OAK RIDGE
National Laboratory

Channel Access Security

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Material copied from IOC Application Developers Guide
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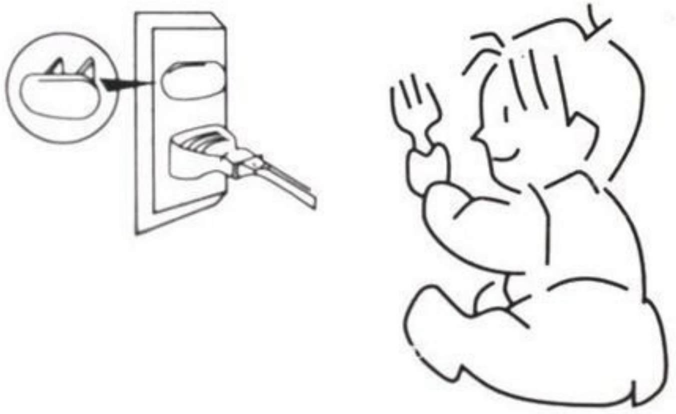
“Security”?

Not like this

- Fend off malicious hackers, evildoers, long-haired troublemakers

More like this

- Prevent casual users from making mistakes
- Help operators follow procedures



http://asset3.cbsistatic.com/cnwk.1d/i/ne/p/2008/FortKnox_550x338.jpg
http://i01.i.aliimg.com/img/pb/216/247/491/491247216_377.jpg

Function and Scope

Control reading and/or writing of EPICS records via Channel Access

- Almost never used to limit reading

Criteria:

- Who, which user?
  - Control system engineer may always access everything
  - Beam Line Staff may always access most things
  - Beam Line Users cannot write certain things
- From where, which machine?
  - Full access from Beam Line Control Room OPIs
  - No write access from anywhere else
- When, in which system state?
  - Read-only while experiment is running, while automation is enabled, …
  - Writable when experiment idle, manual control enabled, …

Limitations

… Via Channel Access

- Nothing is encrypted
- IOC console (*dbpf*, …) not affected

Who?

- $USER

From Where?

- Host name, easy to fake

Specification Summary

- A record belongs to one access security group (ASG)
- CA Security config file defines ASG:
  - Multiple rules (read or write)
    - Groups of users (which user)
    - Groups of hostnames (which machine)
    - Optionally qualified by the value of PVs (which state)
  - Rules give statements like:
    - Operators may write any property of PVs in this group from any OPI in the control room in any system state
    - Maintenance personnel may write values of PVs in this group from any maintenance OPI when the system state is *maintenance*

EPICS DB

- Record
  - Assigned to access security group
  - `field(ASG, "LIMITED")`
  - Default ASG is *DEFAULT*

- Fields have *Access Security Level* property
  - Most in ASL1
  - Some are ASL0
  - Nobody can remember. See *.dbd

Access Security File

```
UAG(<name>) { <user> [, <user> ...] }

...

 HAG(<name>) { <host> [, <host> ...] }

...

ASG(<name>) {
        [INP<index>(<pvname>) ...]
        RULE(<level>,NONE |READ|WRITE [,NOTRAPWRITE | TRAPWRITE] ) {
                [UAG(<name> [,<name> ...])]
                [HAG(<name> [,<name> ...])]
                CALC(<calculation>)
        }
        ...
}
...
```

RULE(<level>, <what>,[<trap option>])

- <level> is 0 or 1.
  - The dbd file assigns each field an access security level. Level 1 fields are typically related to record behavior and configuration. Level 0 fields are related to value.
    - Example: For the AI record, VAL is level 0, all the rest are level 1
  - Rules for level 1 also grant access to level 0
  - Example: Everybody can write VAL (level 0), but restrict other fields:

```
ASG(WRITE_SOME)
{
    RULE(1, READ)
    RULE(0, WRITE)
    RULE(1, WRITE)
    {
       UAG(x_users)
       HAG(x_hosts)
    }
}
```

- <what> is NONE, READ, or WRITE
  - Plus an optional *TRAPWRITE*, which will cause invocation of a *trap write listener*, i.e. custom C code that may be added to the IOC. This can be used to log write access by user and host, it doesn't otherwise affect access security.

Default Implicit Behavior

- If no access security file is loaded, all users from anywhere may read and write all fields of all records anytime
- The previously mentioned *DEFAULT* ASG has no effect

Equivalent Explicit Default Configuration

- Create file *simple.acf* with the following content:

```
ASG(DEFAULT)
{
        RULE(1, READ)
        RULE(1, WRITE)
}
```

- Add the following line to your st.cmd:

```
asSetFilename("path_to_the_file/simple.acf")
asSetSubstitutions("P=prefix,N=14")
```

Result:

- ✓ Since, by default, records belong to the ASG named *DEFAULT*
  - ✓ full *read*/*write* to all records is allowed
- ✓ Functionally equivalent to doing nothing
- ✓ But now, the *asprules* and *asdbdump* commands show something

- Caveat:
  - If the AS config file does not exist or contains a syntax error, *all access is prohibited!*
  - Use the *ascheck* utility on the host before loading a file into the IOC

Read-Only

- Group that allows read, but no write:

```
ASG(READONLY)
{
  RULE(1, READ)
  # Nothing in here about WRITE…
}
```

- To have any effect, set the ASG field of at least one record to *READONLY*
  - You can change ASG fields at runtime
  - … via Channel Access, unless AS prohibits it…
- *caput* will show that the old and new values stay the same
- Display tools (*edm, CSS BOY*, ..) will indicate read-only access via cursor or disabled widgets

Limit Write to Users and Hosts

- Limit write access to
  - members of a user access group UAG
  - while on a computer in the host access group HAG

```
UAG(x_users) { training }
HAG(x_hosts) { training-VirtualBox }
ASG(X_TEAM)
{
  RULE(1, READ)
  RULE(1, WRITE)
  {
     UAG(x_users)
     HAG(x_hosts)
  }
}
```

- Caveats:

  The CA *client library* sends the user and host names to the server. Especially the host name can be tricky:

  - It's *not* the client's IP address
  - It's the result of the *hostname* command, which might be *myhost* or *some.site.myhost*, might differ from DNS name
  - The *casr* command on the IOC can sometimes help to show who and from where is connecting via CA, and the *asdbdump* command shows who they pretend to be

Limit Access by System State

- Limit write access to times where some set of variables meets some criteria

  -
    ```
    ASG(MODE)
    {
      INPA(accelerator_mode)  # accelerator_mode is normal pv
      RULE(1, READ)
      RULE(1, WRITE)
      {
        CALC(A < 5)
      }
    }
    ```
- This is based on the same code as the *CALC* record
  - PVs may be assigned to inputs *A* through *L*
  - The computation should result in 0 or 1, the latter allowing access

SNS Beamline Example

- DEFAULT
  - Anybody can read
  - Special list of experts can always write
  - Normal users cannot write in certain modes
- ALWAYS
  - Anybody can always read and write
  - Use for “STOP”, “ABORT” type PVs
- EXPERT
  - Anybody can read
  - Only special list of experts can write

Additional Security Measures

- Place IOCs in private network
  - No ‘telnet’ to their console
  - No Channel Access from malicious clients
  - Outside access (ssh, VNC, …) controlled the usual way
- Add Channel Access Gateway to other networks
  - Gateway also has access security
  - Make it read-only

And that's all I have to say about that!