JPL VLBI Correlator (JVC)

Steve Rogstad
Chuck Goodhart, Eric Clark
Sue Finley, Les White, Gabor Lanyi – Caltech/JPL
Overview

• A collection of Commercial Off The Shelf (COTS) hardware and custom software processes that function as a VLBI correlator
• Uses SoftC as the correlation engine
• Exists in the DSN’s Radio Source Observation (RSO) Subsystem
• JVC data is used to support JPL spacecraft Navigation
  – VLBI Source Catalogue Maintenance and Enhancement Task (CAT M&E)
  – Time and Earth Motion Precision Observations Task (TEMPO)
• JVC was the replacement for the Block II Correlator
  – Requirements were the same – 112MB/sec rate, 24-hour TEMPO etc…
  – Software running on COTS, instead of custom, hardware
  – Much easier operations and maintenance
  – Can process a TEMPO pass up to 4 times faster (~2hr. vs. ~8hr.)
JVC within the RSO Subsystem

- DSN Stations
  - Mark V Disks
- Field System
- VLBI Science Data
  - Ship Disks
- External VLBI Customers
  - JVC
- ITT Monrovia
  - JPL VLBI Correlator
  - Disk Array
  - Mark V
  - Beowulf Cluster
- JPL
  - Fit Modest
  - Radio Source Modeling
JVC Hardware

• **Mark 5A data system**
  – Developed by Haystack
  – Used in the JPL VLBI Data Acquisition Terminal (DAT)
  – Provides the data input to the JVC

• **RAID storage device**
  – 12x 750GB drives in a RAID 50 configuration (RAID 5 + RAID 0)
  – Provides a temporary archive for the Mark 5 data

• **Processors put together as a 16-node Beowulf cluster**
  – Beowulf hardware from Professional Service Super Computer (PSSC) Labs
  – Provides the processing power and parallelization for SoftC
JVC Block Diagram

DSN Stations

- DSCC STATION #1
- DSCC STATION #2

JVC Beowulf

- MARK5 #1
- RAID #1
- MARK5 #2
- RAID #2

- NODE 1
- NODE 2
- NODE 3
- NODE 4
- NODE 5
- NODE 6
- NODE 7
- NODE 8
- NODE ...
- NODE n

- USER WORK STATION
- POST PROCESS

Flight OPS LAN
JVC Photo
JVC Software

- JVC delivered to the Deep Space Network (DSN), Sept 2008
  - Software at version 1.0.1
  - SoftC v1531 for correlation engine
  - Mark 5 Data system software version 2.1.0
  - Beowulf nodes using Fedora Core 4 Operating System

- Developed software consists of:
  - SVC Extraction software (Perl code)
  - M5a2sdf Translator software (C code)
  - Node synchronization software (SQL code)
  - Misc. wrapper scripts and utilities (Bash & Perl code)
JVC Software Process Diagram

master node

Operator enters
> corproc

corproc

extract

translate

correlate

Mark 5

storage

Mark 5

storage

compute
compute
compute
compute
compute
compute
compute
compute
compute
compute

Extraction, Translation and Correlation are parallel tasks
JVC Corstat Display

-8.18155e-1, 2.48188e+8
Recent JVC Development

• Version 1.1.0 delivery planned for late FY09 (Summer 2009)
  – Fixed phase cal tone anomaly with new version of SoftC (v. 1534)
  – Fixed missing scan anomaly with updates to Translator software
  – Operations improvements – detecting bad disks, scan ordering, email
  – More storage node capacity – 12x1.5TB disks
  – JVC is now Gbit rate capable – new Translator software
  – Larger SATA-based disk packs pending a Mark 5 software upgrade

• Future Development Plans
  – Upgrade to Mark5C
  – Increase bandwidth capability to 10 GB/sec rates
  – Addressing data flow bottlenecks