MxN Working Group Progress Report!

(Yeah, we actually have some! ☺)

Bishop's Lodge, Santa Fe, NM
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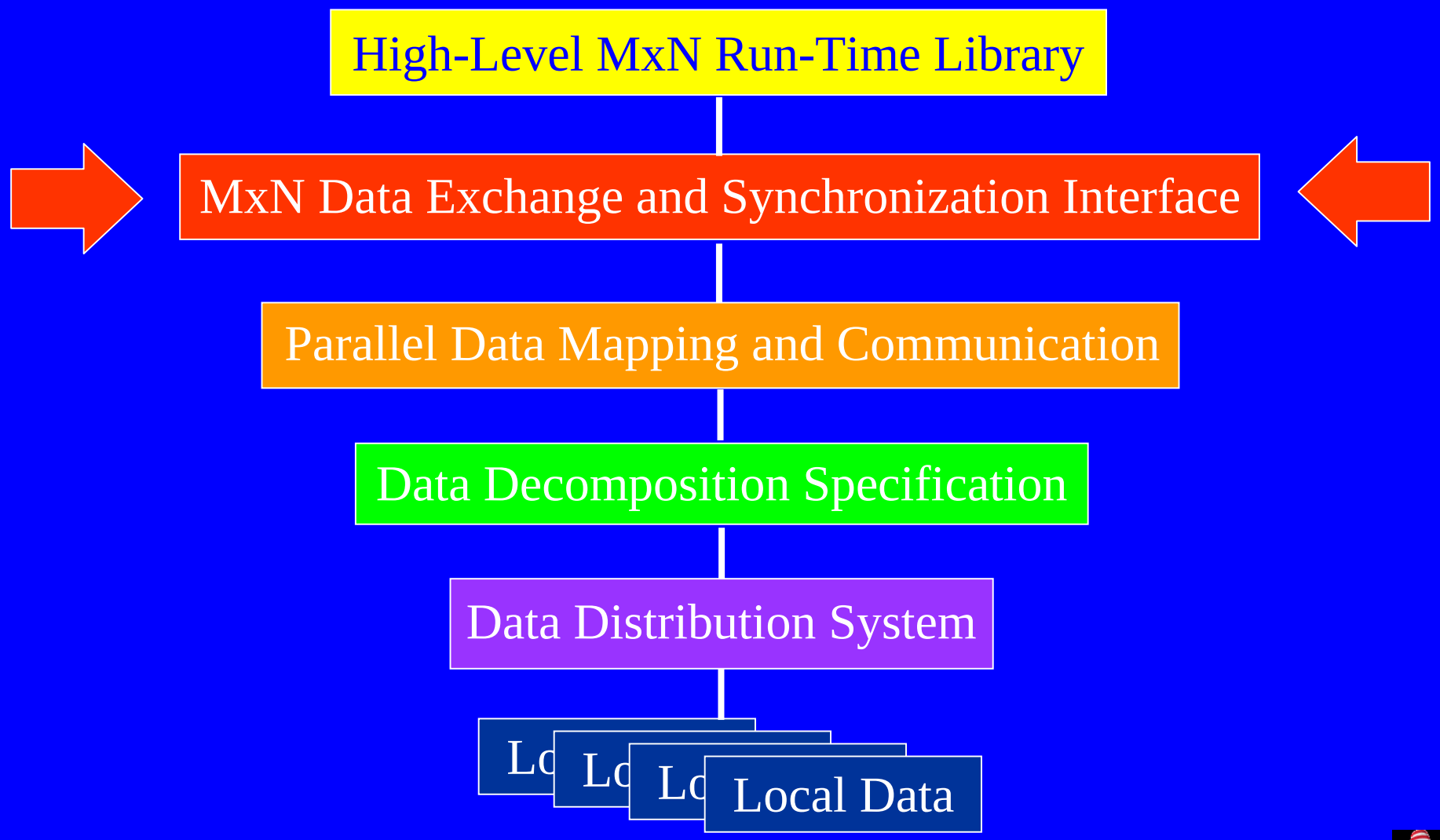
(with the full assortment of other MxN-ers!)

“MxN” Parallel Data Redistribution

- Share Data Among Coupled Parallel Models
  - ⇒ Ocean / Atmosphere, Solver / Optimizer, Viz (Mx1)
- Encapsulate Existing Technologies:
  - ⇒ CUMULVS (ORNL), PAWS (LANL), Others…
  - ⇒ Data Decompositions, Communication Schedules, Connections & Synchronization Protocols…
- Foundation for “General” Coupling (Later…!)
  - ⇒ Mapping & Interpolation of Parallel Data is **Hard**.
    - Different Grids, Spatial & Temporal, Units

MxN Internal Structure



Current MxN Spec

- General & Flexible
  - ⇒ Legacy / Independent Components
  - ⇒ Direct or 3rd Party Control
- Several Functional Portions
  - ⇒ Data "Registration"
  - ⇒ Communication Schedules
  - ⇒ MxN Connections
  - ⇒ Data Transfers
    - Metered by "dataReady( )"…

1st Official MxN Working Group Meeting

- Presentations:
  - ⇒ Model Coupling Toolkit (MCT)
    - Rob Jacob (ANL)
  - ⇒ Distributed Data Broker (DDB)
    - Tony Drummond (LBL)
  - ⇒ SC01 Demos
    - PAWS MxN ~ Sue Mniszewski (LANL)
    - CumulvsMxN, VizProxy ~ Jeeeeem (ORNL)
- Good Discussions
  - ⇒ Communication Schedules, Asynchrony…

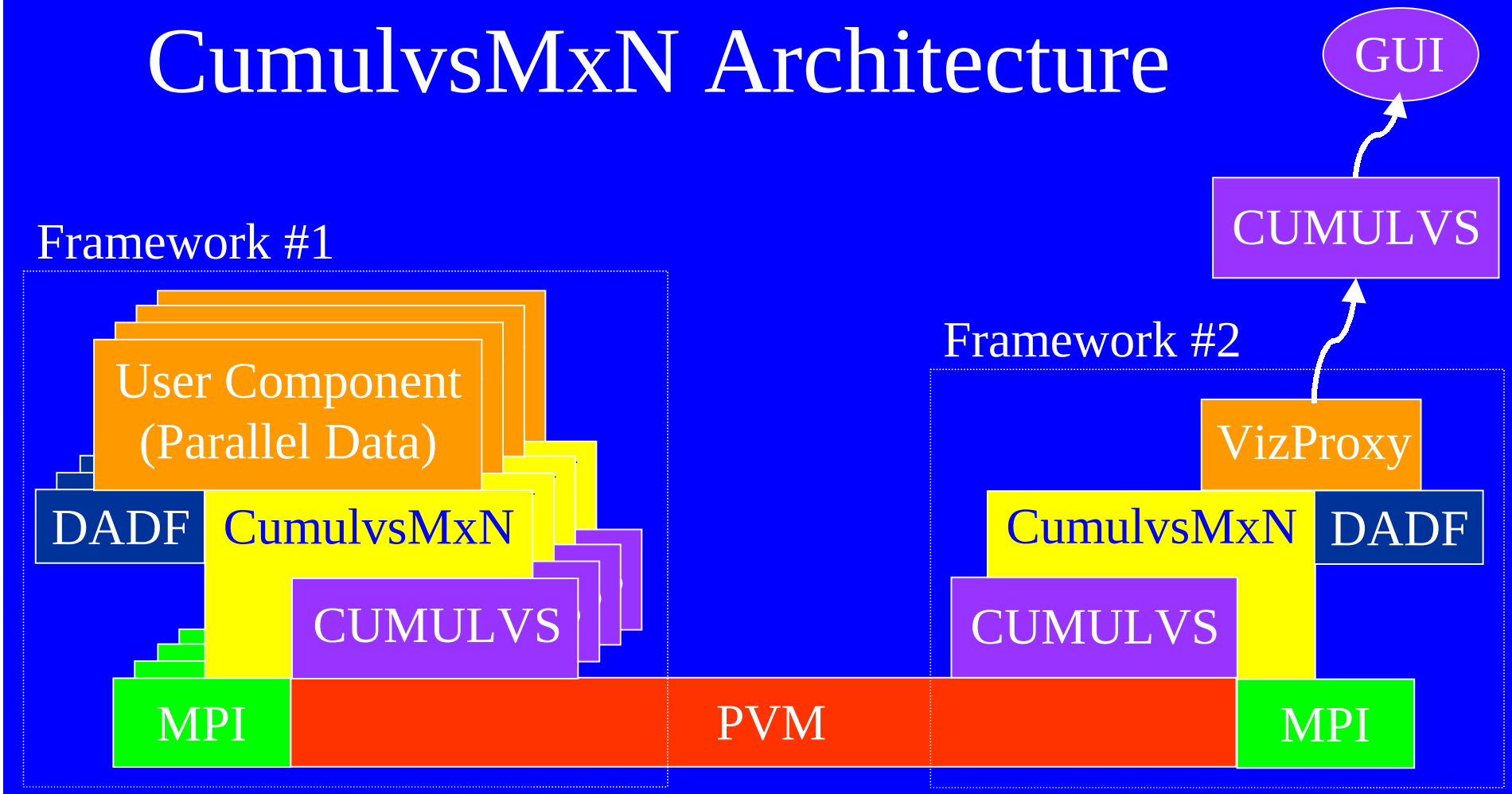
MxN Commonalities

- Current MxN Design Matches with MCT, DDB
  - ⇒ MxN DistArrayDescriptor vs. MCT GSMap
  - ⇒ MxN Communication Schedule vs. MCT “Router”
  - ⇒ MxN Conn/Transfer vs. DDB Consume/Produce Frequencies & MCLGet/SendData( )
- CUMULVS / PAWS MxN Impls Converging
  - ⇒ Application Discovery ~ “partner( )” vs. Mbox
  - ⇒ PAWS MxN “initialize( )” & “ready( )” methods…
  - ⇒ Single CCA Framework vs. Multiple Frameworks

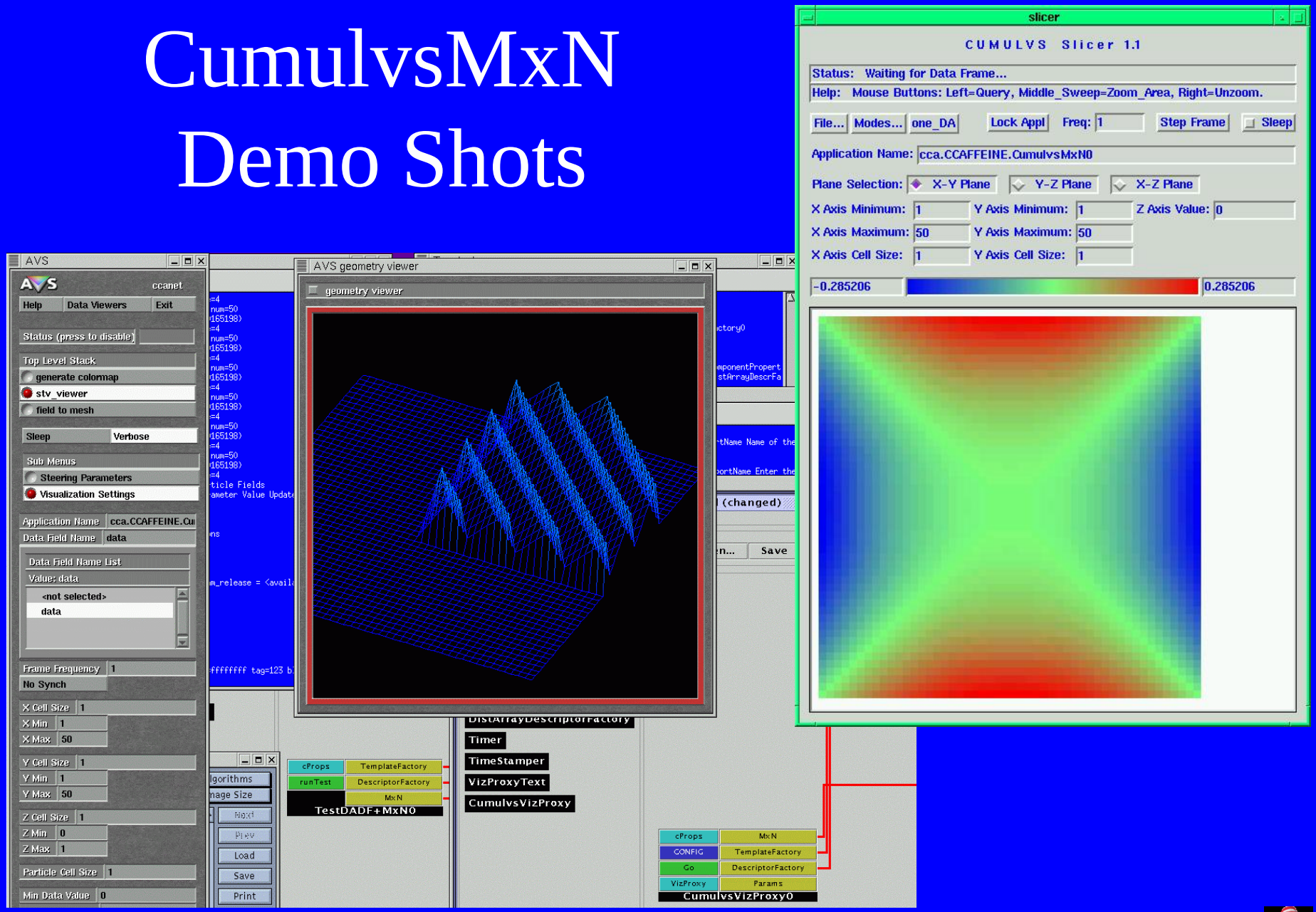
SC01 MxN Demonstrations

- CumulvsMxN for Viz (Mx1) with Ccaffeine
  - ⇒ CUMULVS MxN Component Used to Connect Parallel Components Between CCA Frameworks
  - ⇒ "VizProxy" Component Uses MxN to Collect Parallel Data into Local Array for Visualization
  - ⇒ 3 Appls Re-Use Same MxN / Viz Components
    - Constrained Optimization (Unstructured Rect)
    - Finite Element (Unstructured Triangular)
    - Finite Difference (Adaptive Mesh)

CumulvsMxN Architecture

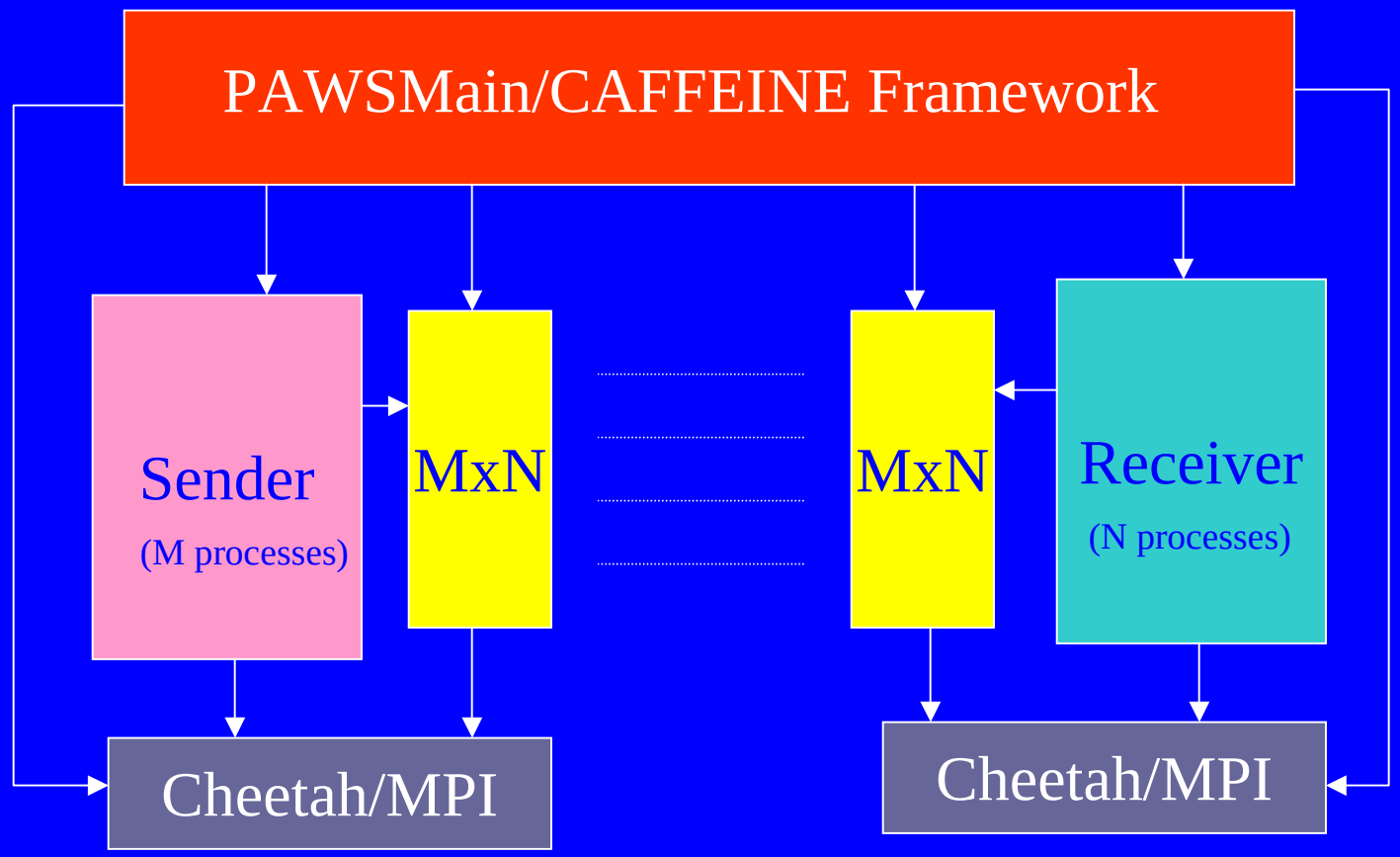


CumulvsMxN Demo Shots



SC01 MxN Demonstrations (cont.)

- PAWS MxN with Ccaffeine / Siloon
  - ⇒ Single CCA Framework Solution
    - 2 - MxN Components ~ M “Sender” & N “Receiver”
  - ⇒ Ping-Pong MxN Transfers
    - Uses Read / Write in dataReady( ) for Ordering…
  - ⇒ Built on PAWS Data Descriptions



CCA PAWS/MxN Prototype

Process Layout for Components

0	1	2	0	1
Framework	Framework	Framework	Framework	Framework
MPI_S	MPI_S	MPI_S	MPI_R	MPI_R
MxN_S	MxN_S	MxN_S	MxN_R	MxN_R
Sender	Sender	Sender	Receiver	Receiver
M = 3			N = 2	

MxN Next Steps…

- Interoperable MxN Components
  - ⇒ CUMULVS & PAWS ~ Hot Swappable (En Masse)
- Finish Implementations (All Args / Options)
- Clean Up Interface
  - ⇒ Extract Sub-Interfaces ~ Data Handles…
  - ⇒ Copy/Modify Communications Schedules
  - ⇒ More DADF Development / Extensions…
- Begin Development of High-Level Interfaces
  - ⇒ Direct One-Shots, PRMI Construction, Framework

Current MxN Status

- Draft MxN Interface Specification
  - ⇒ Unifies Several Existing Approaches
    - One-Shot & Periodic Synchronization Models
- Successful SC01 MxN Component Demos
  - ⇒ CUMULVS & PAWS
  - ⇒ Component Re-Use
  - ⇒ Big Tar Ball Coming Soon… ☺
- Nearing the End of the Beginning…

http://www.csm.ornl.gov/cca/mxn/