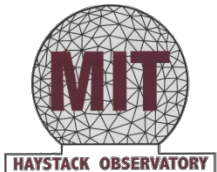


# Mark6 Status - Present and Future

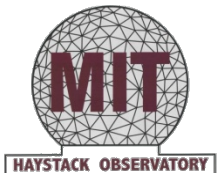
Chet Ruszczyk, Roger Capallo, Alan Whitney  
November 11<sup>th</sup> 2014

MIT Haystack Observatory, Westford, MA



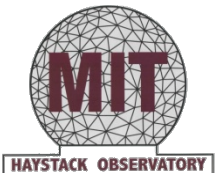
# Agenda

- Mark6 Status
  - Versions
  - New Features / Major Bug Fixes
  - Documentation
- Subgroup Feature
- Correlator Operations
- Future Features



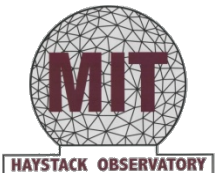
# Mark6 Status

- Software Version 1.1
  - Features:
    - Mark6 service for cplane / dplane on boot up.
      - start / stop / restart / reload
    - Persistent configuration information retained
      - On reboot / reload.
    - Subgroup support
    - Major bug fix
      - Scan check not closing files after checking
  - dplane (data plane - r/w to disk modules)
    - Version 1.16
  - cplane (control plane - VSI-S interface)
    - Version 1.1.1



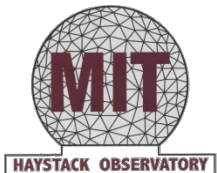
# Mark6 Status

- Bugs presently under investigating
  - 2 streams of 8Gbps (16Gbps) 3% drop
    - Configuration issue
      - IRQ's and SMP\_AFFINITY
      - Assignment to cores
    - Solution has been identified and under test
      - cplane 1.1.2
  - 2 streams of 8Gbps (16Gbps)
    - Standard MTU size < 1500-byte long VDIF frames.



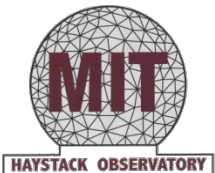
# Mark6 Status

- Documentation
  - Command Set Version 1.1
  - Subgroup memo (use cases)
- Self test software
  - Available but not user friendly
  - Has not been released
- Conditioning software
  - Under test
- Vdifuse - Fuse based interface to scatter gather stored disks (Under test)



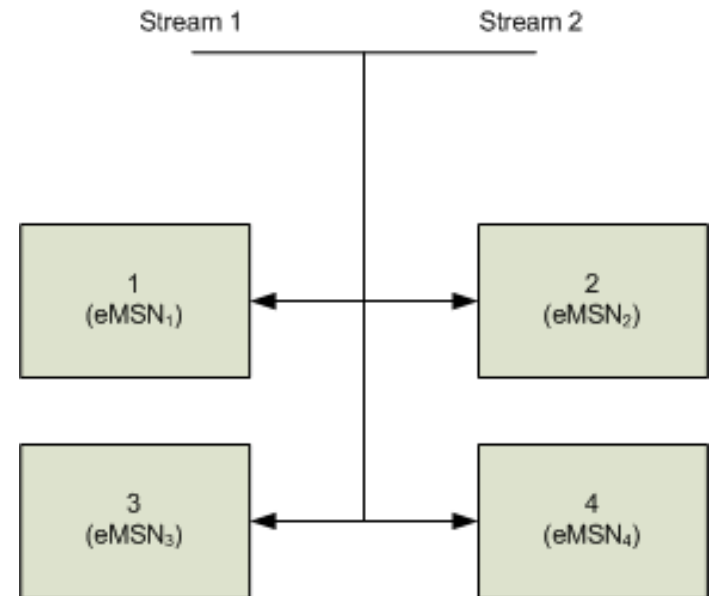
# Mark6 Status

- Hardware
  - New motherboard (identifying, will evaluate)
    - Two motherboards have now reached end of life (Ah COTs hardware)
  - 64G of RAM
  - CX4 or SFP+ 10G
    - Two NIC cards (~20Gbps / NIC supported)
- Haystack has 9 systems in house
  - 3 EHT Development
    - Connected to the correlator
  - 4 Geodesy and development
  - 2 on Correlator (Mark5 Upgraded to Mark6)
- Alma Phasing Project
  - 4 at site and 1 spare
- EHT
  - (9) Ordered for March Campaign



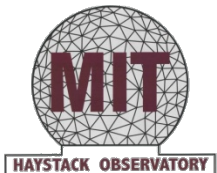
# Subgroup Feature

- Mark6 normal recording mode
  - group\_ref = 1234
    - 4 disk modules open for recording
  - 2 input streams defined for receiving data
    - e.g. eth2, eth4
  - 8Gbps / input stream
  - 16 Gbps is written to all disk modules in group\_ref



# Subgroup Feature (cont)

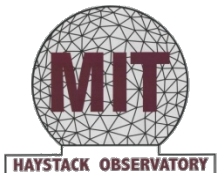
- Imagine if each Ethernet port receives a different polarization
  - eth2  $\leq$  RCP, eth4  $\leq$  LCP
- For existing Mark6 software if correlating a specific polarization, e.g. RCP
  - Requires all 4 disk modules to be inserted at correlator for processing.





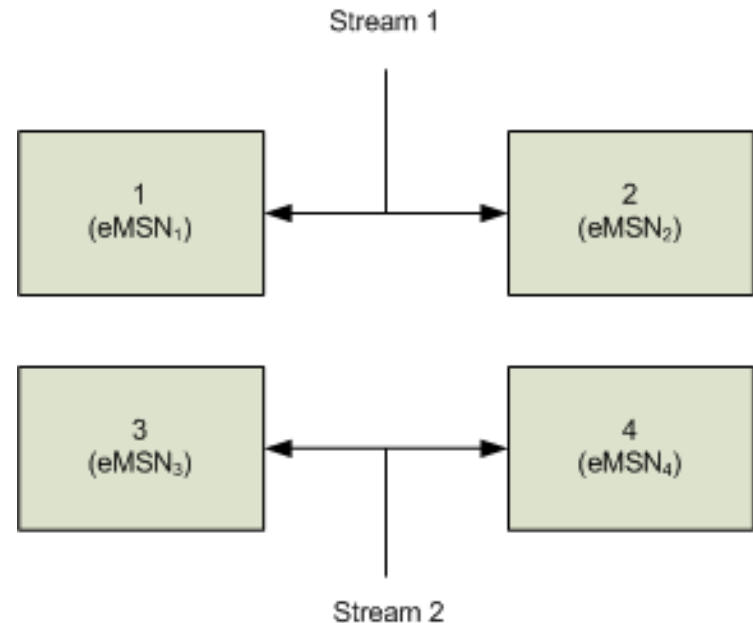
# Subgroup Feature (cont)

- If one disk module is lost in shipment both RCP and LCP are lost (25% of data lost).
- The subgroup feature allows you to specify  
A specific input stream to be written to a  
“subgroup” of disk modules within the  
group\_ref
  - granularity of 8 disks



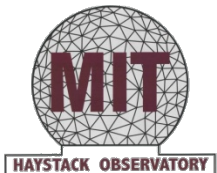
# Subgroup Example

- group\_ref = 1234
  - 4 disk modules open for recording
- input “Stream 1”
  - 8Gbps (RCP)
  - written to disk modules in slot 1 & 2
- input “Stream 2”
  - 8Gbps (LCP)
  - written to disk modules in slot 3 & 4



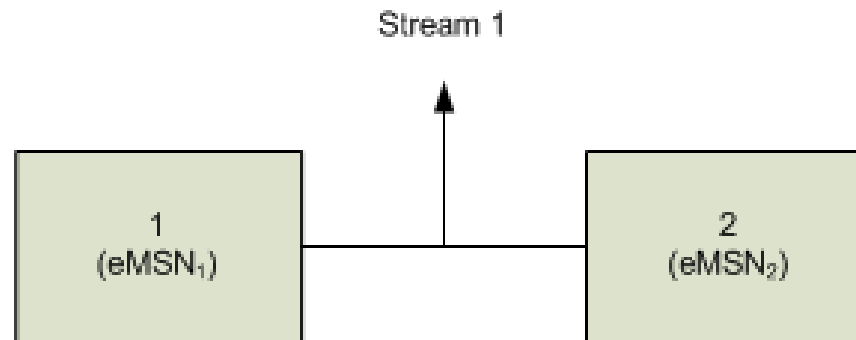
# Subgroup Example (cont)

- When modules are at the correlator awaiting processing
  - RCP is scheduled for the participating antennas to be processed
    - Previously required all 4 disk modules
  - With subgrouping requires only disk modules that were written in Slot 1 & 2 be inserted at the correlator in a Mark6 correlator system
    - $eMSN_1$ ,  $eMSN_2$
    - Do they have to be inserted into slots 1 & 2, **No**



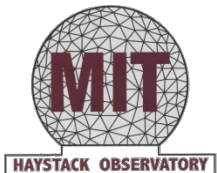
# Subgroup Correlation

- RCP can now be processed.
  - Does not require all of group\_ref
    - Only  $eMSN_1$  and  $eMSN_2$



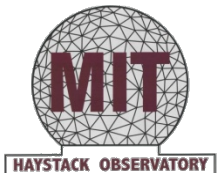
# Subgroup Restrictions

- Software c-plane restrictions
  - Once subgroups are defined, they must be kept for the group\_ref when recording
    - No switching of subgroup's for the group, e.g.
      - input\_stream 1 => 1,2
      - input\_stream 2 => 3,4
      - record “n” scans
      - remove subgrouping as in “normal operations”
      - record “m” additional scans
      - **ILLEGAL**



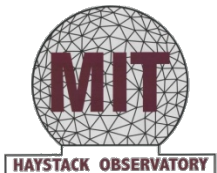
# Subgroup Restrictions

- Software c-plane restrictions (cont)
  - Subgroup assignment must use all disk modules of open group
    - Example of illegal case:
      - » group = open : 1234
      - » input\_stream 1 => 12
      - » input\_stream 2 => 3
      - » disk in slot 4 not assigned : **ILLEGAL**
  - Complete subgroup modules are required for processing
    - input\_stream 1 => 1,2 (eMSN<sub>1</sub>, eMSN<sub>2</sub>)
    - At correlator requires both eMSN<sub>1</sub>, eMSN<sub>2</sub> inserted in same Mark6



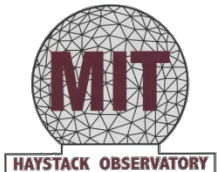
# Correlator Integration

- Vdifuse (Geoff Crew)
  - Scatter / Gather Fuse interface for VDIF
    - Alma Phasing Project - verified
    - General purpose version under test
- Correlator
  - Mount Mark6 Modules with vdifuse
    - process the data directly from the disk modules to DiFX
  - Alternative solution
    - Standard Mark6 system
    - Raid0 in slot 0
    - S/G in other slots
    - Gather / DQA scans to RAID for processing



# Last Operational Test Status

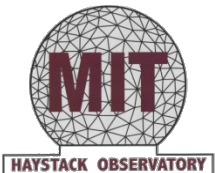
- EHT trial run (Wf to GGAO Baseline)
  - South Pole telescope gear
  - CFA and Haystack
  - R2DBE -> Mark6
    - Roach2
    - Virtex6 FPGA
    - ADC 2Ghz bandwidth
    - 16Gbps / system
  - RDBE-G (1.4 and 3.0 firmware)
  - Success : fringes detected.
- APP Software Verification Mission completed October for 64 Gbps.
  - December 11<sup>th</sup> all bugs fixes required for submission and final version of software.





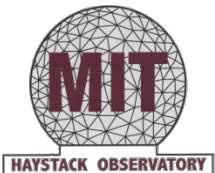
# Next Steps

- New motherboard testing:
  - New OS (Debian Wheezy?)
  - Investigate 32Gbps recording to a single Mark6
    - Impact is reduction of Mark6's needed for EHT, APP.
- Disk module evaluation
  - For disks to be used at 3000m
    - 6TB and 4TB
    - using atmospheric chamber



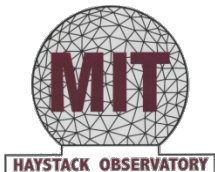
# Next Steps

- Test
  - Create atmosphere for 3000m and write data to fill disk modules (99%) (4 disk modules, 16Gbps).
    - Disks to evaluate
      - He filled 6TB, Seagate 6TB, and WD black 4TB disks
  - Bring atmosphere to sea level (remove disk modules)
  - transfer to another system evaluate data, erase disks, remove and repeat test.
  - Failures seen when disk modules returned to correlator for processing.



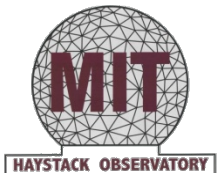
# Future Features

- c-plane : Raid5 support for correlator operations
- d-plane :
  - Record “all” option
    - no packet checking
    - records all packets based upon:
      - Source IP / port
      - packet length filtering
  - e-VLBI
    - Store and retransmit
      - at lower data rates

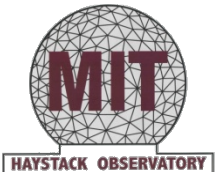


# Summary

- Mark6 used with:
  - Broadband Dev Westford to GGAO 12M
    - VGOS system
    - 4 RDBE-G -> Mark6 (8Gbps)
  - Alma Phasing Project (64Gbps)
  - Event Horizon Telescope (32Gbps)
- Integration with the field system (ongoing)
- Software and documentation available shortly



Thank you / Questions?



# Mark6 Status

- Availability
  - Order from Conduant
    - \$15,285 US for 16Gbps system
      - 60 day lead time
    - Does not include disk module ~\$550 per
      - or disks
  - Upgrade cost for Mark5
    - \$7,588 for host
    - Plus misc items
- <http://www.haystack.mit.edu/tech/vlbi/mark6/index.html>

