiments and Telescopes

EPICS

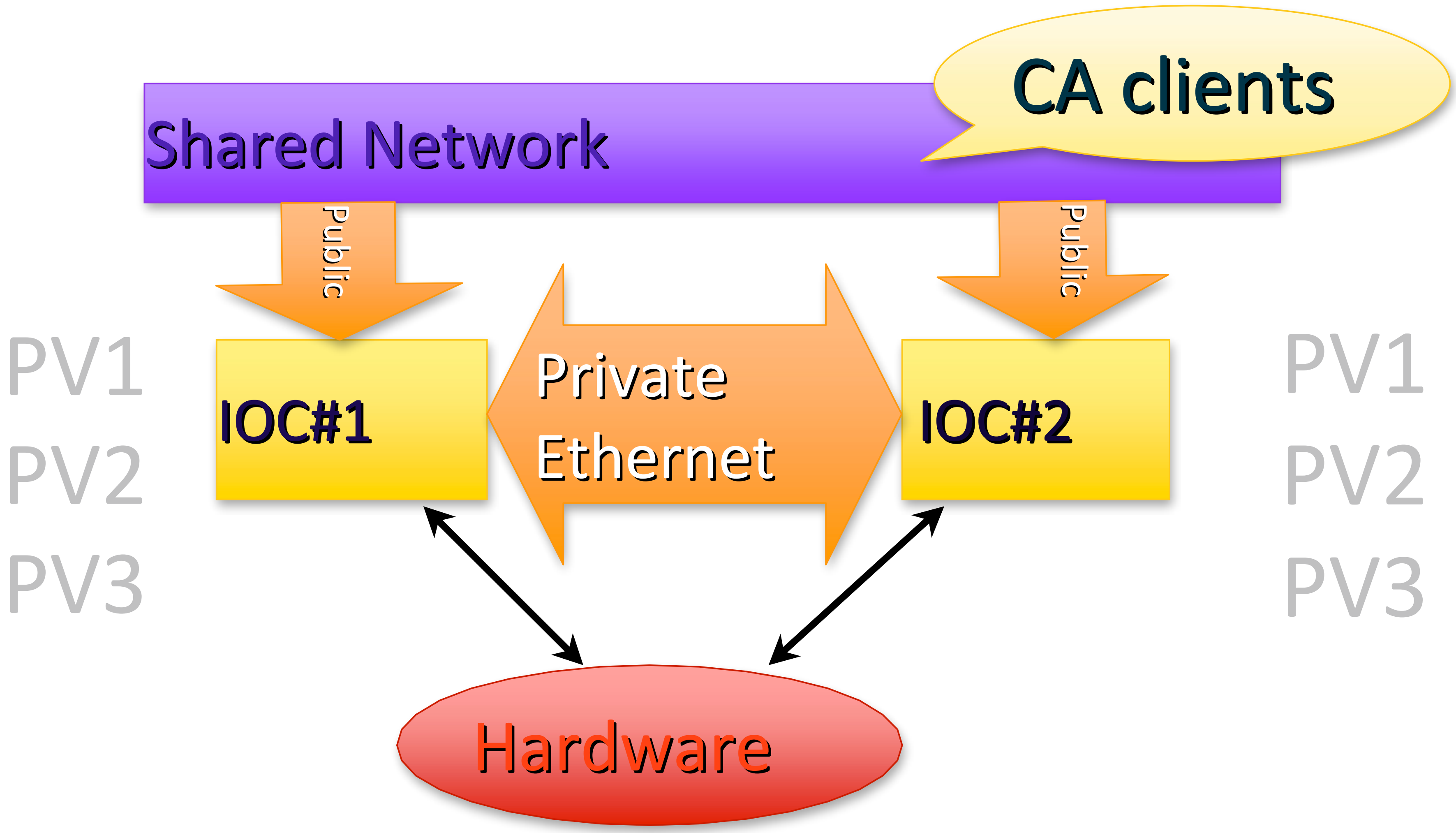
- Client/Server model
- Communication protocol: Channel Access (CA)
  - CAC: client
  - IOC/CAS: server
- PV: Process Variable
  - Named Piece of Data



Redundant IOC

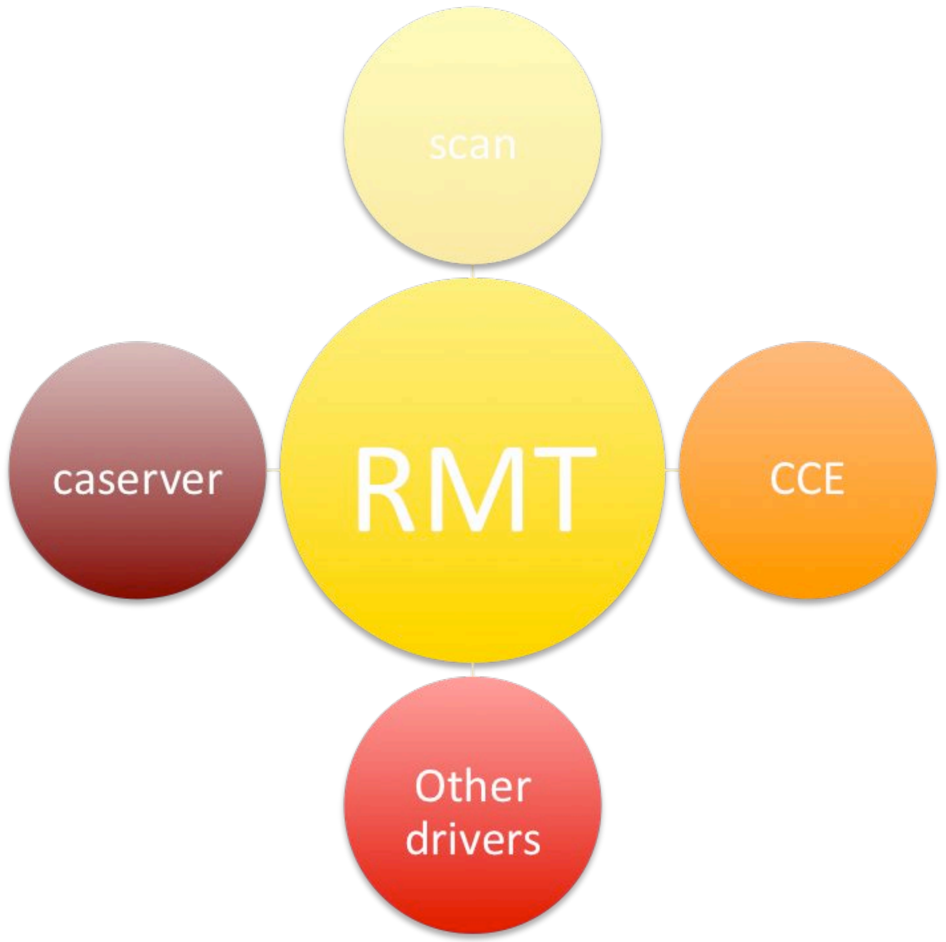
- Provides redundancy support for EPICS IOCs
- Developed at DESY, Germany
- Supported in “official” EPICS distribution since v3.14.10 release
  - No need to patch/reconfigure/recompile BASE
  - Just download RIOC libs and link them to your IOC to make it redundant

What is redundant IOC?



Redundancy Monitoring Task(RMT) - Key component of RIOC

- Controls drivers
- Monitors “health” of the drivers
- Checks the partner status
- Decides when to failover (or not to)



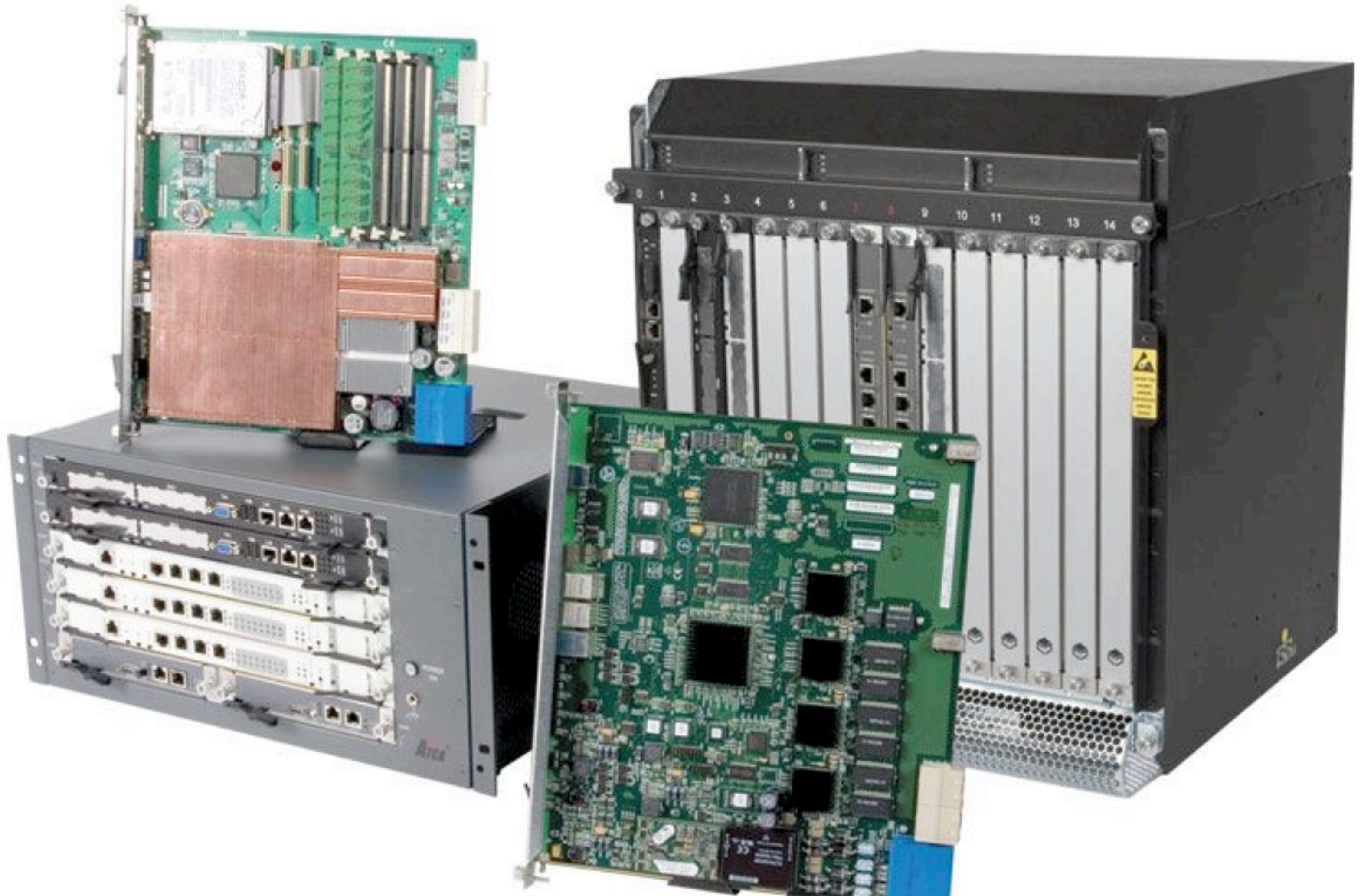
RMT – Key component of RIOC

- Independent from EPICS core facilities
  - It uses libCom though
- Defines RMT driver interface API
  - Which is very simple and easy to use
- Can be used to make other software redundant
  - i.e. caGateway

Advanced Telecom Computing Architecture (AdvancedTCA)

- Defined by PCI Industrial Computer Manufacturers Group with 100+ companies participating
- Targeted to requirements for the next generation of carrier grade communications equipment
- Incorporates the latest trends in high speed interconnect technologies, next generation processors and improved reliability, manageability and serviceability

AdvancedTCA chassis and blades



Why run RIOC on ATCA?

- ATCA is a modern industry standard for HA applications
  - Supposed to be very reliable (99.999% design availability)
- ATCA is suggested as a platform for the ILC control system
- ATCA is a hardware designed for critical applications and RIOC is a software designed for critical applications

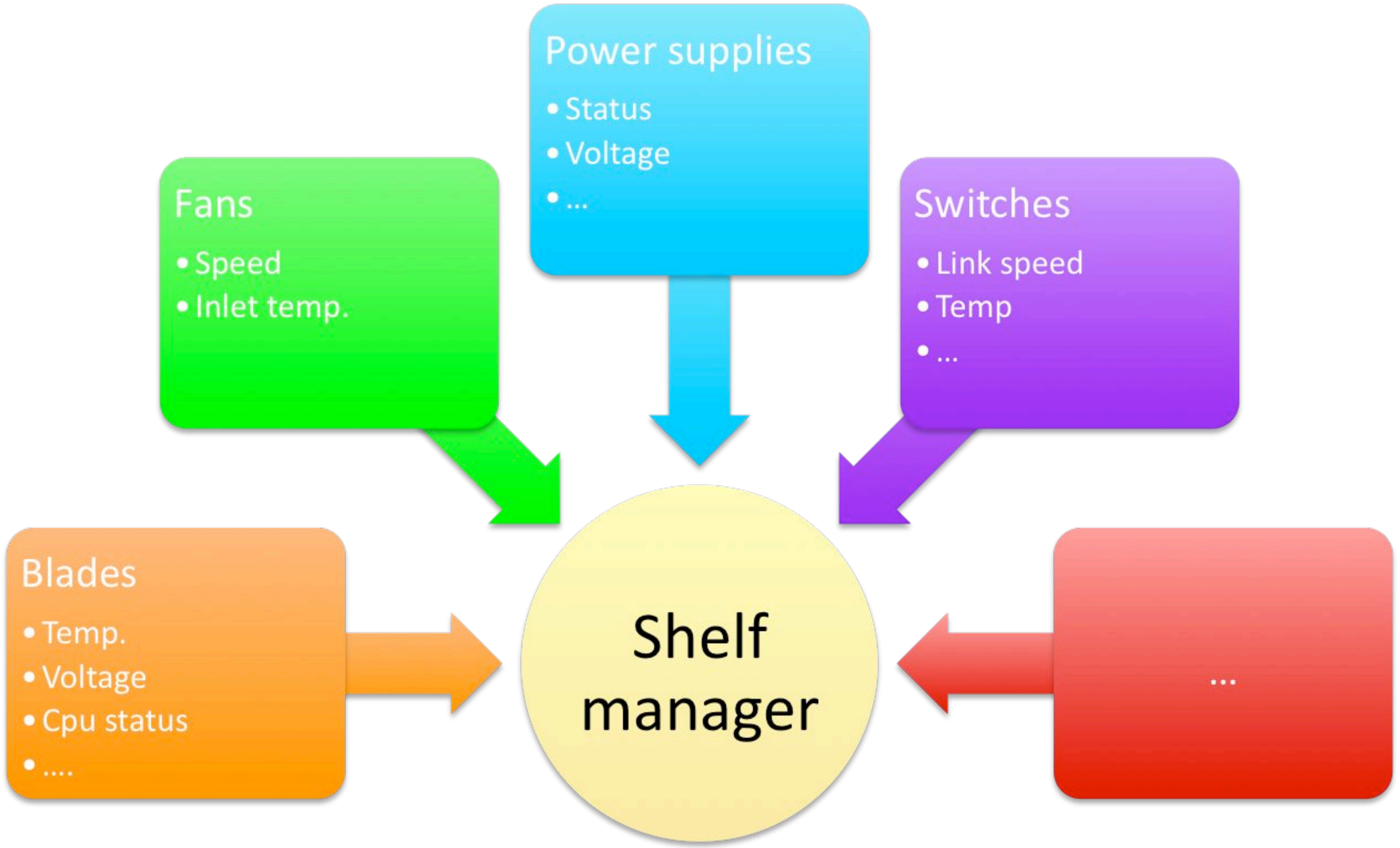
ATCA Features

ATCA provides monitoring and management controls for many parts of the system: fans, network connection, power supplies, bios images, boot ROMs etc…

- The key role in this process is played by Shelf Manager

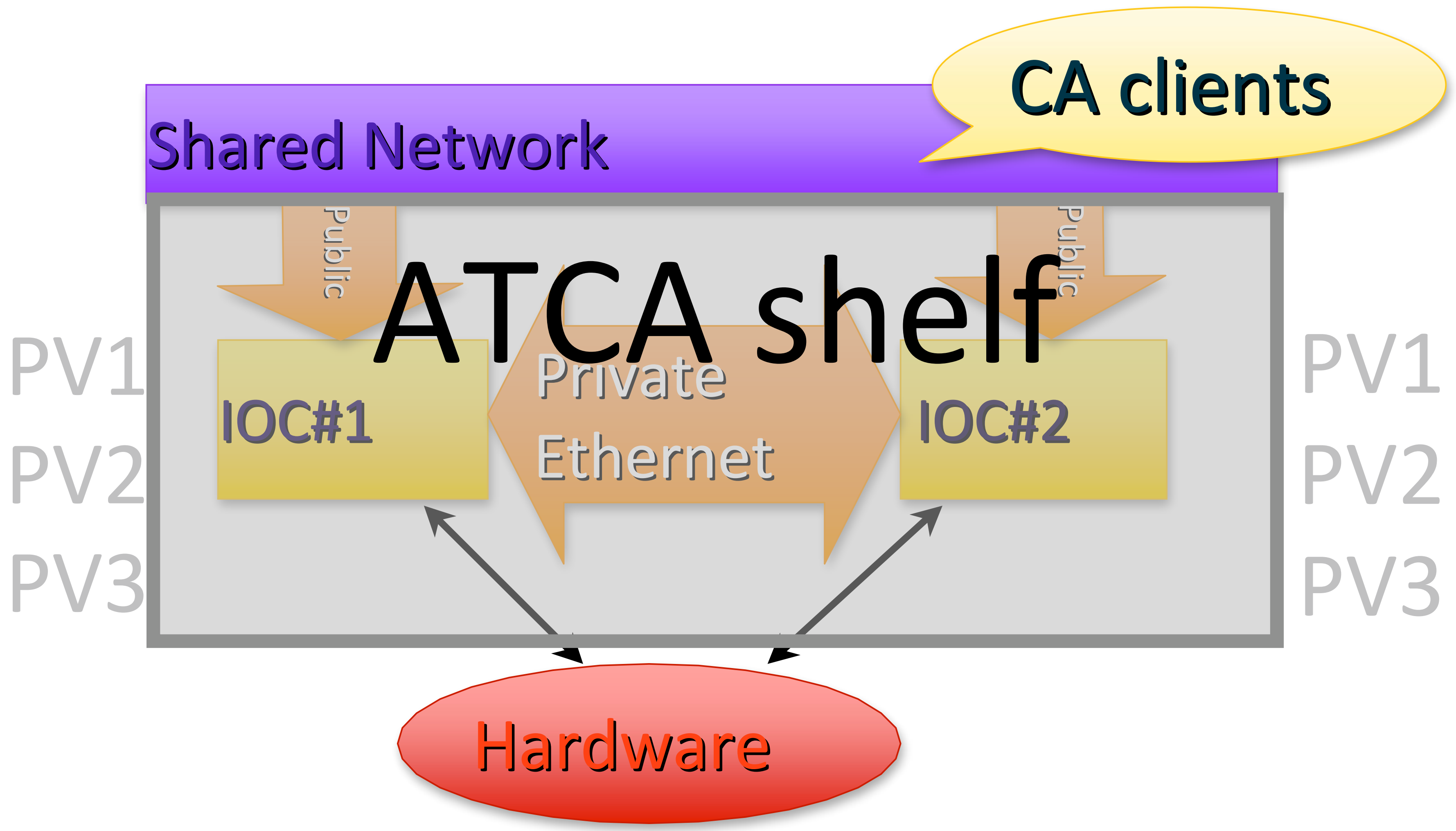
We want to use this features to make better decisions for fail-over

ATCA Shelf manager



Data is exchanged through redundant Intelligent Platform Management Bus IPMB

“plain” Redundant IOC on ATCA



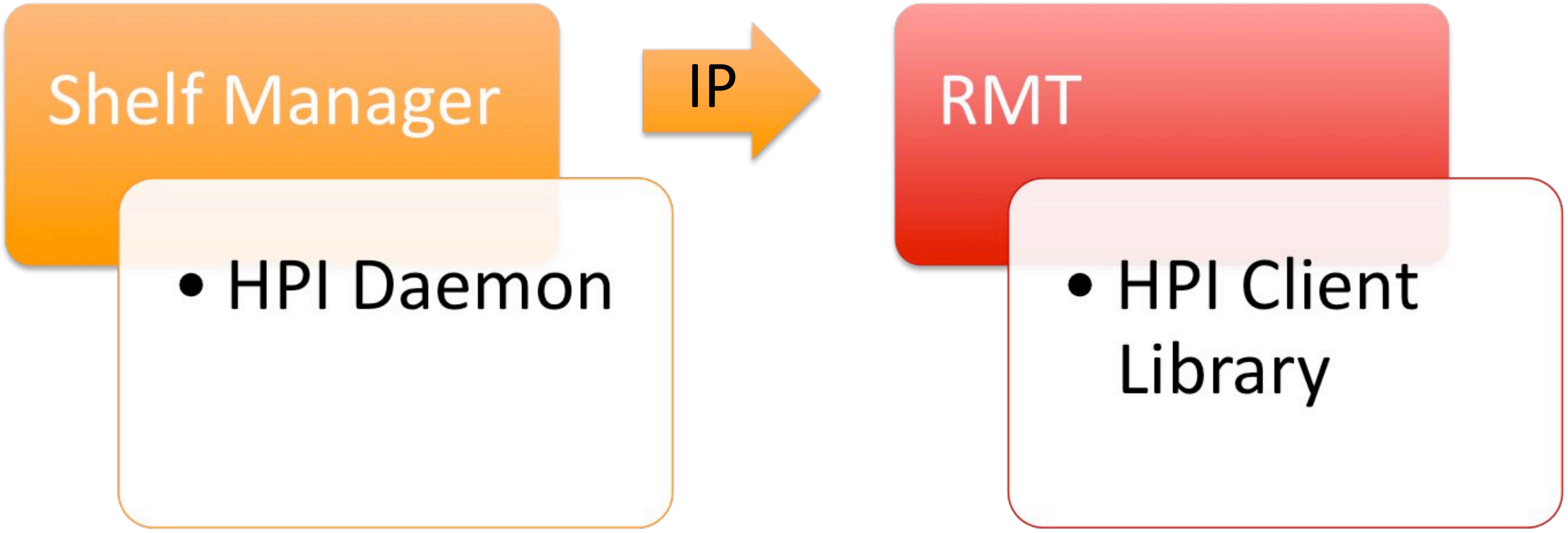
“plain” Redundant IOC on ATCA

- Runs “as-is”
- But does not know anything about the “smart” hardware of ATCA
- Basically is same as running on two normal PCs

Benefits of “ATCA”-aware RIOC

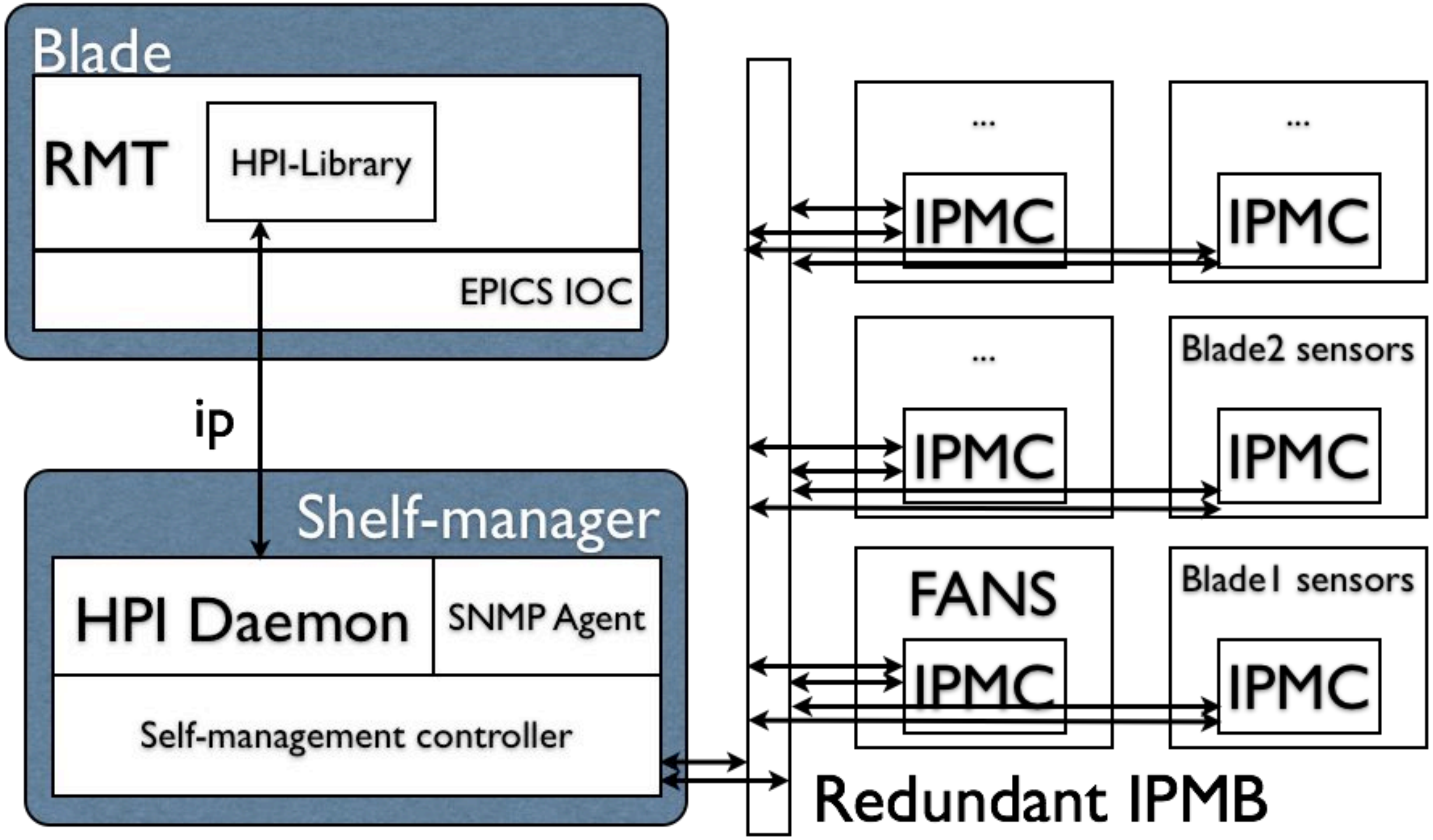
- Failures can be “predicted”
  - i.e. temperature starts to rise and the CPU is still working -> we can initiate fail-over procedure before actual hardware fails -> fail-over occurs in more stable and controlled environment
- Client connections can be gracefully closed
  - Allowing the client to reconnect to back-up IOC within 1 second
  - In case of “real” hardware failure reconnect would occur only after 30 seconds

ATCA/HPI driver for RMT



HPI - Hardware Platform Interface – Generic Platform Independent specification to monitor and control HA systems

“HPI-aware” RIOC on ATCA



Result:

- Reliable Hardware (ATCA) was used in conjunction with Reliable Software (RIOC)
- RIOC was extended to use available hardware sensors to make better failover decisions
- The software can be used on other hardware (i.e. “common” server-type PC): the requirement is HPI library, which can run on top of IPMI, SNMP, Sysfs(linux)…

Now RMT can monitor any available sensor on ATCA shelf and make better fail-over decision

configuration via iocSh:

```
rmtHPIDriverStart
"{RACK,0}{ADVANCEDTCA_CHASSIS,0}{PHYSICAL_SLOT,4}{PICMG_FRO
NT_BLADE,0}" 1

rmtHPIDriverStart “entityPath” “Sensor ID”
```

How to improve Reliability of a Control System:

- Design with HA in mind
- Use better Software
- Implement redundancy for critical parts
- Etc...

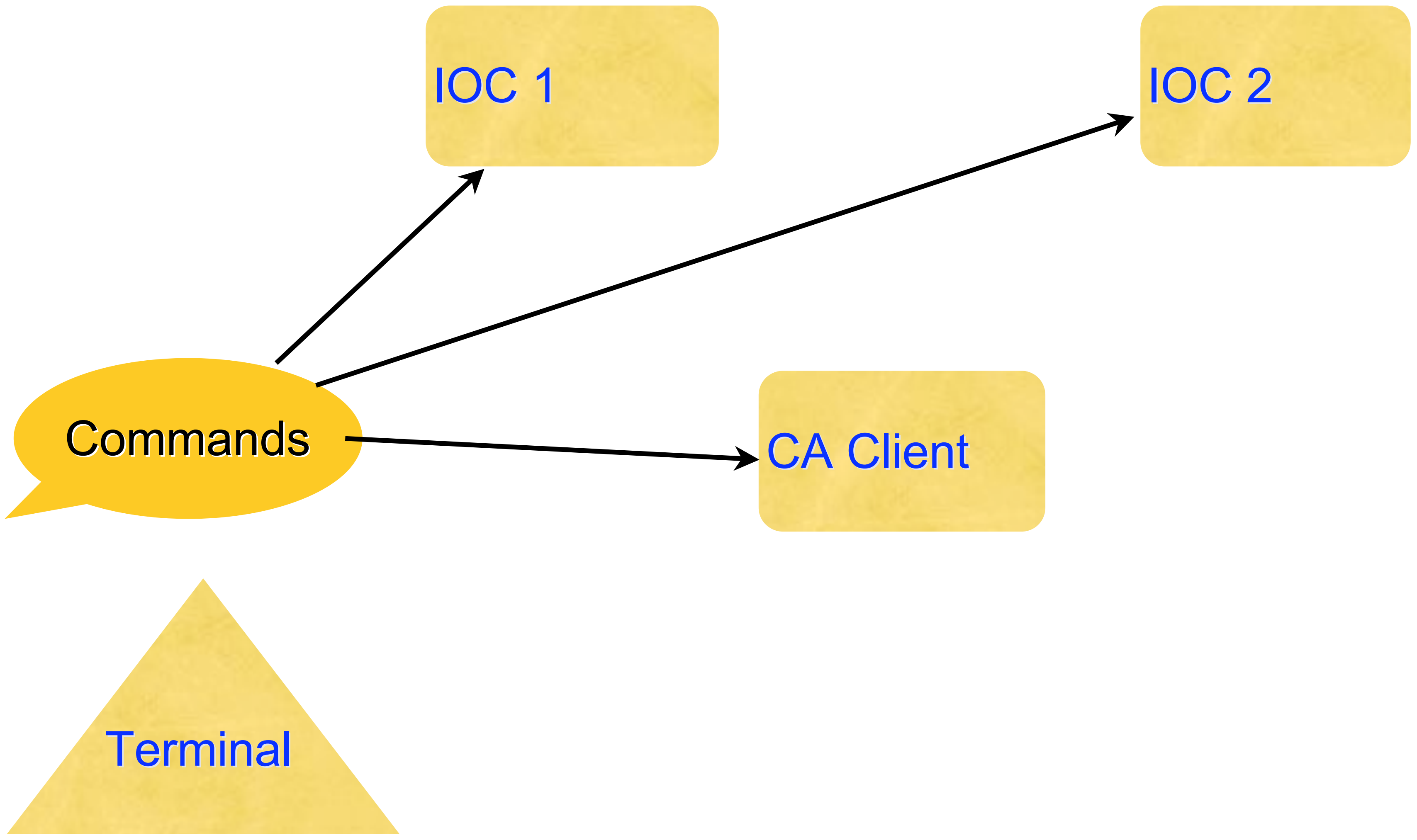
The Problem

- EPICS can run on many different OS (Linux, Windows, Mac OS, FreeBSD, Solaris, vxWorks, RTEMS, osf-alpha)
- Usually even within one laboratory more than one OS is used
- OS versions are also different
- We need to test all the configurations being used in real control systems

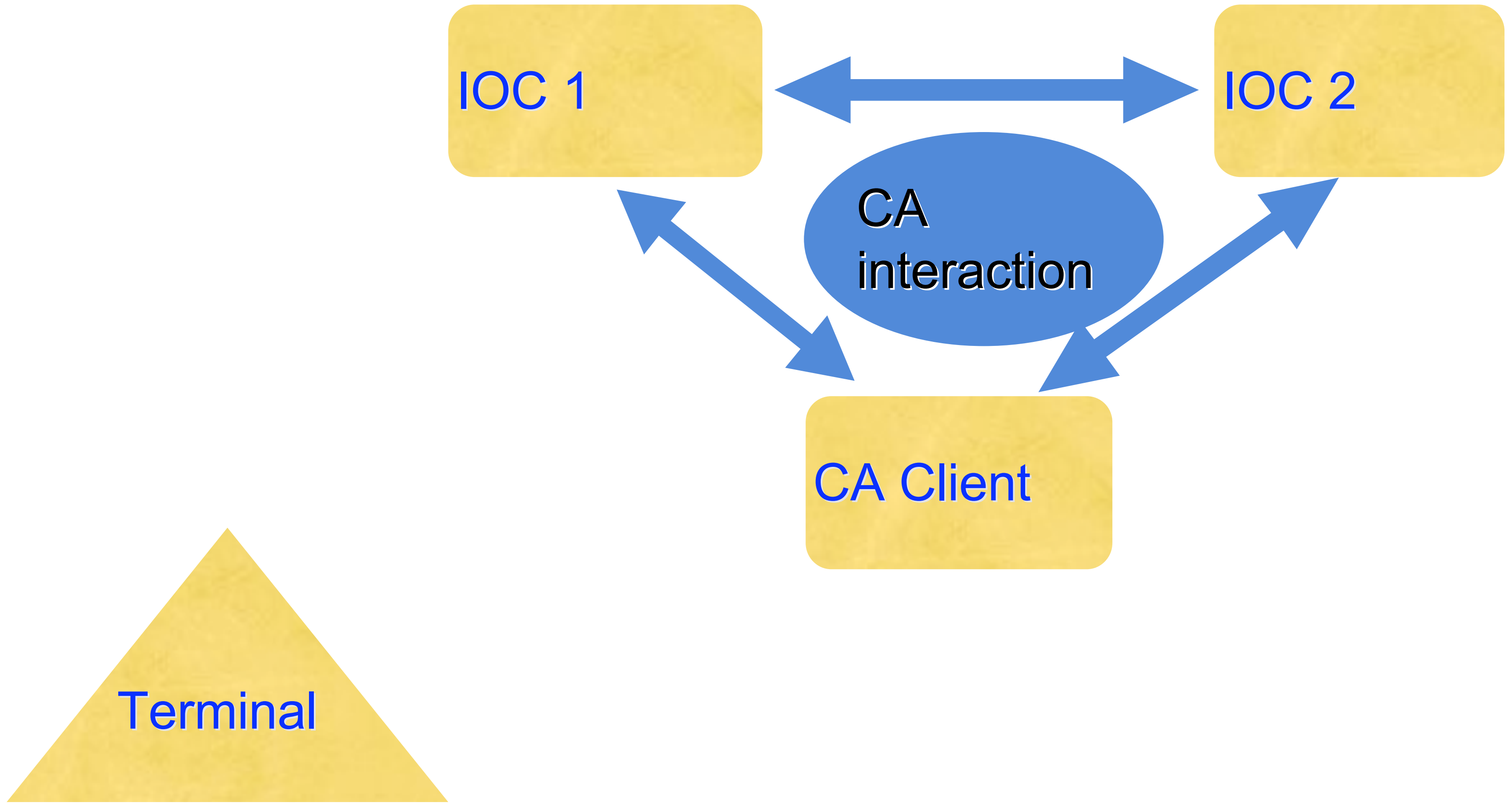
EPICS existing system test package (mrkSoftTest)

- Nobody remembers how to run these tests, so every time people have to read instructions => most people do not run tests
- You have to configure, execute, compare results MANUALLY
- it’s inconvenient and IT TAKES TIME

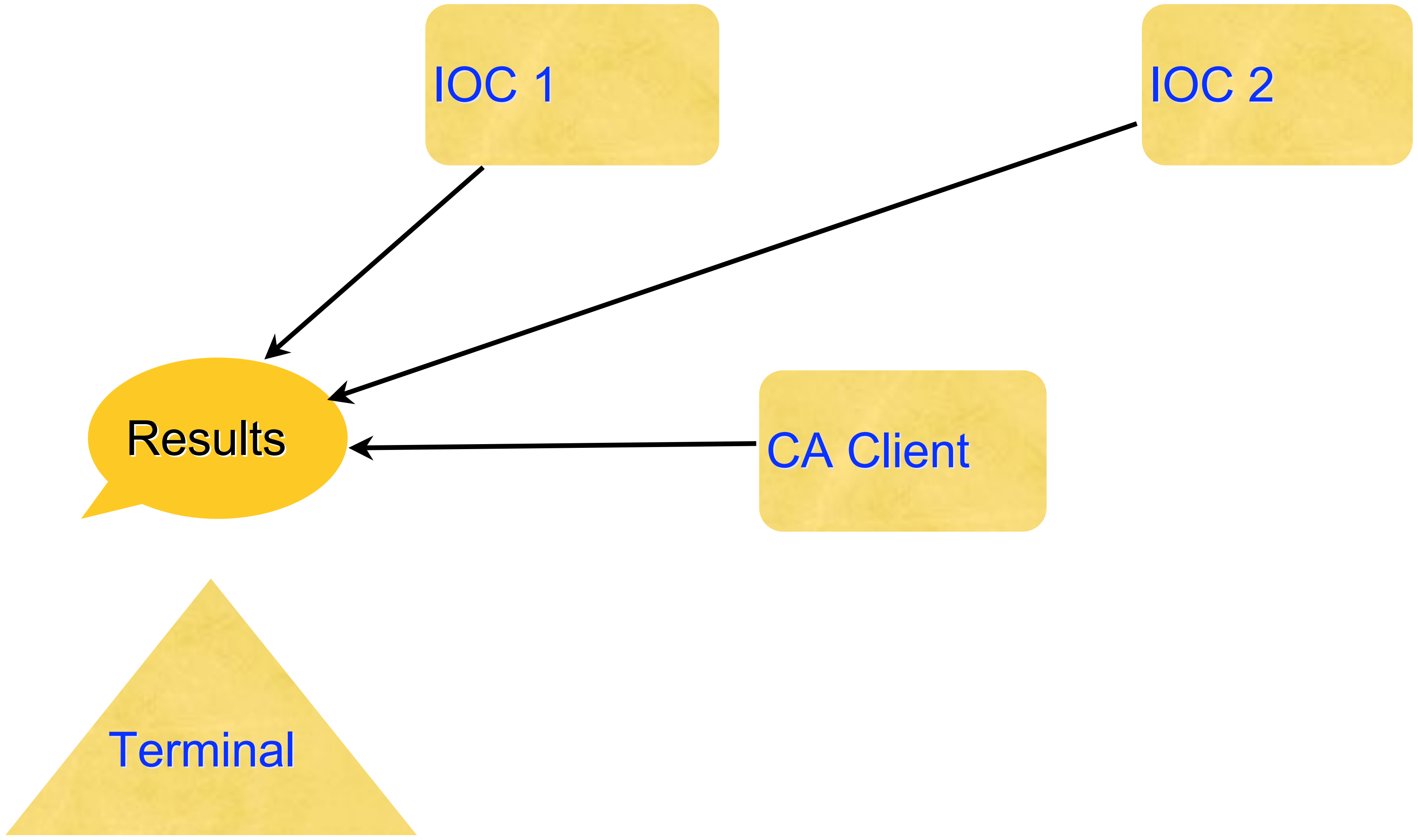
Typical Test Scenario: configure & start components



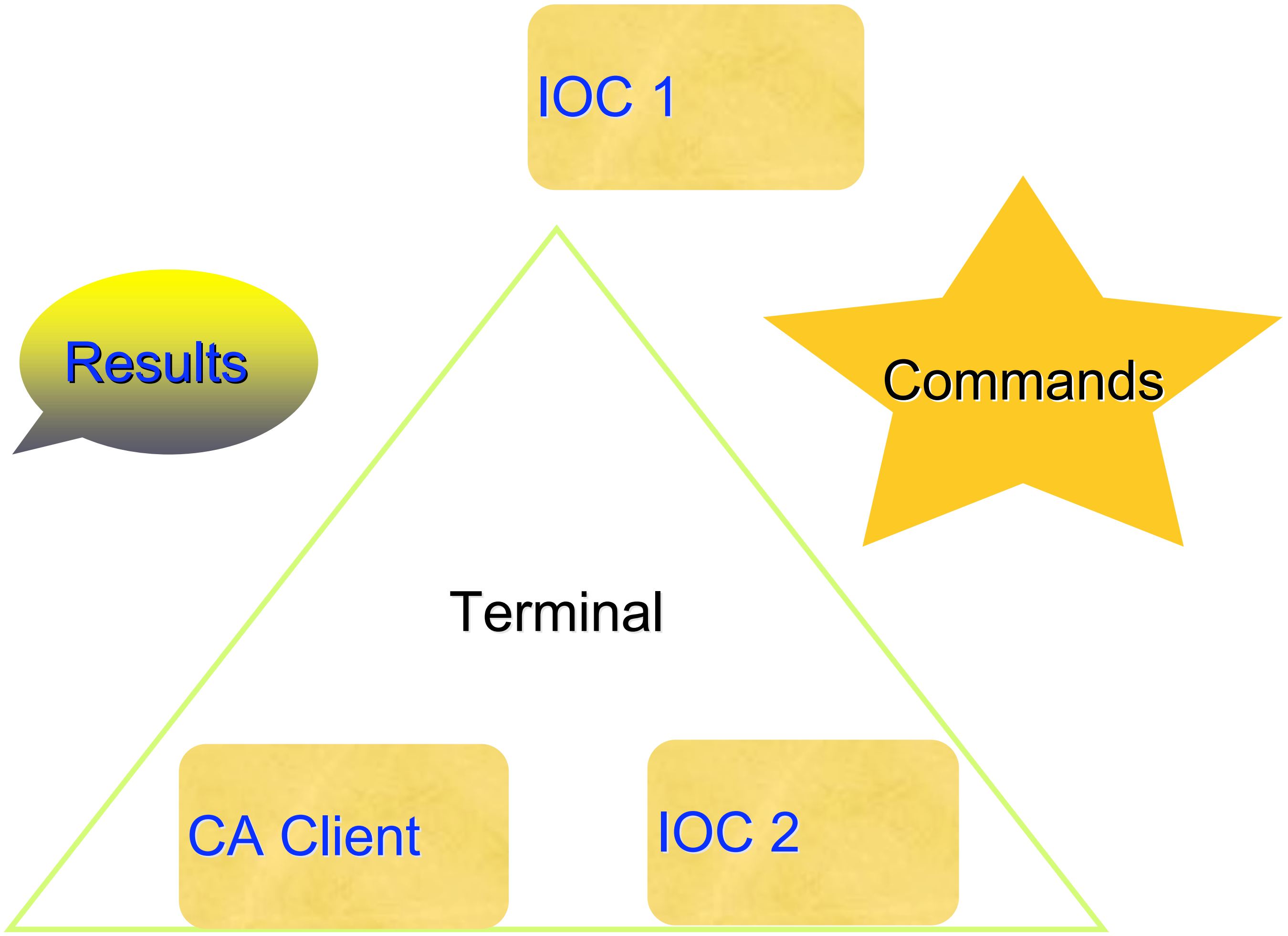
Typical Test Scenario: wait for the results



Typical Test Scenario: gather results & analyze



Typical Test Scenario: commands depend on configuration



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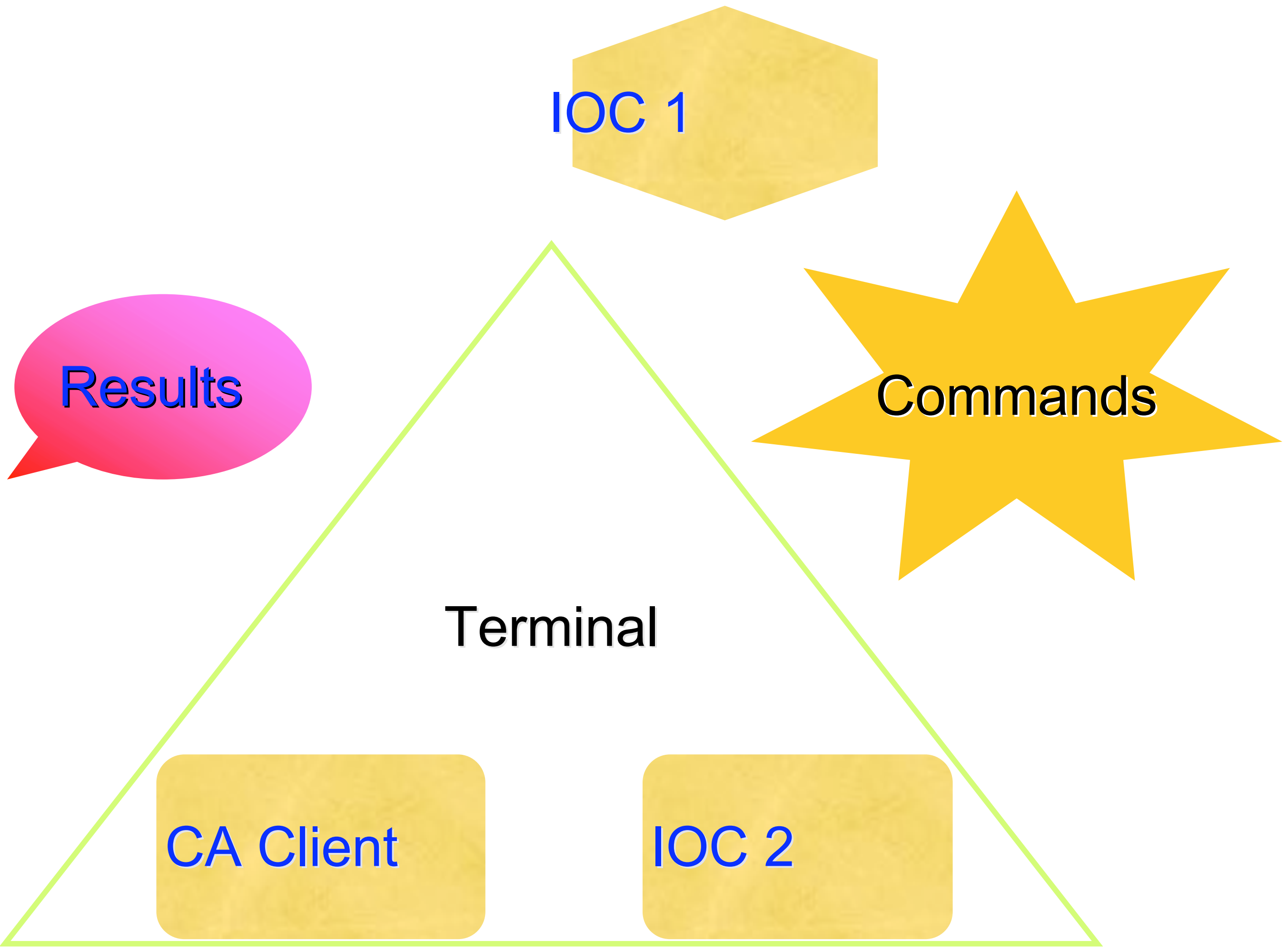

The Answer: Automation

- Just say “run all tests for me” :)
- Actually you say: ./runAllTests.rb
- Currently automated tests can be run on local/remote machine over sh, ssh, rsh, telnet, cu ... any other “shell-like” program

How to create new test:

- Develop the test: ioc, clients, reference results file, etc..
- write the corresponding section in the config file: config.yml
- write “test scenario” using provided ruby classes

Config.yml

```
:TestGeneric:
  <<: *default
  IocBootDir: iocBoot/iocput
  Cmd: put.main
  reference: testcache26MAR2008.darwinx86
```

Simple example

```
class TestGeneric < RubTap::TestCase
@ioc = common_setup_local
 def test_name
   @ioc.talk("< p2sec", 5)
   cache_response = @ioc.talk( "< testcache", 20)
   assert_equal(@testcache_reference,cache_response)
 end
```

Running tests

- Group tests into a test suite

```
ts = RubTap::TestSuite.new
ts<<TestGeneric.new(TestConfig::AllTestsCo
  nfig.new("config.yml"))
ts.run
```

EPICS Test Automation package

- Was used to automate the existing test package, making it much more user-friendly and easy to run
- Can be used to write new automated tests

- on-going work: to make it more “human” readable
- git://github.com/akazakov/epicstest.git