CMP: Control Monitor Processor

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Introduction

- ## What is the CMP?
  - Monitor & Control the VLA antennas through the EVLA M&C.
  - Real Time Monitor & Control System.
  - Temporary system during the transition period from VLA to EVLA.
  - Lasts as long as the VLA correlator is in use
    - To control the D-Racks, Flukes and other devices in the control building
  - It is an important part of the MODCOMP retirement plan.
  - A unified interface for the EVLA M&C.
    - A similar behavior and interface to the MIBs
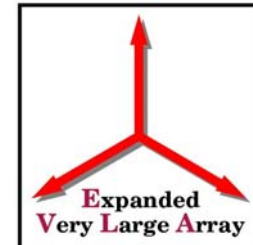
/users/bsahr/EVLA/diagrams/overall_design/SW_components:
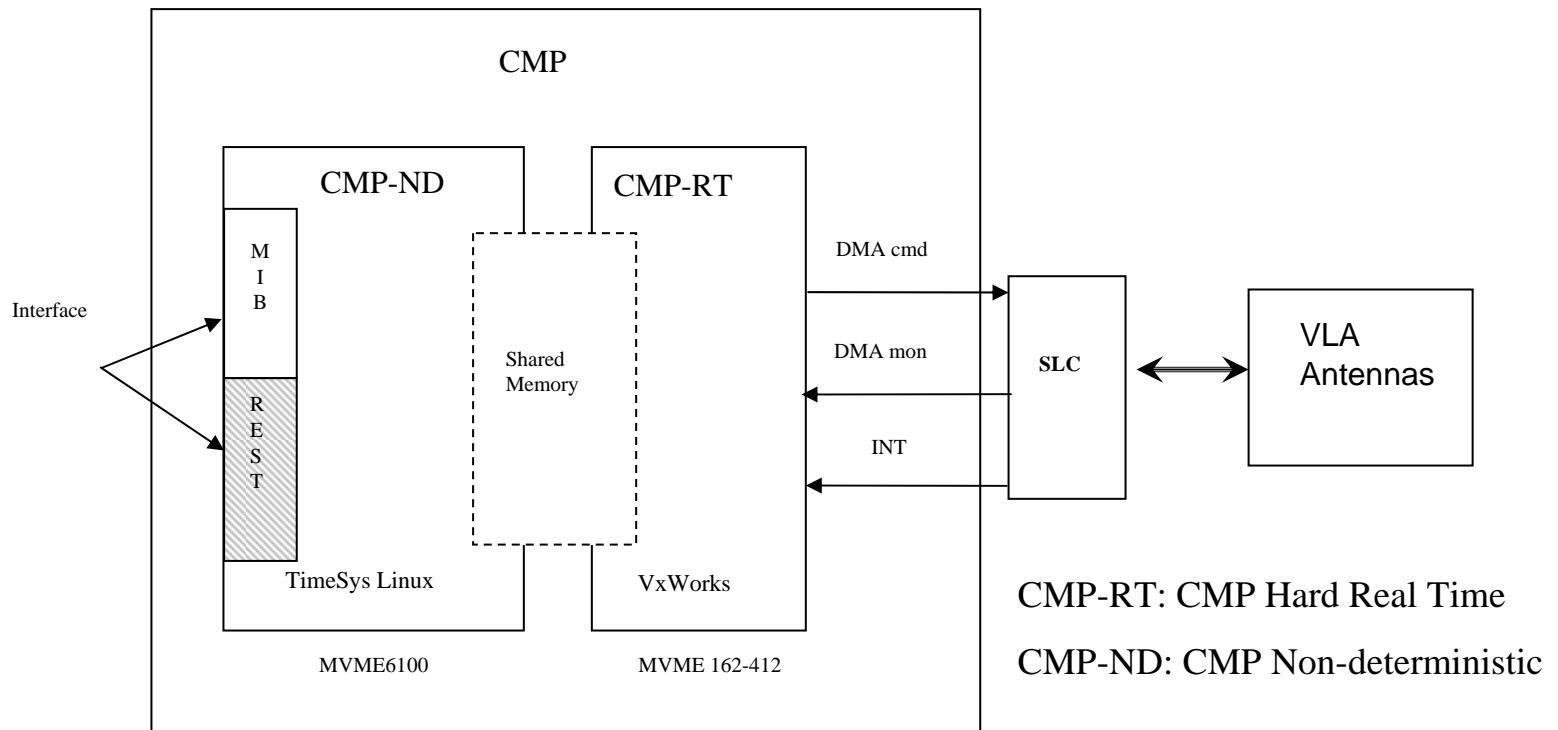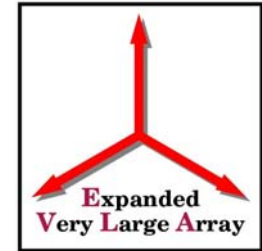Transition System-3, 11/2006, Bill Sahr
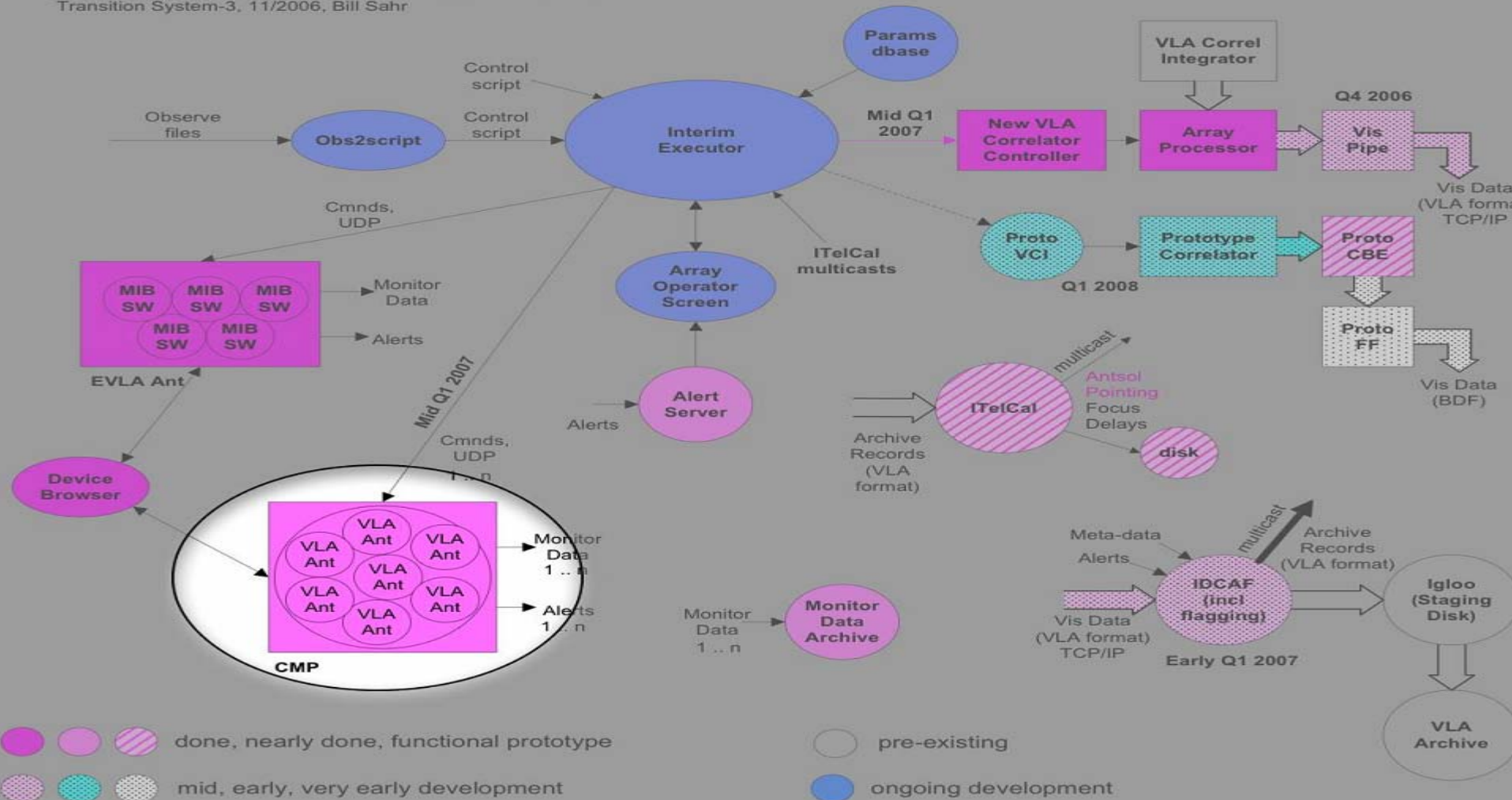
Terminology

- DCS#: Digital Control System.
  - DCS addresses are associated with "D"-Rack physical location sequenced from 1 through 33_8 starting with "D"-Rack 1 on the southwest arm of "D"-Racks.

- SLC: Serial Line Controller.

- DMA: Direct Memory Access

- ISR: Interrupt Service Routine. Code that get executed when an interrupt is triggered.
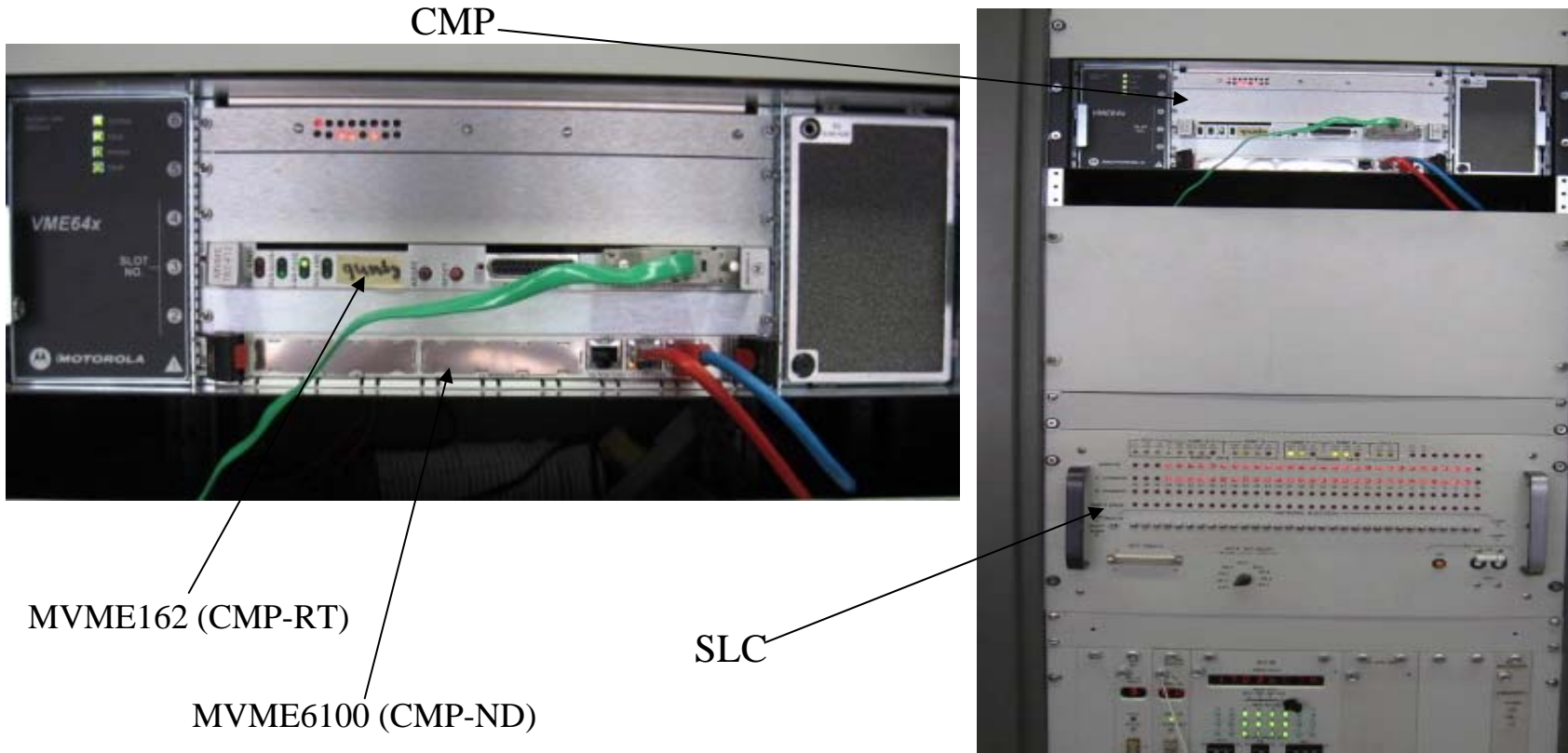
- COTS: commercial off-the-shelf.
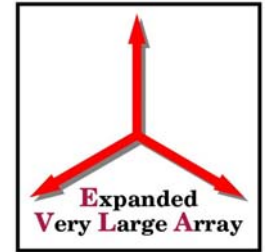
CMP Architecture

CMP

CMP-ND

CMP-RT

Interface

M
I
B

R
E
S
T

Shared
Memory

DMA cmd

DMA mon

INT

SLC

VLA
Antennas

TimeSys Linux

VxWorks

MVME6100

MVME 162-412

CMP-RT: CMP Hard Real Time

CMP-ND: CMP Non-deterministic

Picture
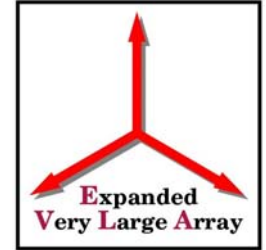

CMP

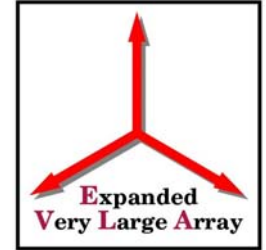MVME162 (CMP-RT)

MVME6100 (CMP-ND)

SLC

CMP Hardware

- CMP is a cooperation of 2 COTS VME boards:
  - A MVME 162-412 board running VxWorks 5.3
    - 25MHz MC68LC040
    - 4MB of RAM
    - 2 IP-Unidig-P cards used to DMA in & out data.
    - CIO-32 card to intercept interrupts
    - Talks to the SLC (Serial Line Controller)
    - Synchronized with the Wave Guide Cycle
    - Handles all deterministic and real time operations.

CMP HW (cont')

- A MVME6100 board, running Real Time Linux from TimeSys.
  - 1.267 GHz MPC7457 PowerPC
  - 1GB DDR memory
  - 128MB Flash
  - Dual Gigabit Ethernet
- The two boards communicate through a shared memory
  - The MVME 162-412 is mapped to the memory of the MVME6100 board which makes all of it accessible.

CMP Software Characteristics

- Hide all the details (DS and MUX) from the high level user/application: the CMP is in charge of mapping properties, commands with the right DS and MUXs.
- To be able to sequence deferred commands internally.
- Execute deferred commands in sync with the Waveguide cycle.
- Present a similar interface to the MIB
  - Service Port
  - Data Port
  - Telnet interface
  - Multicasting Data & alerts
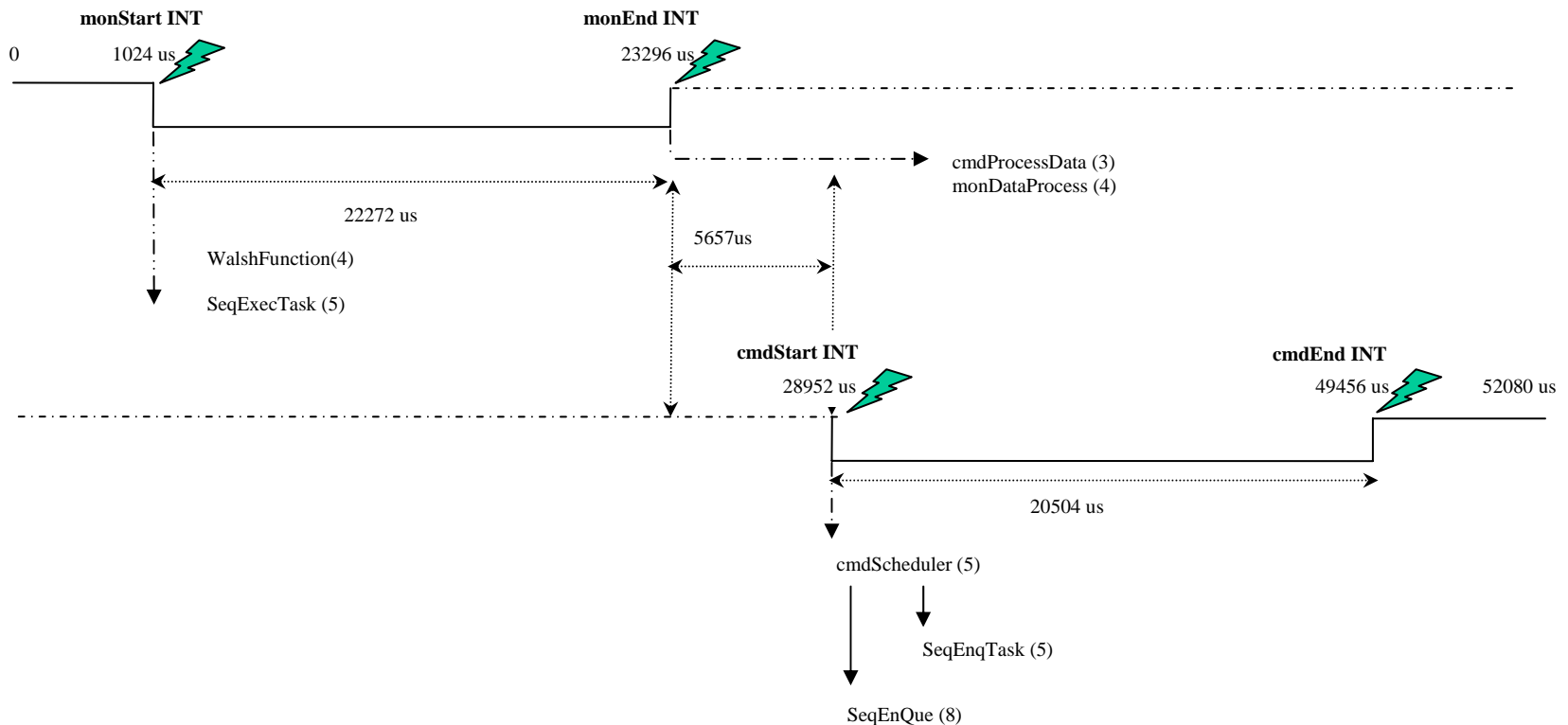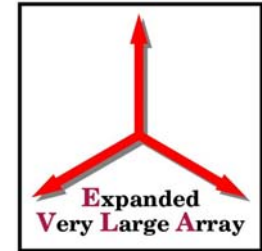- Each DCS# is addressed & managed independently

Software Architecture
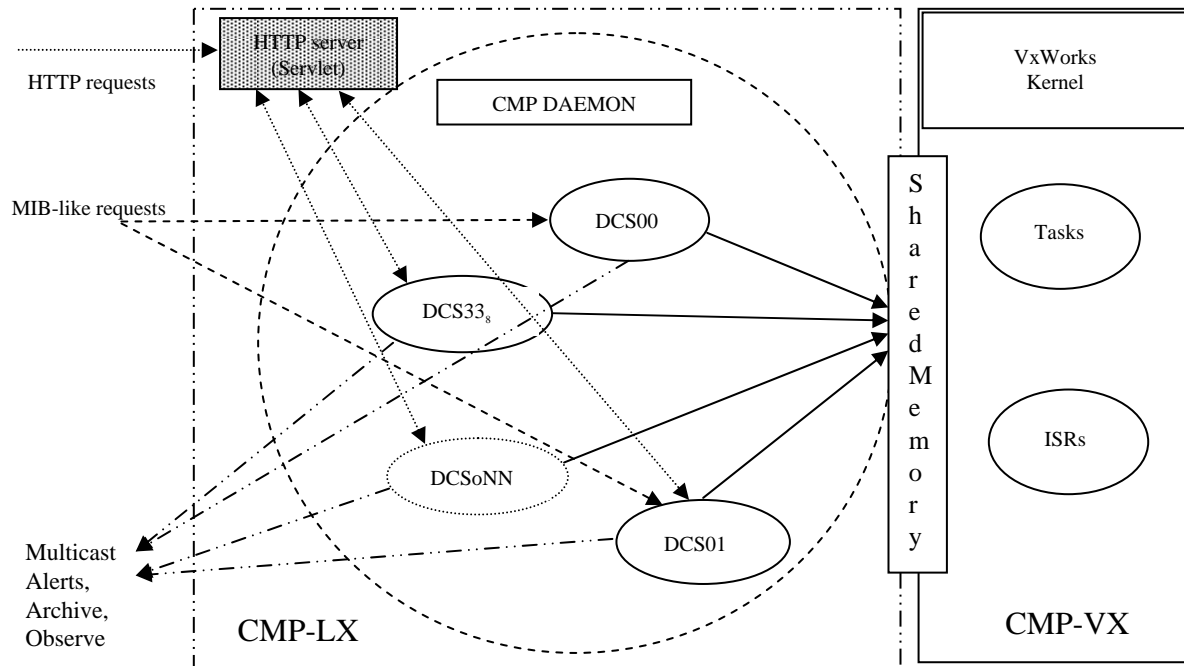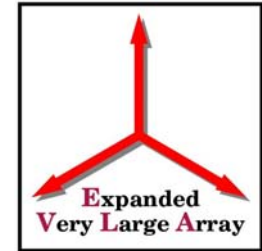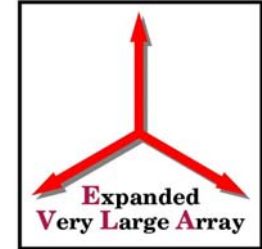

CMP = Set of Virtual Antennas

HW Interrupts/ISRs/Tasks

Software - CMP VxWorks

- ISRs: Respond to interrupts from the SLC
  - isrMonitorStart: triggered by an interrupt at Start Monitor Cycle
    - Sets the DMA engines to transfer the data from the SLC to the board memory
    - Prepares the system for the End Monitor event.
  - isrMonitorEnd: triggered by an interrupt at End Monitor Cycle
    - Verifies the DMA transfer of monitor data
    - Prepares the system for next Monitor Cycle.
  - isrCommandStart: triggered by an interrupt at Start Command Cycle
    - Sets up the DMA engine to start the transfer of commands from the board's memory to the SLC.
    - Prepares the system for the End Command event.
  - isrCommandEnd: triggered by an interrupt at End Command Cycle
    - Verifies the integrity of the DMA transfer of commands
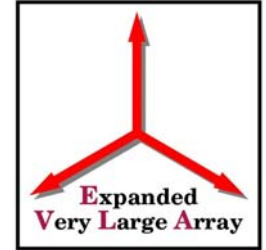   - Prepares the system for the next Command cycle.

Software - CMP VxWorks
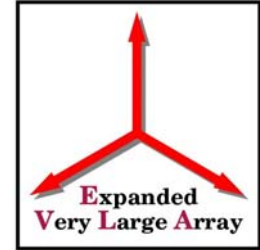
- Tasks:
  - Sequencer
    - Queues commands internally for execution in sync with the waveguide cycle.
  - ACU function
    - Takes care of doing all the calculation and update for the ACU unit
  - Walsh function
    - Used to inject the Walsh sequence
  - Data collection
    - Once data is ready, signaled by the SLC, data is processed and presented to the higher board
  - Commands collection
    - Prepares commands in a buffer for the DMA transfer
  - Shared memory worker
    - Collects commands from the shared memory and executes them or passes them to the sequencer
  - Watchdog Timer:
    - if this task fails to run within a 2 seconds interval, a reset signal is issued and both boards are reset.
  - TimeKeeper:
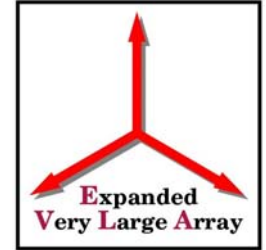   - Keeps the time in sync with the NTP time server.

Software - CMP Linux

- ## Main function
  - Public interface, including multicasting the archive, observing stream (o-stream) and alerts data, accepts command input and handles any non deterministic operations.

- ## IP aliasing
  - Assign multiple IP addresses to the same physical interface.
  - Every DCS# can have it's own IP address.
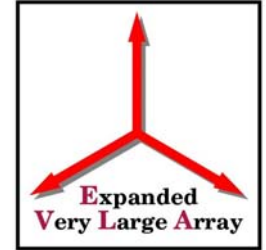 - Every DCS# is addressed individually & independently

Software - CMP Linux

- ## Multithreaded design and implementation
  - Every DCS# is managed by an independent thread
  - The interface to a DCS# is very similar to the MIB interface and includes
    - Data port
    - Service port
    - Telnet interface
    - Archive data stream
    - Observing data stream (o-stream)
    - Alerts.

- ## Entry point: CMPdaemon
  - Spawns a thread for every managed DCS#
  - Acts as supervisor to watch for the health of the threads and the system
  - Offers a diagnostic interface.

Software - CMP Linux

- ## Tasks
  - Archive
    - Takes care of multicasting archive, observing stream (o-stream) data
  - Service port
    - Listens for incoming commands and schedule them for execution.
  - Telnet
    - Listens for Telnet requests and handles them
  - Periodic scan Task
    - Collects data from the shared memory and makes it ready for the others tasks.

Commands Path

- Commands initiated from user through Telnet session or UDP port
- Received on CMP board running Linux. If the command is not internal to the CMP, reformat and write to shared memory.
- A task running on VxWorks periodically checks the shared memory for new commands.
- If new command present, check for immediate execution or to be sequenced. If immediate, execute. Otherwise, pass to the sequencer task.
- CMP-VX interrupted at the start of command cycle => DMA commands to the SLC.

user   CMP-LX   CMP-VX   SLC

UDP/Telnet request

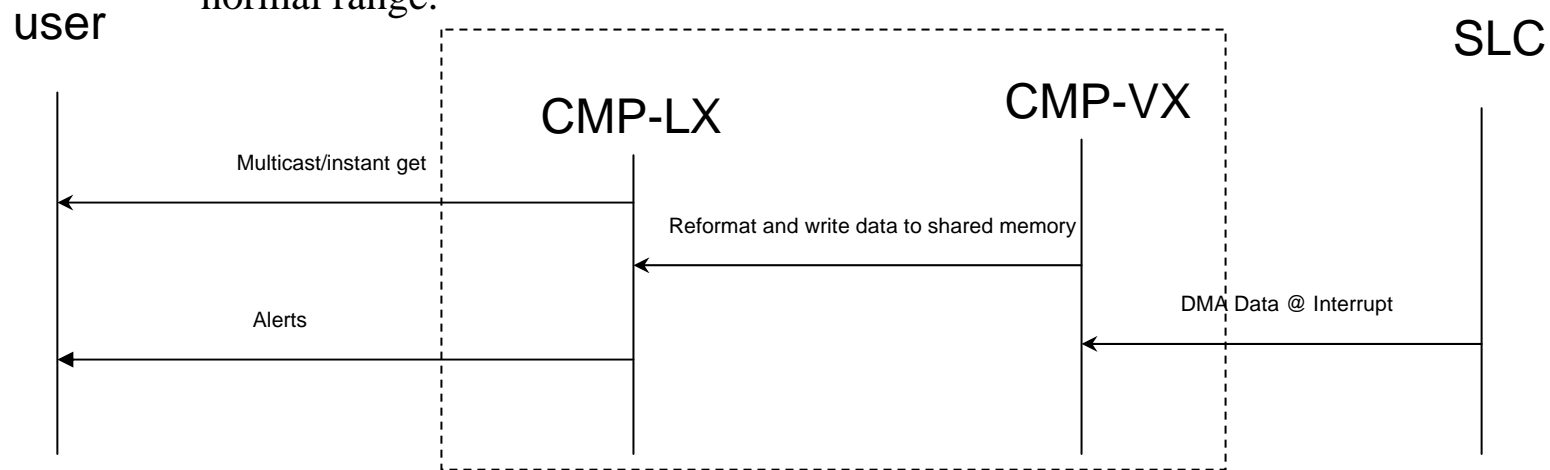Reformat and write command to shared memory
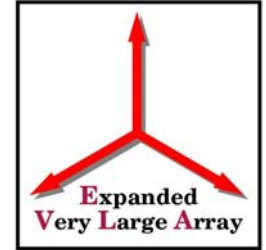
DMA commands @ Interrupt
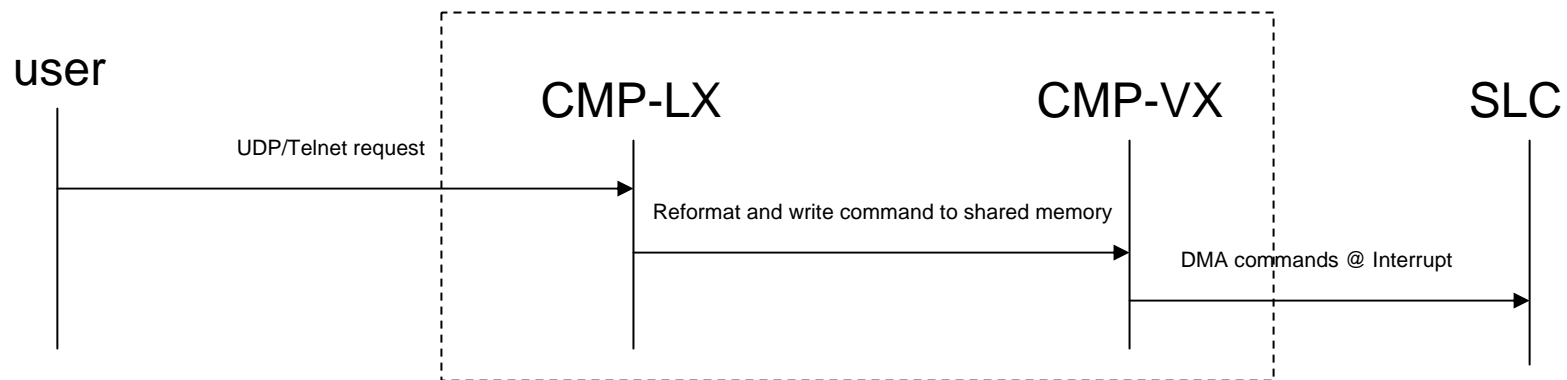
Data Path
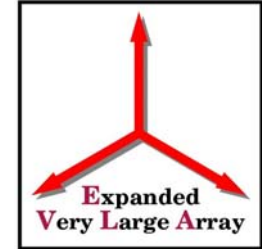
- Data collected every Waveguide Cycle (52 ms)
- CMP is interrupted every 52 ms to receive the data from the SLC
- Data is DMAed, formatted, and saved in shared memory
- The Scan task running on CMP-LX, collects the data from the shared memory
- The Archive task multicasts the data
- Alert task goes through the data and generates alerts for any data outside the normal range.

user

SLC

CMP-LX

CMP-VX

Multicast/instant get

Reformat and write data to shared memory

DMA Data @ Interrupt

Alerts

Testing & Deployment

- Testing
  - Phase 1: done on the test bench.
    - Test and verify the interface and communication with higher level application/users.
    - Stability testing
    - Stress testing
    - Performance measurement.
  - Phase 2: done @ the VLA site
    - Test and verify the CMP-SLC-antennas communication.
    - Test and verify the data collection process.
    - Test and verify the commands path.
    - Test and verify the complete path from the high level applications /users to the antennas and vise-versa.
    - Test and verify the timing and synchronization.
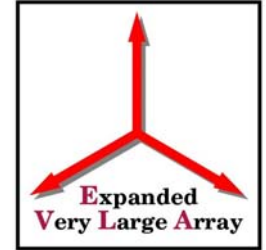
Current Status

- The CMP is up and running and has been collecting monitor data for few months.

- Archive, observe data and alerts are active.

- Used in the experimental control of a subset of 2 VLA antennas with the EVLA antennas.
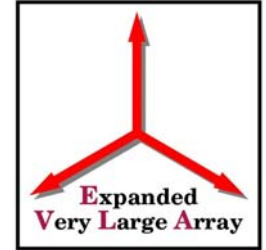
- Ongoing testing and tweaking.
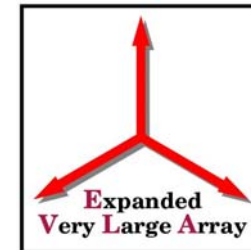
Work to be completed

- Use the system to control the whole VLA array

- Add a hard disk to the CMP-LX for better debugging and ease of deployment

- Final deployment

Demo

- [Device browser](#)

- Telnet interface

Questions