Hardware Scaling Lessons from the TA

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AUG - IRIS
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Skamania, Washington
ANF Operations Year 1 - 2004

• TA Field
  - 13 TA Stations
  - 66 Contributed stations (CI, BK, AZ)

• Server Hardware
  - Sun Blade 1000

• Software
  - Nagios - system monitoring
ANF Operations Year 2 - 2005

• TA Field
  – 66 TA Stations
  – 65 Contributed stations (CI, BK, AZ, NN)

• Server Hardware
  – Sun Blade 1000 removed in Fall - Load average too large
  – Sun V240 installed in Fall
  – 3.5 TByte SCSI storage array installed
  – Linux Webserver

• Software
  - Nagios - system monitoring
  - cfengine - system configuration
ANF Operations Year 3 - 2006

• TA Field
  – 232 TA Stations
  – 75 Contributed stations (CI, BK, AZ, NN, US)

• Server Hardware
  – Sun V240 - load average problems
  – Sun T2000 installed - moved acquisition
  – 3.5 TByte SCSI storage array
  – SRB Brick brought online
  – SDSC V240 backup brought online
  – DMC V240 backup brought online
  – ANF export V100 brought online
  – iSCSI Storage Area Network implemented
  – Linux Webserver

• Software
  - Nagios - system monitoring
  - cfengine - system configuration
ANF Operations Year 4 - 2007

• TA Field
  – 411 TA Stations
  – 77 Contributed stations (CI, BK, AZ, NN, US)

• Server Hardware
  – Sun Cluster Installed with zones - 2 V240s, 1 V245, and 3 T2000
  – SRB Brick
  – SDSC V240 backup replaced with T2000
  – DMC V240 backup replaced with T2000
  – iSCSI Storage Area Network - 3.5 TByte capacity expanded to 15 Tbytes
  – Veritas VxFS replaces ufs file system - inode problems
  – Linux Webserver

• Software
  - Nagios - system monitoring - Deprecated
  - intermapper - system monitoring installed
  - cfengine - system configuration
RT system at the Array Network Facility
ANF Operations Year 5 - 2008

• TA Field
  – 442 TA Stations
  – 57 Contributed stations (CI, AZ, NN, US)

• Server Hardware
  – Sun Cluster - 3 V240s and 3 T2000
  – SRB Brick
  – iSCSI Storage Area Network 15 TBytes
  – Decommissioned Sun Cluster
    – PxFS replaced with QFS
    – Discovered Sun Cluster does not support iSCSI
    – Kept zone functionality
  – Installed 3 T5220 for web support

• Software
  - intermapper - system monitoring installed
  - cfengine - system configuration
  - Confluence installed for ANF Wiki
ANF Operation Zones

- Real time
  - anfops
    - Q330 acquisition
  - anfexport
    - acquire Q330 field station data
    - acquire contributed regional/national network data
    - serve data to internal and external clients
  - anfproc
    - realtime event processing
  - anfwf
    - waveform writer
  - anfanalyst
    - analyst review
ANF Operations Zone

- Miscellaneous
  - anfdev
    - development and testing
  - anfpublic
    - limited public access
  - anfmon
    - intermapper

- Web
  - anfwebproc
    - backend web page production
  - anfwebproj
    - web page exports
  - anfwebtest
    - web content development and testing
Metrics and Applications from the TA

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USArray Data Flow at ANF

- 3 Tbytes of data - April 2004 - June 2008 (compressed)
- As of June 2008
  - 4 Gbytes/day compressed data
  - 2 Mbit/sec data export
  - 436 seismic stations
  - 2616 seismic channels
  - 13516 soh channels
  - 1.5M picks
  - 32K events
Operational Statistics

Availability (uptime)
- Consistently > 90%
- Redundant data recovery mechanisms
- Acquiring ~ 1.2 Tb/y (~5 Gb/day)

85% is official performance goal

Data availability for past 36 months

Measured at end of month Measured after 3 months
• Identification of data gaps;
• Recovery of data gaps using BalerAdmin software;
• Building databases from field cdroms;
• Rebuilding station-day volumes once all gaps are filled for each station-day;
• Replay updated gap filled station-day volumes to DMC for arc

Saturday, June 7, 2008
Monthly gap processing - gathering data

- miniseed2db - build monthly rt wfdisc
- rt_daily_return - final gap identification
- dmcgap2db - convert DMC gap list into db
- baler loop
  - build_baler_data - build non-overlapped wfs
    - cdroms - multiple dbs
    - baler_admin - multiple dbs
  - gap_status - identified recovered gaps
  - baler_request - baler_admin input
  - baler_admin
- interate loop several times ~ 1-2 days
Monthly gap processing - sending data

• build_baler_data - build non-overlapped wfs
  • cdroms - multiple dbs
  • baler_admin - multiple dbs
• fill_gaps
  • builds gap replaced station/day volumes
• dbreplay
  • sends repaired data to DMC

• START NEXT MONTHS PROCESSING!
2008 Stats

• 1 Jan - 16 May
  • 50307 Station Days
  • 44585 Station Days 100% data return - 88%
  • 94.3% Total Data return

• 10 March - 16 May
  • 87% Station/Days 100% data return
  • 96.9% Total Data return

• 2398 DMC identified gaps
• 65431 ANF identified gaps
Orientation

http://www.ldeo.columbia.edu/~ekstrom/Projects/USARRAY/POLARIZATION/

- Empirical orientation determination using surface and mantle wave polarization techniques of USArray and other networks

- TA made direct measurement of orientation of stations using fiber-optic gyroscope
  
  **IXSEA Octans IV**

  *(Nonmagnetic orientation accurate to < 0.2 degrees)*

- Techniques agree to within 1.2 Degrees

- TA uses Octans at all new station installations and on station removal.

*(Ekstrom, Busby submitted SRL 2008)*
State of Health Review

- Real-time monitoring of SoH
  - Detect problems
  - Initiate corrective actions
- Station QC & SoH on the web
  - SoH channel displays for near-real-time and summary
  - Metrics for arbitrary time intervals

PDF noise analysis by station-channel

Temperature and voltage - life of station

Mass position - life of station

From ANF station status web pages

From DMC QUACK tool
Diagnostic view: discovery!

Guralp Vertical: Mass Pos vs noise
• Automated process to command, capture and analyze cal signals applied in situ using Antelope.

• Interpret calibration analyses to verify amplitude and phase response, stationarity of sensor.

• Will be applied to all stations at beginning and end of deployment.

• Will be archived as Data Product.

User Commands

NAME dbcalibrate – sensor and cross comparison calibration analysis program
SYNOPSIS dbcalibrate [-out dbout] [-psmn] [-p pfname] [-calper calper]
[-resp_dir resp_dir] [-resp_didle resp_didle] [-resp_dflile resp_dflile]
[-dcalcwf after calwf] [-cgeen singen] [-outcome] [-v] 
[-error_at_calper] [-template name] [-dbcmp dbcmp]
[-noise cnoise] [-type (ratio|power|coherence)]
dbin [sequence id | sequence id cmp(chan cmp)]
Metadata:
Instrument responses

STS-2
3 Generations
Metadata:
Instrument responses

TA Sensors
3 Types