Writing a Motor Controller Driver

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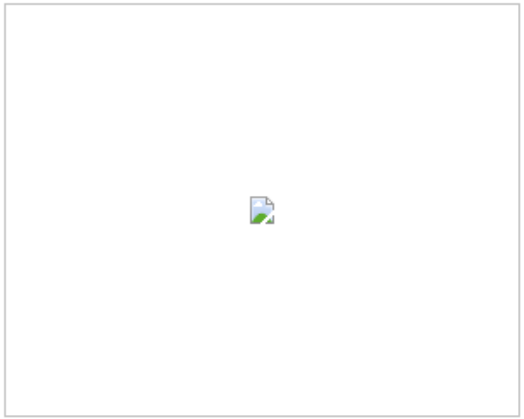
Software used during this presentation

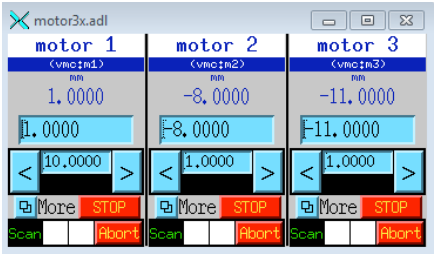
- Prebuilt IOC (Windows, OS X, Linux)
- Virtual Motor Controller (requires Python 2.7)
  - Provides 8 axes (400 steps per EGU)



- Software setup instructions:
  - http://www.xray.aps.anl.gov/~kpetersn/motorClass.html

Prerequisites

- Familiarity with the motor record

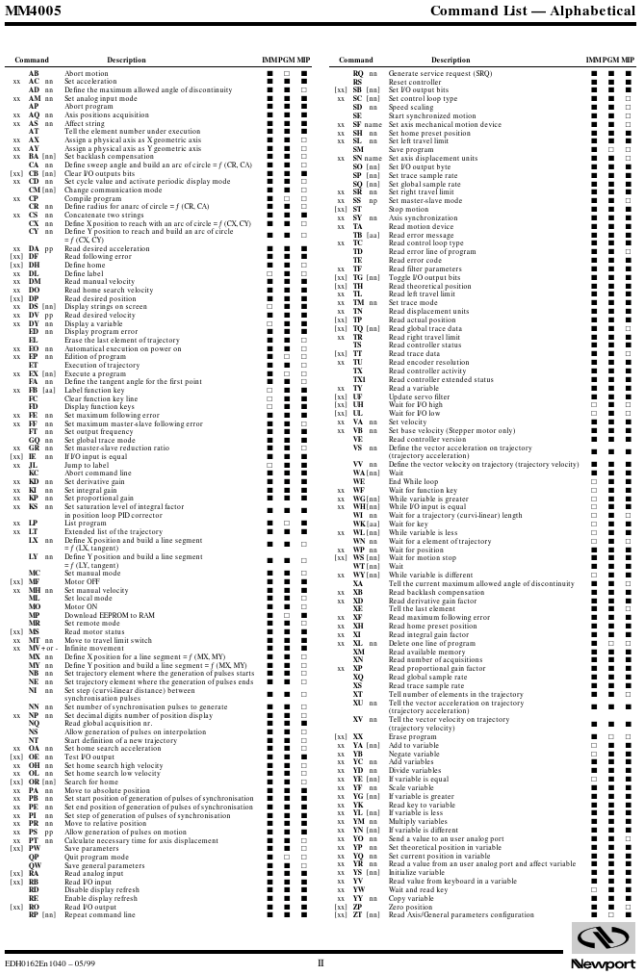


- Some programming experience

```
ssh
Installing created dbd file ../../../dbd/iocvmcLinux.dbd

/usr/bin/g++ -c  -D_POSIX_C_SOURCE=199506L -D_POSIX_THREADS -D_XOPEN_SOURCE=500          -D_X86_64_  -DUNIX  -D_
BSD_SOURCE -Dlinux  -D_REENTRANT   -O3   -Wall      -m64      -MMD -I. -I../O.Common -I. -I.. -I../../../include/
os/Linux -I../../../include   -I/APSshare/epics/base-3.14.12.3/include/os/Linux -I/APSshare/epics/base-3.14.12.3/
include  -I/APSshare/epics/synApps_5_7/support/asyn-4-21/include -I/APSshare/epics/synApps_5_7/support/autosave-5
-5/include/os/Linux -I/APSshare/epics/synApps_5_7/support/autosave-5-5/include  -I/APSshare/epics/synApps_5_7/sup
port/busy-1-6/include  -I/APSshare/epics/synApps_5_7/support/calc-3-2/include  -I/APSshare/epics/synApps_5_7/supp
ort/motor-6-8/include  -I/APSshare/epics/synApps_5_7/support/seq-2-1-13/include  -I/APSshare/epics/synApps_5_7/su
pport/sscan-2-9/include  -I/APSshare/epics/synApps_5_7/support/std-3-2/include        ../VirtualMotorDriver.cpp
../VirtualMotorDriver.cpp: In member function 'virtual asynStatus VirtualMotorAxis::poll(bool*)':
../VirtualMotorDriver.cpp:428: error: expected ';' before 'comStatus'
../VirtualMotorDriver.cpp:435: error: expected ';' before 'direction'
../VirtualMotorDriver.cpp:447: error: expected ';' before 'limit'
../VirtualMotorDriver.cpp:457: error: expected ';' before 'skip'
../VirtualMotorDriver.cpp:421: error: label 'skip' used but not defined
make[3]: *** [VirtualMotorDriver.o] Error 1
make[3]: Leaving directory `/tmp/vmc/vmcApp/src/O.linux-x86_64'
make[2]: *** [install.linux-x86_64] Error 2
make[2]: Leaving directory `/tmp/vmc/vmcApp/src'
make[1]: *** [src.install] Error 2
make[1]: Leaving directory `/tmp/vmc/vmcApp'
make: *** [vmcApp.install] Error 2
[bcdapc14 /tmp/vmc]$
```

- Knowledge of controller commands



Writing a model 3 driver: The standard approach

- Obtain documentation for the new controller
- Find a similar controller that already has EPICS support
- Use the similar controller's driver as a starting point
- Implement the necessary asynMotor{Controller,Axis} methods

Writing a model 3 driver: The standard approach

- Obtain documentation for the new controller
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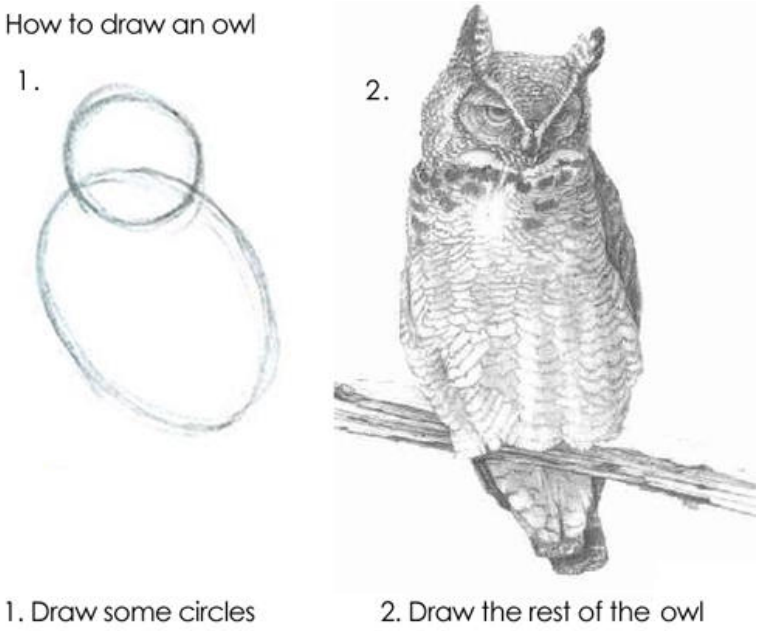
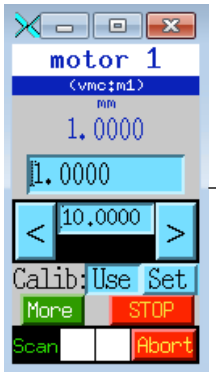
- Implement the necessary asynMotor{Controller,Axis} methods



References

- asynMotor documentation in the motor module
  - motor/documentation/motorDeviceDriver.html
    - Suggested example motor drivers:
      - ACS MCB-4B (simple driver, no additional asyn params)
      - Parker ACR (simple driver, adds few asyn params)
      - Newport XPS (complex driver, implements profile moves)
  - motor/documentation/motorDoxygenHTML/index.html
    - Install doxygen (if not already available)
    - cd motor/documentation
    - make (creates motorDoxygenHTML)
  - comments in asynMotor source code (if unable to build doxygen documentation)
    - motor/motorApp/MotorSrc/asynMotor{Controller,Axis}.{cpp,h}
- Motor record source code

Road Map


motor 1
(vmc:m1)
MM
1.0000
1.0000
10.0000
<
>
Calib:
Use
Set
More
STOP
Scan
Abort

???

How does the IOC associate the model-3 motor driver with the motor record?

*vmc.cmd

```
23 drvAsynIPPortConfigure("VMC_ETH","127.0.0.1:$(VMC_PORT1)", 0, 0, 0)
24
25 # VirtualMotorController(
26 #    portName          The name of the asyn port that will be created for this driver
27 #    VirtualMotorPortName     The name of the drvAsynSerialPort that was created previously
28 #    numAxes           The number of axes that this controller supports
29 #    movingPollPeriod  The time between polls when any axis is moving
30 #    idlePollPeriod    The time between polls when no axis is moving
31 VirtualMotorCreateController("VMC1", "VMC_ETH", 3, 250, 10000)
32
33 dbLoadTemplate("vmc.substitutions")
34
```

vmc.substitutions

```
 1 file "$(TOP)/db/asyn_motor.db"
 2 {
 3 pattern
 4 {P,      N,    M,        DTYP,          PORT,   ADDR,
 5 {vmc:,   1,   "m$(N)",   "asynMotor",   VMC1,   0,
 6 {vmc:,   2,   "m$(N)",   "asynMotor",   VMC1,   1,
 7 {vmc:,   3,   "m$(N)",   "asynMotor",   VMC1,   2,
 8 {vmc:,   4,   "m$(N)",   "asynMotor",   VMC1,   3,
 9 {vmc:,   5,   "m$(N)",   "asynMotor",   VMC1,   4,
10 {vmc:,   6,   "m$(N)",   "asynMotor",   VMC1,   5,
11 {vmc:,   7,   "m$(N)",   "asynMotor",   VMC1,   6,
12 {vmc:,   8,   "m$(N)",   "asynMotor",   VMC1,   7,
13 }
```

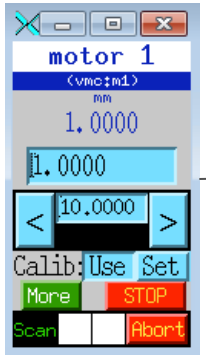
motorSupport.dbd

```
 6 registrar(motorRegister)
 7 registrar(asynMotorControllerRegister)
 8 device(motor,INST_IO,devMotorAsyn,"asynMotor")
```

asyn_motor.db

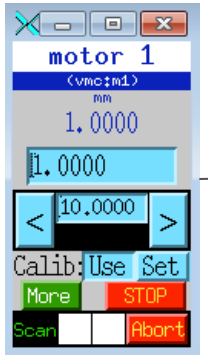
```
 6 record(motor, "$(P)$(M)") {
 7    field(DESC, "$(DESC)")
 8    field(DTYP, "$(DTYP)")
 9    field(DIR, "$(DIR)")
10    field(VELO, "$(VELO)")
11    field(VBAS, "$(VBAS)")
12    field(ACCL, "$(ACCL)")
13    field(BDST, "$(BDST)")
14    field(BVEL, "$(BVEL)")
15    field(BACC, "$(BACC)")
16    field(OUT,"@asyn($(PORT),$(ADDR))")
17    field(MRES, "$(MRES)")
18    field(PREC, "$(PREC)")
19    field(EGU, "$(EGU)")
20    field(DHLM, "$(DHLM)")
21    field(DLLM, "$(DLLM)")
22    field(INIT, "$(INIT)")
23    field(RTRY, "$(RTRY=10)")
24    field(TWV, "1")
25 }
```

Road Map



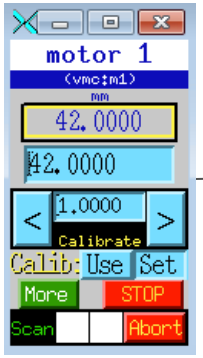
motor record → asynMotor device support → ??? → controller-specific asynMotor driver

Road Map



motor record → asynMotor device support → asynMotorController & asynMotorAxis base classes → controller-specific asynMotor driver

Road Map



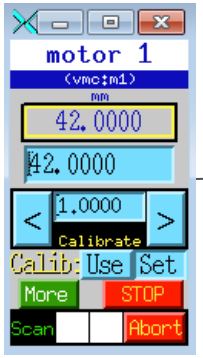
motor record

asynMotor device support

asynMotorController & asynMotorAxis base classes

controller-specific asynMotor driver

Road Map



motor record

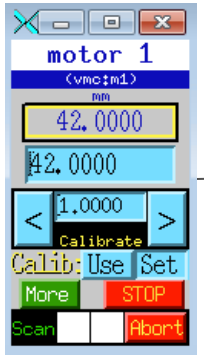
asynMotor device support

asynMotorController & asynMotorAxis base classes

controller-specific asynMotor driver

```
/* Load pos. into motor controller.
INIT_MSG();
WRITE_MSG(LOAD_POS, &newpos);
SEND_MSG();
```

Road Map



motor record

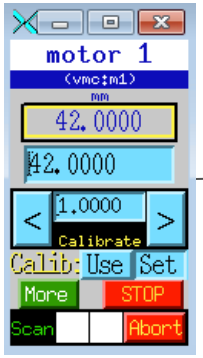
asynMotor device support

asynMotorController & asynMotorAxis base classes

controller-specific asynMotor driver

```
switch (command) {
case LOAD_POS:
    pmsg->command = motorPosition;
    pmsg->dvalue = *param;
    pPvt->moveRequestPending++;
    break;
```

Road Map



motor record

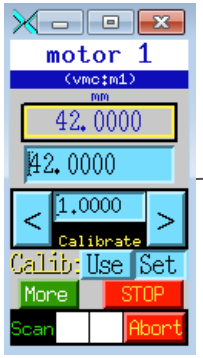
asynMotor device support

asynMotorController & asynMotorAxis base classes

controller-specific asynMotor driver

```
else if (function == motorPosition_) {
status = pAxis->setPosition(value);
pAxis->callParamCallbacks();
```

Road Map



motor record

asynMotor device support

asynMotorController & asynMotorAxis base classes

controller-specific asynMotor driver

```
asynStatus VirtualMotorAxis::setPosition(double position)
{
  asynStatus status;

  sprintf(pC_->outString_, "%d POS %d", axisIndex_, NINT(position));
  status = pC_->writeReadController();
  return status;
}
```

Why are these details important?

- Understanding the source of the arguments passed to the driver makes writing simple model-3 drivers easier
  - Variables in motor drivers don't always have the most helpful names
- Understanding the role the asynMotorController base class makes it easier to write complex model-3 drivers
  - Adding new features requires adding parameters and implementing additional methods from the base classes
- It makes debugging less confusing
  - Knowing that motor commands get placed in asyn queues is crucial for following code execution from the motor record to the model-3 driver

Which asynMotor{Controller,Axis} methods need to be implemented?

- There are many methods that could be implemented

asynMotorController::asynMotorController(const char*, int, int, int, int, int, int, int, int)
asynMotorController::report(FILE*, int) : void
asynMotorController::writeInt32(asynUser*, epicsInt32) : asynStatus
asynMotorController::writeFloat64(asynUser*, epicsFloat64) : asynStatus
asynMotorController::writeFloat64Array(asynUser*, epicsFloat64*, size_t) : asynStatus
asynMotorController::readFloat64Array(asynUser*, epicsFloat64*, size_t, size_t*) : asynStatus
asynMotorController::readGenericPointer(asynUser*, void*) : asynStatus
asynMotorController::getAxis(asynUser*) : asynMotorAxis*
asynMotorController::setDeferredMoves(bool) : asynStatus
asynMotorController::getAxis(int) : asynMotorAxis*
asynMotorController::startPoller(double, double, int) : asynStatus
asynMotorController::wakeupPoller() : asynStatus
asynMotorController::poll() : asynStatus
asynMotorController::asynMotorPoller() : void
asynMotorController::startMoveToHomeThread() : asynStatus
asynMotorController::asynMotorMoveToHome() : void
asynMotorController::writeController() : asynStatus
asynMotorController::writeController(const char*, double) : asynStatus
asynMotorController::writeReadController() : asynStatus
asynMotorController::writeReadController(const char*, char*, size_t, size_t*, double) : asynStatus
asynMotorController::initializeProfile(size_t) : asynStatus
asynMotorController::buildProfile() : asynStatus
asynMotorController::executeProfile() : asynStatus
asynMotorController::abortProfile() : asynStatus
asynMotorController::readbackProfile() : asynStatus
asynMotorController::setMovingPollPeriod(double) : asynStatus
asynMotorController::setIdlePollPeriod(double) : asynStatus
setMovingPollPeriod(const char*, double) : asynStatus
setIdlePollPeriod(const char*, double) : asynStatus
asynMotorEnableMoveToHome(const char*, int, int) : asynStatus

asynMotorAxis::asynMotorAxis(class asynMotorController*, int)
asynMotorAxis::move(double, int, double, double, double) : asynStatus
asynMotorAxis::moveVelocity(double, double, double) : asynStatus
asynMotorAxis::home(double, double, double, int) : asynStatus
asynMotorAxis::stop(double) : asynStatus
asynMotorAxis::poll(bool*) : asynStatus
asynMotorAxis::setPosition(double) : asynStatus
asynMotorAxis::setEncoderPosition(double) : asynStatus
asynMotorAxis::setHighLimit(double) : asynStatus
asynMotorAxis::setLowLimit(double) : asynStatus
asynMotorAxis::setPGain(double) : asynStatus
asynMotorAxis::setIGain(double) : asynStatus
asynMotorAxis::setDGain(double) : asynStatus
asynMotorAxis::setClosedLoop(bool) : asynStatus
asynMotorAxis::setEncoderRatio(double) : asynStatus
asynMotorAxis::report(FILE*, int) : void
asynMotorAxis::doMoveToHome() : asynStatus
asynMotorAxis::setReferencingModeMove(int) : void
asynMotorAxis::getReferencingModeMove() : int
asynMotorAxis::setIntegerParam(int, int) : asynStatus
asynMotorAxis::setDoubleParam(int, double) : asynStatus
asynMotorAxis::callParamCallbacks() : asynStatus
asynMotorAxis::initializeProfile(size_t) : asynStatus
asynMotorAxis::defineProfile(double*, size_t) : asynStatus
asynMotorAxis::buildProfile() : asynStatus
asynMotorAxis::executeProfile() : asynStatus
asynMotorAxis::abortProfile() : asynStatus
asynMotorAxis::readbackProfile() : asynStatus

Which asynMotor{Controller,Axis} methods need to be implemented?

- But the motor record only uses a limited number of commands

motor.h

```
 92 typedef enum  {
 93         MOVE_ABS,        /* Absolute Move. */
 94         MOVE_REL,        /* Relative Move. */
 95         HOME_FOR,        /* Home Forward. */
 96         HOME_REV,        /* Home Reverse. */
 97         LOAD_POS,        /* Load Position. */
 98         SET_VEL_BASE,    /* Set Minimum Velocity. */
 99         SET_VELOCITY,    /* Set Jog and Trajectory Velocity. */
100         SET_ACCEL,       /* Set Acceleration. */
101         GO,              /* Start previously programmed move. */
102         SET_ENC_RATIO,   /* Set Encoder Ratio. */
103         GET_INFO,        /* Update Motor Status. */
104         STOP_AXIS,       /* Stop Axis Motion. */
105         JOG,             /* Momentary Jog. */
106         SET_PGAIN,       /* Set Proportional Gain. */
107         SET_IGAIN,       /* Set Integral Gain. */
108         SET_DGAIN,       /* Set Derivative Gain. */
109         ENABLE_TORQUE,   /* Enable Servo Closed-Loop Control. */
110         DISABL_TORQUE,   /* Disable Servo Closed-Loop Control. */
111         PRIMITIVE,       /* Primitive Controller command. */
112         SET_HIGH_LIMIT,  /* Set High Travel Limit. */
113         SET_LOW_LIMIT,   /* Set Low Travel Limit. */
114         JOG_VELOCITY,    /* Change Jog velocity. */
115         SET_RESOLUTION   /* Set resolution */
116 } motor_cmnd;
```

Which asynMotor{Controller,Axis} methods need to be implemented?

- Limiting the driver to motor-record commands shrinks the list

asynMotorController::asynMotorController
asynMotorController::report
asynMotorController::getAxis

asynMotorAxis::asynMotorAxis
asynMotorAxis::move
asynMotorAxis::moveVelocity
asynMotorAxis::home
asynMotorAxis::stop
asynMotorAxis::poll
asynMotorAxis::setPosition
asynMotorAxis::setHighLimit
asynMotorAxis::setLowLimit
asynMotorAxis::setPGain
asynMotorAxis::setIGain
asynMotorAxis::setDGain
asynMotorAxis::setClosedLoop
asynMotorAxis::setEncoderRatio
asynMotorAxis::report

Which asynMotor{Controller,Axis} methods need to be implemented?

- The Virtual Motor Controller driver implements these methods

asynMotorController::asynMotorController
asynMotorController::report
asynMotorController::getAxis

asynMotorAxis::asynMotorAxis
asynMotorAxis::move
asynMotorAxis::moveVelocity
asynMotorAxis::home
asynMotorAxis::stop
asynMotorAxis::poll
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asynMotorAxis::setLowLimit
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asynMotorAxis::setIGain
asynMotorAxis::setDGain
asynMotorAxis::setClosedLoop
asynMotorAxis::setEncoderRatio
asynMotorAxis::report

Which asynMotor{Controller,Axis} methods need to be implemented?

- A driver will be usable* if only these methods are implemented

asynMotorController::asynMotorController
asynMotorController::report
asynMotorController::getAxis

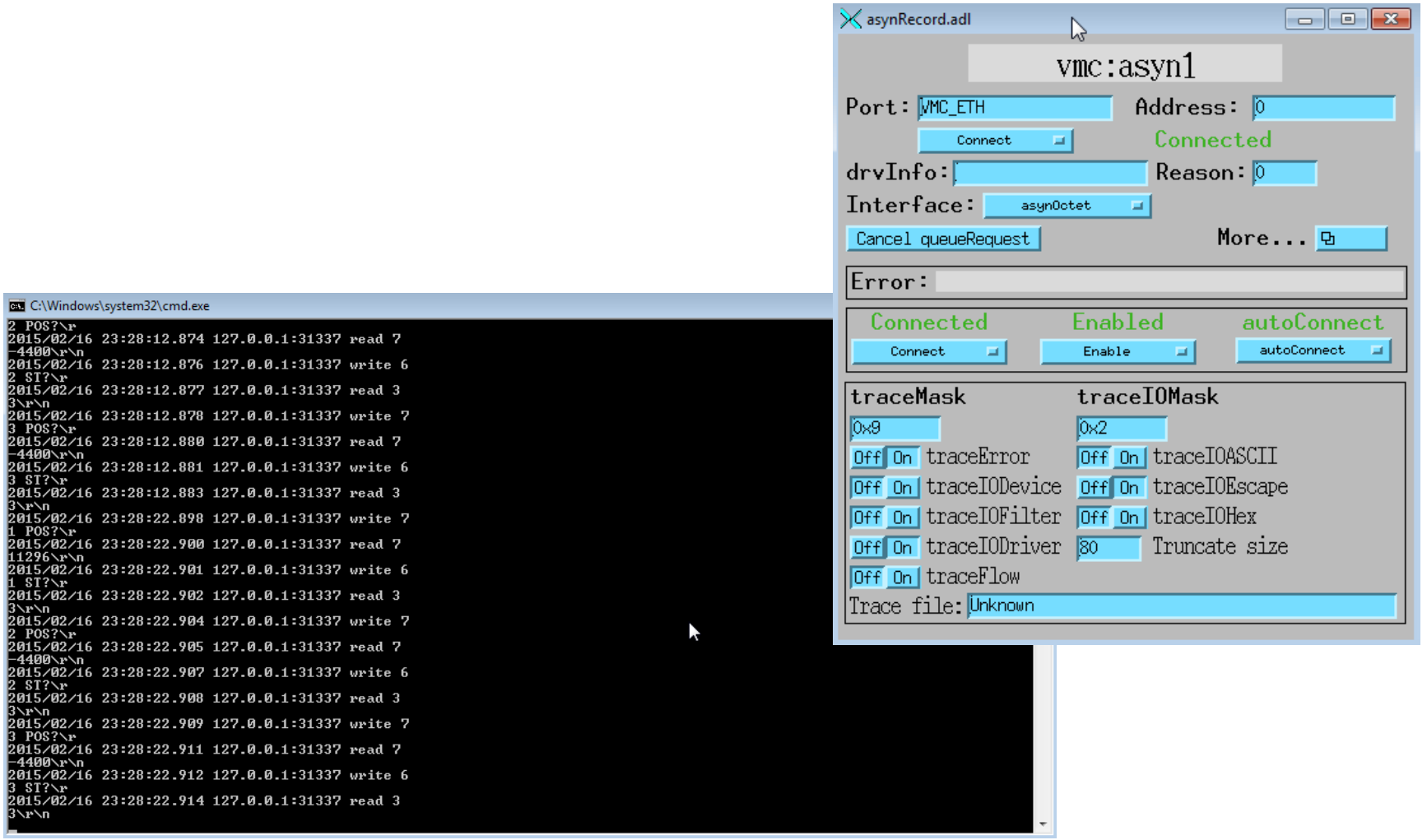
asynMotorAxis::asynMotorAxis
asynMotorAxis::move
asynMotorAxis::moveVelocity
asynMotorAxis::home
asynMotorAxis::stop
asynMotorAxis::poll
asynMotorAxis::setPosition*
asynMotorAxis::setHighLimit
asynMotorAxis::setLowLimit
asynMotorAxis::setPGain
asynMotorAxis::setIGain
asynMotorAxis::setDGain
asynMotorAxis::setClosedLoop
asynMotorAxis::setEncoderRatio
asynMotorAxis::report

* motorAxis::setPosition is needed for autosave to restore a position to the controller

Virtual Motor Controller Commands

- The commands can be found in the vmc documentation directory
  - vmc/documentation/VirtualMotorControllerCommands.txt

Seeing controller communication



Implementing VirtualMotorController methods: constructor, report, getAxis

- constructor
  - Connects to the controller
  - Initializes the controller
    - Querying version strings usually occurs here
  - **Creates the VirtualMotorAxis objects**
  - Starts the poller
- report
  - Prints the values that were passed to VirtualMotorCreateController
  - Calls the report method of the base class (asynMotorController)
- getAxis (both forms)
  - Return VirtualMotorAxis pointers

Implementing VirtualMotorAxis methods: constructor, report

- constructor
  - Initializes the axis
    - May involve querying axis settings
  - Sets internal variables
    - 1-based index instead of zero
  - **Sets asyn parameters**
    - **Some MSTA bits need to be set here (GAIN_SUPPORT, ENCODER_PRESENT)**
  - Calls callParamCallbacks() to make changed parameters take effect
- report
  - Prints the values that were passed to VirtualMotorAxis constructor
    - 1-based index value for each axis
  - Calls the report method of the base class (asynMotorAxis)

Implementing VirtualMotorAxis methods: stop

```
/*
 * stop() is called by asynMotor device support whenever a user presses the stop button.
 * It is also called when the jog button is released.
 *
 * Arguments in terms of motor record fields:
 *    acceleration = ???
 */
asynStatus VirtualMotorAxis::stop(double acceleration)
{
  asynStatus status;

  sprintf(pC_->outString_, "%d AB", axisIndex_);
  status = pC_->writeReadController();
  return status;
}
```

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  status = pC_->writeReadController();
  return status;
}
```

Implementing VirtualMotorAxis methods: poll

```
asynStatus VirtualMotorAxis::poll(bool *moving)
{
 // Read the current motor position
  sprintf(pC_->outString_, "%d POS?", axisIndex_);
  comStatus = pC_->writeReadController();

 // The response string is of the form "0.00000"
  position = atof((const char *) &pC_->inString_);
  setDoubleParam(pC_->motorPosition_, position);

 // Read the status of this motor
  sprintf(pC_->outString_, "%d ST?", axisIndex_);
  comStatus = pC_->writeReadController();

 // The response string is of the form "1"
  status = atoi((const char *) &pC_->inString_);

 // Read the direction
  direction = (status & 0x1) ? 1 : 0;
  setIntegerParam(pC_->motorStatusDirection_, direction);

  // Read the moving status
  done = (status & 0x2) ? 1 : 0;
  setIntegerParam(pC_->motorStatusDone_, done);
  setIntegerParam(pC_->motorStatusMoving_, !done);
  *moving = done ? false:true;

  // Read the limit status
  limit = (status & 0x8) ? 1 : 0;
  setIntegerParam(pC_->motorStatusHighLimit_, limit);
  limit = (status & 0x10) ? 1 : 0;
  setIntegerParam(pC_->motorStatusLowLimit_, limit);

  callParamCallbacks();
  return comStatus ? asynError : asynSuccess;
}
```

Implementing VirtualMotorAxis methods: poll

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  comStatus = pC_->writeReadController();

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  setDoubleParam(pC_->motorPosition_, position);

 // Read the status of this motor
  sprintf(pC_->outString_, "%d ST?", axisIndex_);
  comStatus = pC_->writeReadController();

 // The response string is of the form "1"
  status = atoi((const char *) &pC_->inString_);

 // Read the direction
  direction = (status & 0x1) ? 1 : 0;
  setIntegerParam(pC_->motorStatusDirection_, direction);

  // Read the moving status
  done = (status & 0x2) ? 1 : 0;
  setIntegerParam(pC_->motorStatusDone_, done);
  setIntegerParam(pC_->motorStatusMoving_, !done);
  *moving = done ? false:true;

  // Read the limit status
  limit = (status & 0x8) ? 1 : 0;
  setIntegerParam(pC_->motorStatusHighLimit_, limit);
  limit = (status & 0x10) ? 1 : 0;
  setIntegerParam(pC_->motorStatusLowLimit_, limit);

  callParamCallbacks();
  return comStatus ? asynError : asynSuccess;
}
```

Implementing VirtualMotorAxis methods: poll

```
asynStatus VirtualMotorAxis::poll(bool *moving)
{
 // Read the current motor position
  sprintf(pC_->outString_, "%d POS?", axisIndex_);
  comStatus = pC_->writeReadController();

 // The response string is of the form "0.00000"
  position = atof((const char *) &pC_->inString_);
  setDoubleParam(pC_->motorPosition_, position);

 // Read the status of this motor
  sprintf(pC_->outString_, "%d ST?", axisIndex_);
  comStatus = pC_->writeReadController();

 // The response string is of the form "1"
  status = atoi((const char *) &pC_->inString_);

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```

Implementing VirtualMotorAxis methods: move

```
/* Arguments in terms of motor record fields:
 *    position (steps) = RVAL = DVAL / MRES
 *    baseVelocity (steps/s) = VBAS / abs(MRES)
 *    velocity (step/s) = VELO / abs(MRES)
 *    acceleration (step/s/s) = (velocity - baseVelocity) / ACCL    */
asynStatus VirtualMotorAxis::move(double position, int relative, double minVelocity, double maxVelocity, double acceleration)
{
  asynStatus status;
  status = sendAccelAndVelocity(acceleration, maxVelocity, minVelocity);

if (relative) {
    sprintf(pC_->outString_, "%d MR %d", axisIndex_, NINT(position));
  } else {
    sprintf(pC_->outString_, "%d MV %d", axisIndex_, NINT(position));
  }
  status = pC_->writeReadController();

  // If controller has a "go" command, send it here
  return status;
}
```

Implementing VirtualMotorAxis methods: move

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```

Implementing VirtualMotorAxis methods: sendAccelAndVelocity

```
/* sendAccelAndVelocity() is called by VirtualMotorAxis methods that result in the motor moving: move(), moveVelocity(), home()
* Arguments in terms of motor record fields:
 *    baseVelocity (steps/s) = VBAS / abs(MRES)
 *    velocity (step/s) = depends on calling method
 *    acceleration (step/s/s) = depends on calling method  */
asynStatus VirtualMotorAxis::sendAccelAndVelocity(double acceleration, double velocity, double baseVelocity)
{
  asynStatus status;
  // Send the base velocity
  sprintf(pC_->outString_, "%d BAS %f", axisIndex_, baseVelocity);
  status = pC_->writeReadController();

  // Send the velocity
  sprintf(pC_->outString_, "%d VEL %f", axisIndex_, velocity);
  status = pC_->writeReadController();

  // Send the acceleration
  sprintf(pC_->outString_, "%d ACC %f", axisIndex_, acceleration);
  status = pC_->writeReadController();
  return status; }
```

Implementing VirtualMotorAxis methods: sendAccelAndVelocity

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  asynStatus status;
  // Send the base velocity
  sprintf(pC_->outString_, "%d BAS %f", axisIndex_, baseVelocity);
  status = pC_->writeReadController();

  // Send the velocity
  sprintf(pC_->outString_, "%d VEL %f", axisIndex_, velocity);
  status = pC_->writeReadController();

  // Send the acceleration
  sprintf(pC_->outString_, "%d ACC %f", axisIndex_, acceleration);
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Implementing VirtualMotorAxis methods: sendAccelAndVelocity

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  // Send the velocity
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Implementing VirtualMotorAxis methods: sendAccelAndVelocity

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Implementing VirtualMotorAxis methods: setPosition

```
/*
 * setPosition() is called by asynMotor device support when a position is redefined.
 * It is also required for autosave to restore a position to the controller at iocInit.
 *
 * Arguments in terms of motor record fields:
 *     position (steps) = DVAL / MRES = RVAL
 */
asynStatus VirtualMotorAxis::setPosition(double position)
{
  asynStatus status;

  sprintf(pC_->outString_, "%d POS %d", axisIndex_, NINT(position));
  status = pC_->writeReadController();
  return status;
}
```

Implementing VirtualMotorAxis methods: setPosition

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  return status;
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```

Implementing VirtualMotorAxis methods: moveVelocity (jog)

```
/*
 * moveVelocity() is called by asynMotor device support when a jog is requested.
 * If a controller doesn't have a jog command (or jog commands), this a jog can be simulated here.
 *
 * Arguments in terms of motor record fields:
 *    minVelocity (steps/s) = VBAS / abs(MRES)
 *    maxVelocity (step/s) = (jog_direction == forward) ? (JVEL * DIR / MRES) : (-1 * JVEL * DIR / MRES)
 *    acceleration (step/s/s) = JAR / abs(EGU)
 */
asynStatus VirtualMotorAxis::moveVelocity(double minVelocity, double maxVelocity, double acceleration)
{
  asynStatus status;

status = sendAccelAndVelocity(acceleration, maxVelocity, minVelocity);

  sprintf(pC_->outString_, "%d JOG %f", axisIndex_, maxVelocity);
  status = pC_->writeReadController();
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Implementing VirtualMotorAxis methods: home

```
/*
 * home() is called by asynMotor device support when a home is requested.
 * Note: forwards is set by device support, NOT by the motor record.
 *
 * Arguments in terms of motor record fields:
 *    minVelocity (steps/s) = VBAS / abs(MRES)
 *    maxVelocity (step/s) = HVEL / abs(MRES)
 *    acceleration (step/s/s) = (maxVelocity - minVelocity) / ACCL
 *    forwards = 1 if HOMF was pressed, 0 if HOMR was pressed
 */
/*
asynStatus VirtualMotorAxis::home(double minVelocity, double maxVelocity, double acceleration, int forwards)
{

  // Homing isn't currently implemented

  return asynSuccess;
}
*/
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 *    maxVelocity (step/s) = HVEL / abs(MRES)
 *    acceleration (step/s/s) = (maxVelocity - minVelocity) / ACCL
 *    forwards = 1 if HOMF was pressed, 0 if HOMR was pressed
 */
/*
asynStatus VirtualMotorAxis::home(double minVelocity, double maxVelocity, double acceleration, int forwards)
{

  // Homing isn't currently implemented

  return asynSuccess;
}
*/
```

Final Thought

The model-3 driver for the Virtual Motor Controller was written to handle every value sent by the motor record without having to convert it. This makes it an ideal starting point for writing a simple model-3 driver, since there is very little code to remove before implementing support for a new controller.