Design of the NEESgrid data acquisition system

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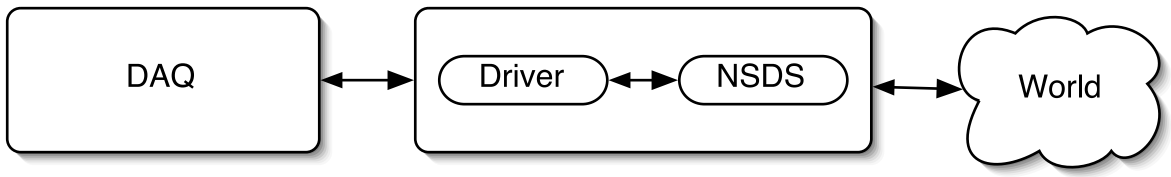
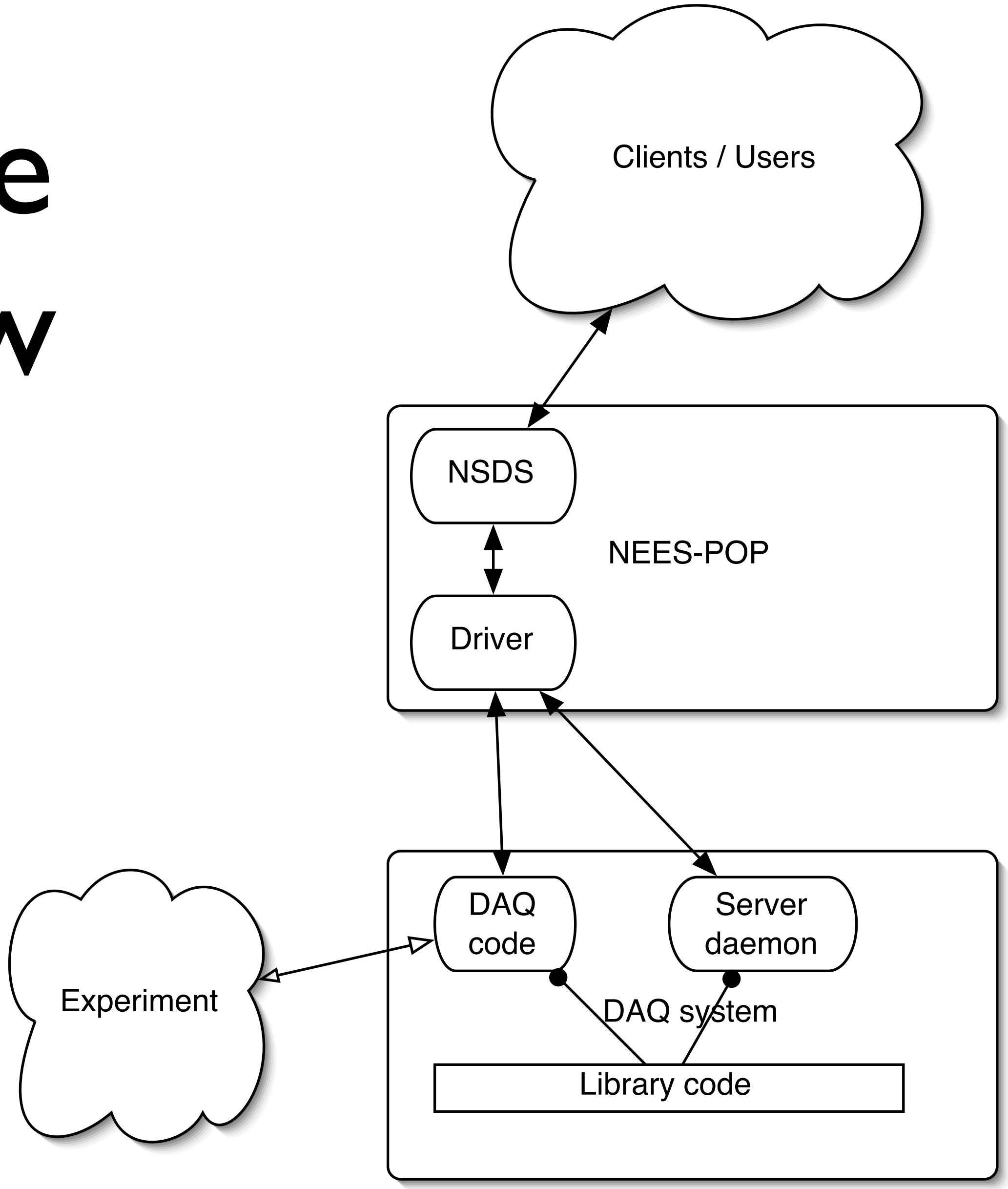
April 23, 2003


DAQ
Driver
NSDS
World

Your system NEES-POP Your users

Architecture and dataflow



Design Principles

- Assume that sites have or will build their own customized DAQ system
  - We will not provide a turnkey solution; we do provide a reference implementation in LabVIEW
  - Our code should drop into yours with minimal effort: small modules
  - Minimize impact on the existing system

Design Principles 2

- DAQ code should not know or notice if network is up or down
  - Auto reconnect logic is our problem, not yours
  - Small buffers in the driver
- Simple protocol that's easy to emulate
  - Code included does so: DI-194 DAQ, fake_daq
- Include examples and testing code

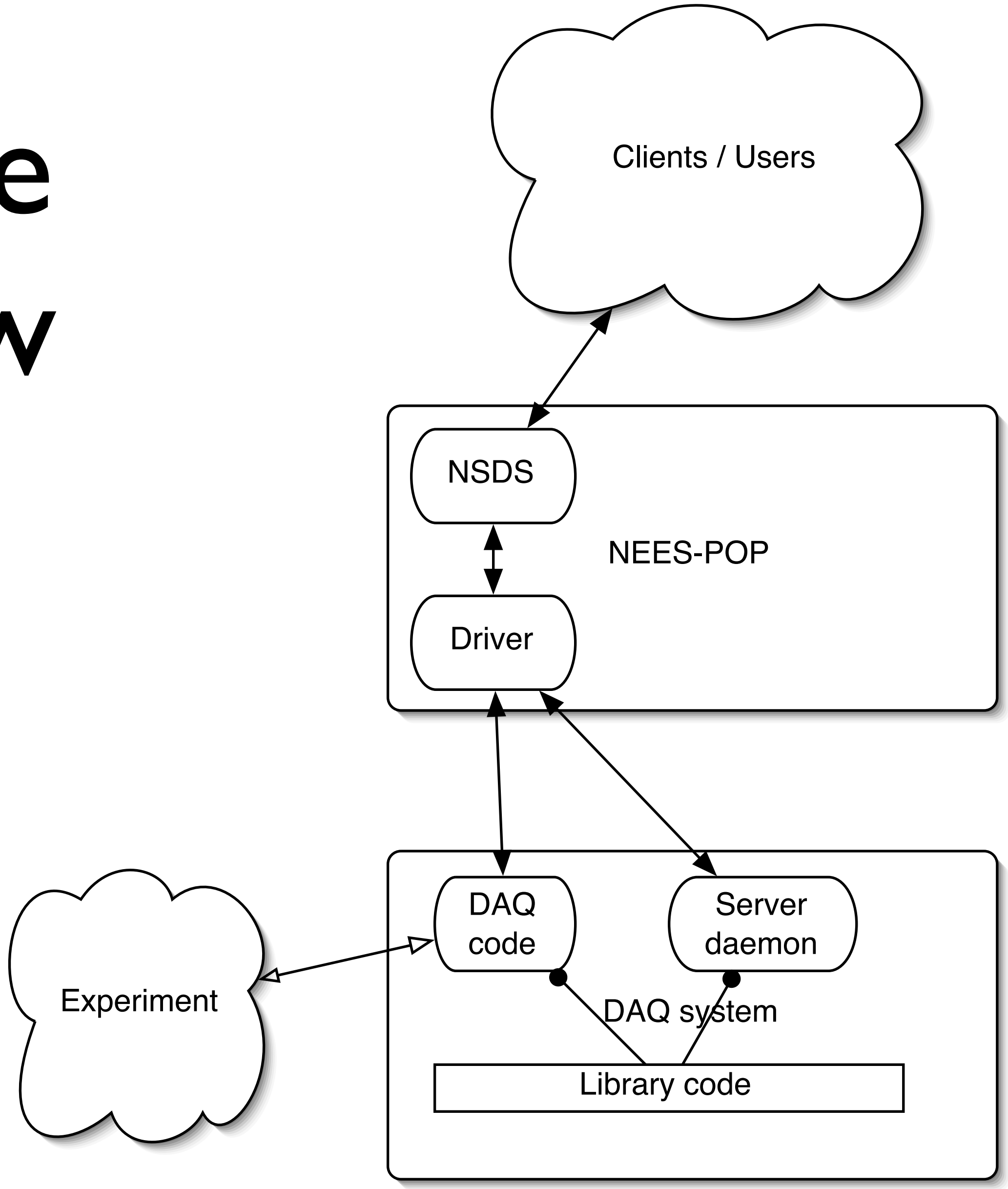
Terminology

- NSDS - NEESgrid Streaming Data Server. Java-based app, runs on the NEES-POP, central to the design.
- NEES-POP - Linux PC, onsite, that runs the NEESgrid collaboration code
- NSDS driver - C code, running on the NEES-POP, to mediate between the NSDS and the DAQ code. Rewrite for other DAQs.

Minimum requirements
for running and testing the DAQ code

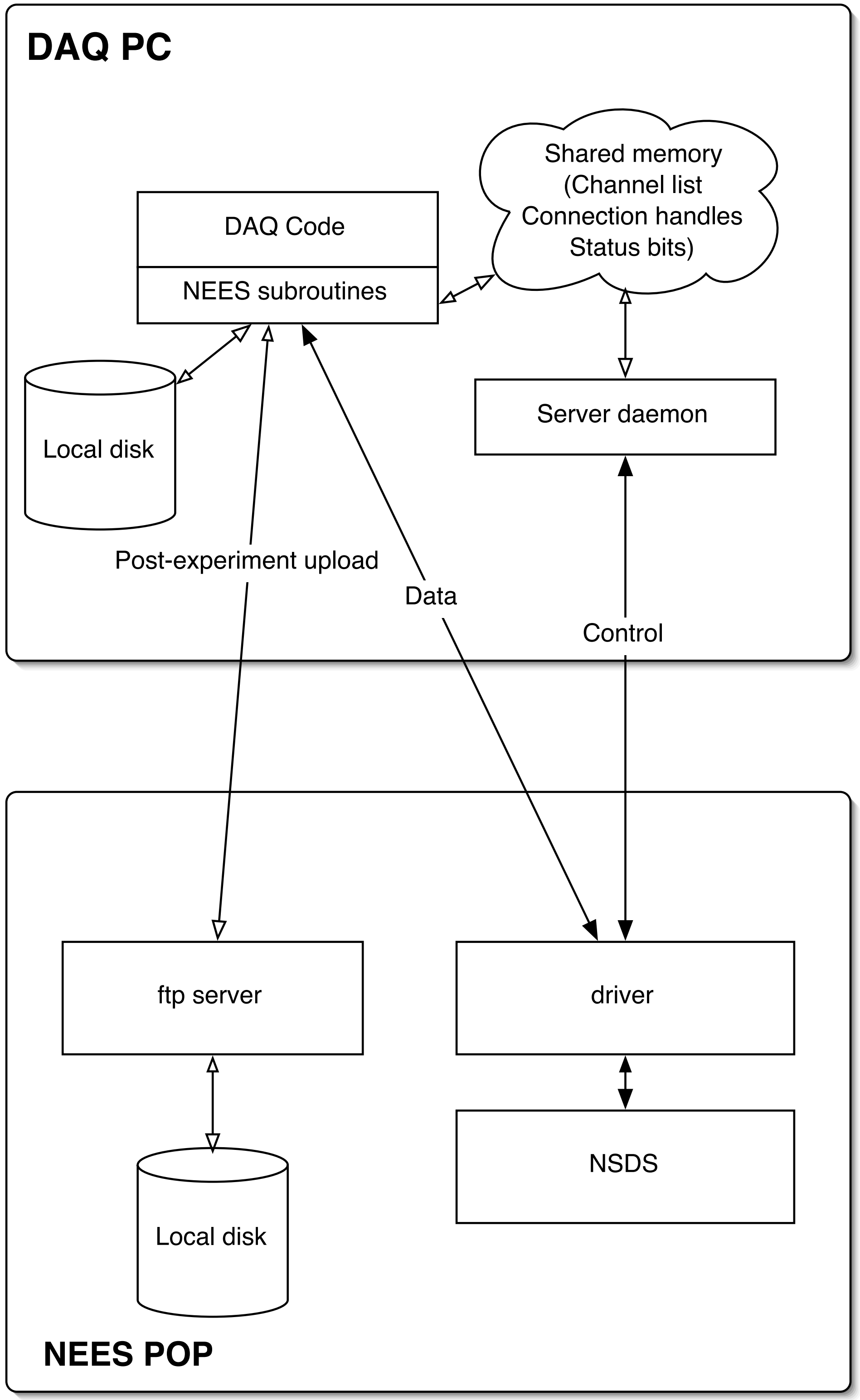
- LabVIEW DAQ system
    - Requires v6.1 and Internet Toolkit (~ $2,500)
    - Tested on MS Windows (2k and XP). Linux testing in progress: caveats apply to driver support. UEI DAQ, etc.
        - PCI 6036E, DaqPad 6052E, 6070E
- NEESgrid DAQ code (see http://www.mcs.anl.gov/neesgrid/daq-install-instructions.pdf)
- NEES-POP or other unix box to run the driver code. (http://www.mcs.anl.gov/neesgrid/driver-install-instructions.pdf
- NSDS (on NEES-POP) or simulator (on DAQ PC)

Architecture and dataflow



Normal configuration

- This slide shows the detailed internals on the NEES-POP and DAQ machines.
- Notes
  - Code provided to save to disk and upload via FTP in a standard ASCII format (Tab-delimited with header)
  - Server daemon establishes the data connection but does not touch it otherwise



Example data file

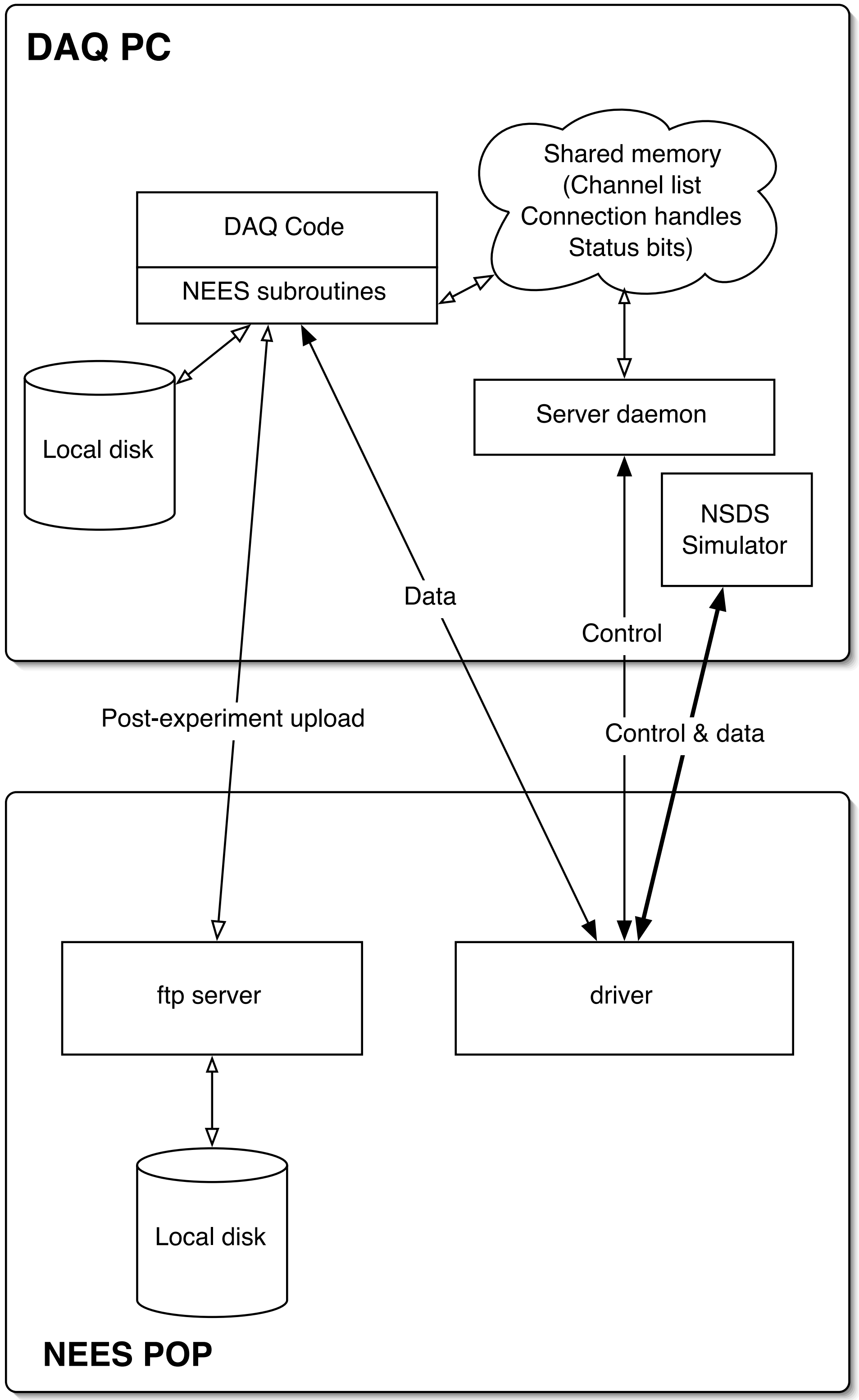
```
Event ID: 19364841J12
Active channels: ACH1,Temp
Sample rate: 200.000000
Channel units: V,Deg C


Time    ACH1    Temp
 2003-01-24T15:42:02.73399      -0.700531      27.603149
 2003-01-24T15:42:02.75000      -1.961975      27.587891
 2003-01-24T15:42:02.75500      2.678223       27.618408
```

Example NSDS stream

```
2003-01-24T15:42:02.73399      ACH1    -0.700531      Temp    27.603149
2003-01-24T15:42:02.75000      ACH1    -1.961975      Temp    27.587891
2003-01-24T15:42:02.75500      ACH1    2.678223       Temp    27.618408
```

Testing with the NSDS simulator

- Same design, but now NSDS is simulated in LabVIEW on the DAQ PC.
  - Verify the driver and network
  - No need to have CHEF available to see data plots
- Code supplied includes:
  - Simple single-channel subscribe and plot
  - Stress test - subscribe to all, no plotting
  - Subscribe and plot all
- This is how I normally develop



Misc Notes

- Separate TCP connections for control and data (ports 55055 & 55056 by default)
  - Control is bidirectional, data is unidirectional (DAQ -> world)
  - Driver <-> NSDS connection on 42420/1
- Commands are sent by the NSDS and answered by ‘server daemon’ on the DAQ PC.
- Data streams from the DAQ, via the driver, thence to the NSDS

Driver details

- Main function is to *initiate* and maintain connections
- Main loop
  - Connect to DAQ
  - Connect to NSDS
  - Forward on both channels until a TCP error occurs
  - Responds to NSDS's initial ID request; ID is configurable via the command line
- POSIX C, pthreads, runs on most Unix variants
- Source code is heavily Doxygen-documented; see the html subdirectory for the results.

DAQ on other platforms

- Not everyone runs LabVIEW for DAQ
- Read ‘NSDS-Driver Protocol’ document and decide if you want to use it or rewrite the driver (http://www.mcs.anl.gov/neesgrid/)
- Example source code in C:
  - fake_daq (in nsds-driver package)
  - neesdaq (DI-194, in nees-di package)
- All source code has Doxygen docs included

Where To Go From Here

- http://www.mcs.anl.gov/neesgrid
    - Pointers to CVS, mailing list, MUD
    - PDF docs
    - Bugzilla
- http://www.ni.com/labview
- phubbard@anl.gov