Design of the NEESgrid data acquisition system

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Your system  NEES-POP  Your users
Architecture and dataflow

[Diagram showing the architecture and dataflow with the following components:
- NSDS
- NEES-POP
- Driver
- DAQ system
- Server daemon
- Library code
- DAQ code
- Experiment
- Clients / Users]

[Diagram indicating the flow from Experiment to DAQ system, then to Server daemon, followed by DAQ code, and finally to NSDS and NEES-POP.]
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