The dome encoder is a serial device. The serial input stream is
handle by the ic/fio_dome/dome_pos.c program. This is a 1 Hz loop
that reads the barcoder serial output and store the position in
shared memory.

The dome movement is controlled by the ic/fio_e/dome_cntl.c program.
The dome_cntl runs at 10 Hz and handles moving the dome to the correct
position using the opto22 analog and digital IO. dome_cntl also handles
variable related to user input (via the GUI) and the dome handpaddles.

1. A summary of the input, output and variables related to dome control:

    dome_cntl inputs are:
    =======================

    // Software User inputs:
    sw_mode;   // UI: dome software mode [auto | manual | lock]
    manual_cntl;   // UI: dome manual control [forward | reverse | stop]
    manual_speed;   // UI: speed factor for dome manual mode [0.0 - 1.0])

    // TO Panel inputs:
    to_panel.dome_cntl; // UI: Dome Control 3 position switch [LOCKED, HANDPADDLE, SOFTWARE]
    dome.hp_left;   // UI: Dome HandPaddle Reverse - off/on logic value (via montary button)
    dome.hp_forward;   // UI: Dome HandPaddle Forward - off/on logic value (via montary button)
    dome.hp_brake;   // UI: Dome HandPaddle Brake   - off/on logic value (via toggle button)

    // Others
    dome.heater_on   // DI: 1=Dome Heater is plugged in. (DI is on fioA)
    obs_azimuth   // azimuth of the telescope.
    obs_zenith   // zenith distance of the telescope.
    fioe->sb.sb_errors   // flag to determine if the safety board is in an error state.

    dome_cntl output are:
    =====================

    dome.motor_cmd;   // requested DA output to drive dome motors, -10 to 10v.
    dome.dome_brake;   // DIO logic for brake enable, ON or OFF

2. Description of Dome control:

    The dome control inputs are from the TO Panel & Dome Handpaddle, and software
      TO Panel - dome_cntl 3-position switch (LOCKED, HANDPADDLE, SOFTWARE)
      Dome HandPaddle - has Left, Right, Brake_offon, and Stop buttons.
      Sofware inputs.

    The dome_cntl (from the TO Panel) defines 3 principle states of the dome_control:
      TOP_DOMECNTL_LOCKED - stop dome and apply brakes.
      TOP_DOMECNTL_HANDPADDLE - only allow handpaddle control.
      TOP_DOMECNT_SOFTWARE - only allow software control.

    Under domecnt_sofware, we have 4 software modes:
      manual mode - Control of dome D/A and brakes under user control via MCC GUI
                     (and handpaddle Left/Righ/Brake,Stop input are valid).
      auto mode - software is tracking the telescope's postion (ignore manual inputs).
      goto mode - moves the dome to a specific azimuth.
      lock mode - Dome is stop & brakes on.

  2.1 Description of DOME_TOP_CNTL_LOCKED.

      dome_da set to 0.
      Software inputs are ignored.
      (sw_mode set to locked).

  2.2 Description of DOME_TOP_CNTL_HANDPADDLE.

      If hp_brake is on, dome_da = 0.
      otherwise hp_forward or hp_left, moves the dome.
      Speed is limited to +/- 6 volts on the dome_da.
      Software inputs are ignored. (sw_mode set to locked).

  2.3 Description of DOME_TOP_CNTL_SOFTWARE.

    2.3.1. DOME_SW_MODE_AUTO software mode:

        Auto mode moves the dome to match the telescope's obs_azimuth.
        Software waits until dome is > 2 deg away from obs_aziumth,
          then move the dome to obs_aziumth. Once the dome comes within
          0.4 degress, the Dome movement is stopped.
        if(within 2 deg of zenith), tracking not required. (don't move dome)

        In auto mode, the dome_da is based on position error, where position error
          is (dome_position - obs_azimuth).
          If err < 2 deg, set dome_da to zero.
          If err between 2-5 deg, set dome_da to a magnatude of 2 volts.
          If err >5 deg, set dome_da to a magnatude of 5 volts.

    2.3.2. DOME_SW_MODE_MANUAL software mode:

        User inputs via the GUI control the manual operations:
          dome_manual_cntl can be RIGHT, LEFT, STOP.
             RIGHT - means apply positive dome_da to move the dome.
             LEFT - means apply negative dome_da to move the dome.
             STOP - means set the dome_da to 0.
          dome_manual_speed scales the voltage output.

        User then set the dome_manual_speed from 0 to 1.0 (scales dome_da from 0 to 10 v).
        User can then set dome_manual_cntl to RIGHT, LEFT, STOP.

    2.3.3. DOME_SW_MODE_GOTO software mode:

        User input via the GUI allow the user to input a destination AZ in deg.
        The software will postion the dome to this AZ.

    2.3.4. DOME_SW_MODE_LOCK software mode:

        dome_da set to 0.
        dome_brakes are Locked.
        dome_ampl is Disabled.

3. Brake on/off timer and ramping of dome AMP input.

    When the dome_da is set to request the a dome movement, the brakes are released,
    then after 0.5 seconds, the voltage is applied to the opto22 Analog out module
    used to drive the AMP inputs.

    When stopping or once the opto22 D/A output for the AMP reaches 0, a 10 seconds
    must elapse before the brakes are enabled. This should allow the dome to come
    to a stop.

    The actual opto22 output to the D/A can only change at a rate of 0.70 volt/seconds.
    The increment of at 0.07 volts applied every 0.1 second (10 hz).

4. Dome position resolution

    The position of the dome is defined by the 1800 barcode labels attached
    to the 360 area of the dome. This provides an encoder resolution of 360/1800
    or 0.2 degrees.

5. Other signals.

    When FIOA_DI_Dome_heater_sense is True,
      then dome_cntl forces the TOP_DOMECNTL_LOCKED mode.

    When fioe->sb.sb_errors is TRUE (Saftyboard errors exist) _AND_ (CF_TCS3 is TRUE),
      then dome_cntl forces the TOP_DOMECNTL_LOCKED mode.

6. TCS1 or TCS3 configurations.

    The P113 cable is switched between FIO_AB and SE_FIOE to change the servo control
    between TCS1 and TCS3. Since the Dome AMP and Brake signal are on these cables,
    the dome_cntl program used the CF_TCS3 flag to tell it how the hardware is cabled up.
    The CF_TCS3 flag is set in the config.mk file.

    if(CF_TCS3)
        Use SE_FIOE for dome control
    else
        Use FIO_AB for dome control

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