



Software Overview and Common Projects

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U.S. ATLAS PCAP Meeting
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Outline

- U.S. ATLAS Software Organization and ATLAS roles
- Strategy and Scope
- Personnel Support Requests
- Core Software
 - Control/Framework
 - Data Management
- Subdetector Software
- Program linkages
- Collaborative Tools
- Software Support
- Software Training
- Common Projects
- Conclusions



Software Subproject Responsibilities

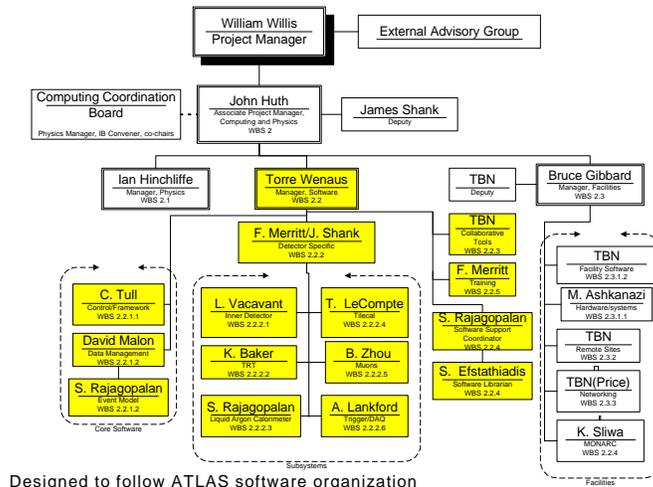
- **Software Subproject - WBS 2.2:** Software projects that are part of the overall ATLAS (also LHC) software effort. Includes contributions assumed by U.S. as part of an overall MOU (in development) with ATLAS for software deliverables
- **Core Software - WBS 2.2.1**
 - u **Control/Framework (C. Tull) - WBS 2.2.1.1**
 - u **Data Management (D. Malon) - WBS 2.2.1.2**
 - s **Event model (S. Rajagopalan)**
 - u **Analysis Tools - WBS 2.2.1.3**
 - u **General simulation and reconstruction software - WBS 2.2.1.4**
- **Subsystem software (F. Merritt/J. Shank) - WBS 2.2.2**
 - u **Simulation, reconstruction, subsystem-specific database**
 - u **Silicon, Transition Radiation Tracker, Liquid Argon, Tile Calorimeter, Muon, Trigger/DAQ, Background Studies**
- **Collaborative tools - WBS 2.2.3**
- **Software Support (S. Rajagopalan) - WBS 2.2.4**
- **Training (F. Merritt) - WBS 2.2.5**

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U.S. ATLAS Software Organization



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Major U.S. Software Positions in ATLAS

Scope of U.S. ATLAS software program follows the domains in which U.S. has important capabilities and responsibilities, reflected in ATLAS roles...

- **Core Software**
 - u **Control/Framework**
 - s **Craig Tull - Architecture Team**
 - s **David Quarrie – Architecture Team, Task Force**
 - s **Paolo Calafiura – Architecture Team**
 - u **Data management**
 - s **David Malon - Co-leader of database group**
- **Subdetector Software**
 - u **Misha Leltchouk - LAr simulation Coordinator**
 - u **Michael Shupe - Convenor of Background working group**
 - u **Fred Luehring - TRT software Coordinator**
 - u **Steve Goldfarb - Muon Database Coordinator**
 - u **Tom LeCompte - Tilecal Database Coordinator**
 - u **Frank Merritt - Training contact, Tilecal Reconstruction Coordinator**

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ATLAS Subsystem Software Leaders

Subsystem software coordinators, U.S. participants in bold

	Offline Coordinator	Reconstruction	Simulation	Database
Chair	N. McCubbin	D. Rousseau	A. Dell'Acqua	D.Malon /RD Schaffer
Inner Detector	D. Barberis	D. Rousseau	F. Luehring	J. Pater
Liquid Argon	J. Collot	J. Schwindling	M. Leltchouk	S. Simion
Tile calorimeter	A. Solodkov	F. Merritt	A. Solodkov	T. LeCompte
Muon	G. Poulard	J.F. Laporte	A. Rimoldi	S. Goldfarb
LVL2 trigger		S. Taprogge		
Trigger/DAQ	S. George		T. Hansl-Kozanecki	H.P. Beck
Event Filter	V. Vercesi	F. Touchard		

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Communication

- Weekly technical control/framework meeting with data management participation
- Will be broadened (after Review Season) to a regular technical software meeting for U.S. ATLAS complementing the existing bi-weekly U.S. ATLAS computing meeting
- Physically together at ATLAS computing weeks; (very) occasional U.S. ATLAS computing meetings (last Aug)
 - must be efficient with travel \$!
- Web site, of course
- HyperNews web-based discussion system installed; hope to prod it into life as in BaBar
 - in appropriate U.S.-centric areas, not supplanting ATLAS communication

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Strategy and Scope

- The Subproject program reflects those ATLAS software activities in which the U.S. can bring unique capabilities to bear on key domains in which our involvement will strengthen both ATLAS and the participation of the U.S. in the ATLAS physics program
 - Core software domains central to offline data processing, physics analysis, data management, and the distributed data management and analysis capability essential to the U.S.
 - Subsystem software domains building on the detector hardware responsibilities of U.S. institutes
- The level of participation is scoped at ~20% of the total effort commensurate with overall U.S. ATLAS scope
- Our focus on limited, coupled software domains will permit strong ATLAS roles in these areas and a coherent program
- The U.S. seeks and is successfully accruing leadership roles in our focus domains

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Strategy and Scope (2)

- FY00 requests have been descoped from preliminary requests to account for funding realities, and are tightly focused on the tasks in which an early ramp is essential to ATLAS and important to secure targeted U.S. responsibilities
 - Includes critical personnel fulfilling key roles
- The core software support profile to '06 is based on continued focus on the selected areas with a software professional corps scaled to the leading U.S. role we foresee in these areas and estimated from existing experiments
- The subdetector software support profile is based on a professional complement of 2 per subsystem supporting a large number of base program physicists in subsystem specific implementations and interfaces to core components, software development and maintenance support

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FY00 Core Software Personnel

FY00 Physicists and Professionals in planned core software program

	ANL	LBL	BNL	U of Michigan
Control/Framework SW Professionals		C. Tull 1.0 D. Quarrie 0.5 C. Day 0.5 J. Milford 0.2		
Control/Framework Physicists		I. Hinchliffe 0.5 M. Shapiro 0.2 P. Calafiura 0.6 C. Leggett 0.6	T. Wenaus 0.2	
Data Management SW Professionals	D. Malon 1.0 G. Pandola 0.5 J. Christiansen 0.5		New Hire 0.5	New Hire 0.5
Data Management Physicists	T. LeCompte 0.5 E. May 0.6 R. Wagner 0.5 R. Blair, L. Price, and others 0.4		S. Rajagopalan 0.5 S. Protopopescu 0.1 S. Snyder 0.1	S. Goldfarb 1.0 (muon subsystem)

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FY00 Subsystem Software Support

- Requested FY00 software professional support for subsystem software development:
 - u WBS 2.2.2.3 - LAr simulation and reconstruction
 - s W. Seligman, 1 FTE, Nevis Lab
 - u WBS 2.2.2.4 - Tilecal simulation and reconstruction
 - s TBN, 1 FTE, U. of Chicago
- NB. Total current U.S. ATLAS software participants, most involved in subsystem software: ~50

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Control/Framework Software - WBS 2.2.1.1

- Operating environment for software modules written by physicists
- Strong experience base in U.S. groups (LBNL, BNL)
- Urgent focus of recent ATLAS planning and activity to establish a design and proceed rapidly to initial implementation
 - u Full implementation over several years
- Architecture Task Force (ATF) recently concluded (11/99 report)
 - u To specify a global ATLAS computing architecture for unified execution framework
 - s With review of existing implementations
 - u US participation: D. Quarrie, M. Shapiro of LBNL major contributors
 - u Component architecture outlined; strategic architectural decisions

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Control/Framework (2)

- Follow-up to the ATF: Architecture Team being formed for design and implementation
 - u Work and experience of LBNL group instrumental in developing U.S. role in Architecture Team
 - s Experience in many framework developments, eg. BaBar, CDF, RHIC
 - s Surveyed existing frameworks and evaluated ATLAS work to date
 - u Three U.S. (LBNL) members appointed: Quarrie, Tull, Calafiura (of ~6)
 - u Aggressive initial milestone: **functional framework for May 2000**
 - s Better functionality than existing ATLAS interim framework (PASO)
 - u GAUDI framework (LHCb) to be used as basis for May prototype
 - s **Potential for longer term collaboration??**
 - u Follow up initial prototype with iterative design, development, release
 - u Complemented by formal software design process -- C. Day (LBNL) participating
 - u Plans elsewhere in U.S. to contribute in testbed prototyping and related development, e.g.
 - s Database effort, event model (OO representation of event)
 - s Subsystem simulation/reconstruction development (LAr, Si tracker)

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Data Management Software - WBS 2.2.1.2

- Event store; databases for calibrations, geometry, ...; interface to memory-resident (transient) event; data organization; distributed data; ...
 - u Also joint responsibility for event model, data I/O in framework, detector description...
- The domain in which much of the scale and complexity impact of ATLAS is faced: managing Petabyte data stores
- Strong U.S. experience base at ANL, LBNL, BNL
 - u HENP Grand Challenge, BaBar, RHIC
 - u Including experience with ATLAS baseline solution: Objectivity
- U.S. well integrated into ongoing ATLAS effort, with major roles
 - u David Malon (ANL), long time ATLAS participant and data management expert (eg. RD45, HENP Grand Challenge), now Co-Leader of ATLAS database domain
 - u U.S. also represented in subsystem database leaders: Muon (Steven Goldfarb, U Michigan), Tilecal (Tom LeCompte, ANL)

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Data Management Software (2)

- U.S. contributions to detector description and geometry data management, Objectivity scalability, event data access
- U.S. activities and plans exploit close couplings of this domain to other U.S. development efforts, e.g.
 - Database interface to control framework
 - Detector description and geometry data management
 - Database support for Geant4 based simulation, and application testbeds
 - Event model and control framework prototyping in reconstruction, with calorimeter event data source
 - Continued use of tile test beam as testbed for core development and production use of Objectivity
- Domain closely coupled to control/framework and subdetector efforts
 - U.S. activities and plans exploit this coupling in coordinated effort to link developments in

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Subsystem Software - WBS 2.2.2

- Wide range of activities in all subsystems, well integrated into ATLAS; many leadership roles
- Broad participation by U.S. ATLAS universities as well as labs
- The subsystem software effort (background studies) is realizing benefit from the new Tier 1 center at BNL
- The Software Project will
 - Manage Project resource requests and allocations among activities
 - Seek to strengthen contributions to ATLAS and U.S. ATLAS through couplings and commonality between subsystem programs and with U.S. core activities for a coherent U.S. program (e.g. next slide)
 - Not supplant ATLAS computing coordination; U.S. activities take place in the context of and under the management of ATLAS computing (ditto for core activities)

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Linking Core and Subsystem Programs

- **Goal in U.S. program: Combining strong core and subsystem software roles to closely couple core development to real-world testbeds and applications**
 - u **Strong core/subsystem linkage recognized in ATLAS as very important**
- **Examples from activities and plans (lead institution is indicated):**
 - u **Tilecal test beam pilot project (ANL): first production application of Objectivity in ATLAS**
 - u **Muon database effort (U Mich) as framework for development and testing of XML detector descriptions and database**
 - u **LAr OO reconstruction (BNL) as testbed for control framework and prototype for event model development**
 - u **Si pixel test beam simulation (LBNL) to be integrated into control framework as application testbed**

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Collaborative Tools - WBS 2.2.3

- **Tools allowing collaboration among distributed sites**
 - u **Video and web based conferencing, whiteboard tools, electronic notebooks, collaborative software development and physics analysis**

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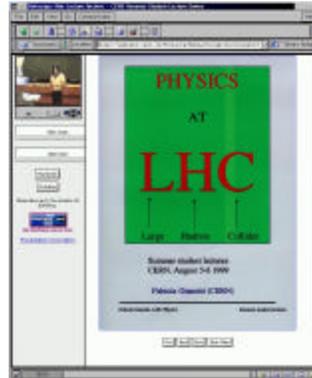


Collaborative Tools: Syncomat

The University of Michigan Web-Based Activity Capture Application: Syncomat

A system for the high quality archiving and replay of captured audio and video in synchronization with slides

- Developed by Charles Severance of the University of Michigan
- Operates on any platform and is of no cost to the client user
- Tested by the University of Michigan ATLAS Collaboratory Project during Summer 1999 by recording many of the CERN Summer Student lectures and several software training presentations (covering LHC++, database technology and software engineering)



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H. Neal; Jan. 7, 2000

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Syncomat - Future Plans

- Plans are being developed for a special set of lectures and tutorials by Andrea Del'Acqua on software topics of particular interest to U.S. ATLAS software developers
- University of Michigan plans to pursue R&D in this area utilizing the QoS protocol.
- NSF ITR pre-proposal has been submitted involving Michigan, Internet2, Merit (former operator of NSFNET), and CERN
- Anticipate strong collaboration with CMS, ATLAS and the CalTech VRVS Group. Result of advances will be immediately fed back to ongoing LHC software training activities.

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H. Neal; Jan. 7, 2000

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DOE 2000 Collaboratory Tools

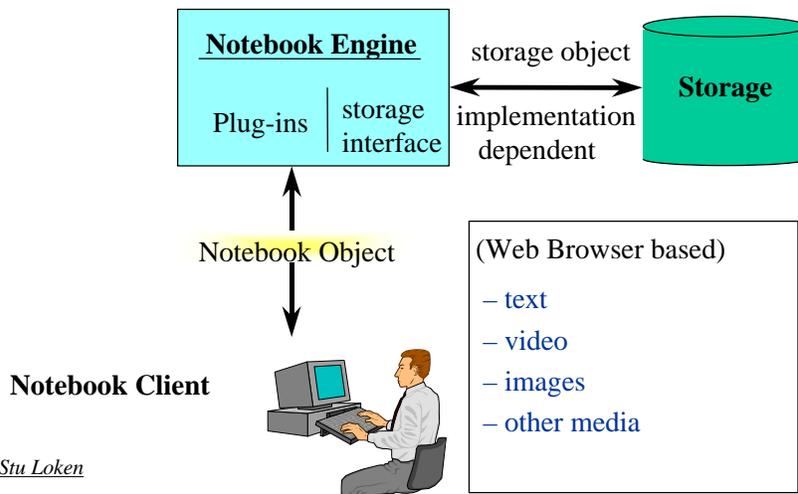
- Tools and technologies supporting network based collaboration
- Tools for **persistent** and **real-time** information
- Now available for use in LHC program:
 - **Video conferencing tools (eg. Mbone)**
 - **Electronic notebooks**
- Security and Quality Of Service mechanisms to enhance control and performance of collaborative applications.
- U.S. ATLAS will incorporate tools into ATLAS
 - **Stu Loken (LBNL) coordinates U.S. ATLAS involvement in DOE 2000**

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Notebook Architecture



Stu Loken

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DOE2000 & Grid Integration

- **Collaboration management framework will integrate all collaboration tools into a simple, easy to use package**
 - u **Being integrated into overall Grid R&D program**
 - u **Will also support shared data views and analysis control**
 - u **Will investigate integration of ATLAS Analysis Framework**

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Stu Loken

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Software Support - WBS 2.2.4

- **Facility subproject: Support for third party tools, facility related tools, production & data distribution software, computing environment**
- **Software subproject: U.S. support for ATLAS offline software: Software Librarian function**
 - u **Basically, software in the CVS repository**
 - u **Support function close to the expertise base**
 - u **U.S. installations of core and subdetector software driven by U.S. needs; help for U.S. usage issues**
 - u **Oversight by Software Support Coordinator**
 - s **An active physicist/developer at BNL well connected to community needs (currently Srinu Rajagopalan)**

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Software Training - WBS 2.2.5

- Until the completion of the ATLAS Physics TDR, procedural Fortran was the primary ATLAS language
- Major transition to OO/C++ now underway
- A developer community skilled in the new tools and technologies is vital to the transition
 - u Experienced software developers, including computer professionals, now working on core software projects as well as advising and contributing to analysis development.
 - u **Software training programs** being employed both at CERN and in the U.S. aimed primarily at the physicists who will be writing the ATLAS analysis code.

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Software Training in the U.S.

- US-ATLAS (Frank Merritt) has organized four professionally-taught courses in OO analysis and related subjects
 - u **Widespread participation: 38 US-ATLAS** physicists from 8 universities, 3 national labs, and all of the main US subdetector systems.
 - u **Well-received by the students, most now engaged in software development for ATLAS subdetectors.**
- We believe the U.S. is in a strong position to play a significant role in the development of analysis software for ATLAS.
- Will continue to grow the skills of the U.S. community

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Common Projects

- **Comments informed by early discussions within U.S. ATLAS and with (U.S.) CMS software leaders Lucas Taylor, David Stickland**
- **As in U.S. ATLAS/U.S. CMS computing projects overall, common project efforts must proceed in the context of the ATLAS and CMS computing programs as a whole**
 - **Cannot 'go it alone'**
- **Common U.S. ATLAS/U.S. CMS needs in distributed data management and analysis already driving common efforts**
 - **Addressed in the complementary programs discussed in the common projects session**
 - **Particle Physics Data Grid: Developing a wide area data access infrastructure**
 - **MONARC: simulation supporting design of tiered distributed computing models**
 - **GriPhyN: Building a Grid-based, tiered computing infrastructure**
- **Many common areas already identified in the LHC program have with well-developed common efforts in place**
 - **RD45 persistent data storage**
 - **Source of data storage R&D and tool development for all LHC experiments**
 - **U.S. ATLAS involvement via our established database activities**
 - **LHC++ analysis tools**
 - **Geant4 object-oriented simulation**

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Common Projects (2)

- **Beyond these established areas, strategies in pursuing new ones**
 - **Model of small component packages developed by small groups and centrally integrated/managed in a shared library probably most practical**
 - **Consistent with favored modular component architectures and widespread use of toolkits and utility libraries**
 - **Implies a community-wide organization for central management**
 - **LHC++ is a model and existence proof within the field**
 - **Many examples in open software**

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Common Projects (3)

- Within areas of the ATLAS and CMS software programs in which the U.S. is active, we can look directly for possible common project efforts
- Some areas mentioned in discussions, some highly tentative...
 - u **Detector description tools**
 - s U.S. CMS is interested in ATLAS work; has discussed ATLAS tools with Steve Goldfarb (U Mich), ATLAS muon system database coordinator active in detector description work
 - u **Distributed databases**
 - s XML as database replication tool
 - u **Collaborative tools**
 - s Definite interest in Syncomat; being pursued
 - s U.S. ATLAS involved in DOE 2000 deployment in LHC in general
 - u **Training**
 - u **Offline framework/architecture**
 - s CMS planning architectural review in a few months; interest in at least an inter-experiment discussion forum on architectural design (next slide...)

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GAUDI as basis for common projects??

- Selection of LHCb's GAUDI as basis for initial ATLAS framework implementation provides potential avenue for common projects
- Interest in reuse of framework/architecture ideas, designs is there
 - u Series of architecture discussions last summer among the LHC experiments initiated by John Harvey (LHCb) regarded as very successful
 - s Interest in reviving them in (U.S.) CMS
- Long term collaboration on code much more challenging
 - u Experience shows this is difficult
 - u Interest -- and good basis for collaboration -- (common ground, long established relationships) in U.S. ATLAS
- Modular architectures can be amenable to common projects at the component/utility level
 - u Ongoing dialogue between experiments during design can promote commonality of interfaces and expose areas where common solutions may be developed
- Contingent upon decisions in ATLAS, CMS, LHCb
 - u U.S. can bring interest in exploring collaboration, and a central ATLAS role, to the discussion

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Geant4

- Geant4 will be used as simulation toolkit by ATLAS, CMS
 - Product of international collaboration of ~75 physicists
- U.S. ATLAS and U.S. CMS both active as users/validators of Geant4 but not as collaborators
 - Only one known current formal collaborator on G4 in U.S. ATLAS and U.S. CMS (Vladimir Sirotenko, N. Illinois U)
 - Partly arising from threshold participation required in MOU organization post-'98
 - SLAC/BaBar joined; FNAL and BNL below threshold
 - Geant4 organization makes collaboration valuable: 'tiered' support
 - Recent increase in activity should enable more direct participation by U.S. ATLAS

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Geant4 in U.S. ATLAS

- Data management in support of simulation
 - Staged approach to implementing data access and storage for Geant4 simulations
 - MC events (4/00), hits (8/00), digitizations (11/00), detector geometry (4/01)
- Detector simulation with Geant4; test beam analysis to verify Geant4
 - Si tracker, TRT, LAr, Tilecal, Muon
- Geant4 geometry optimization
 - Muon group plans tools to tune optimization between CPU intensive volume parameterizations and memory intensive volume instantiations
- Well-attended U.S. ATLAS course on Geant4 (Andrea Del'Acqua)

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Summary, Conclusions

- The U.S. ATLAS software program has leveraged U.S. experience and capabilities to establish leading roles in core software areas key to ATLAS physics analysis
- Our subdetector software program is a broad effort covering all areas of U.S. subsystem activity, supported by an active training program in the new software technologies of ATLAS
- Benefiting from the close coupling of our core software programs and the relevance of core work to subdetector efforts, we are linking core and subsystem development in testbed and prototype environments to closely connect core development with real-world needs and provide design feedback
- De-scoped, carefully prioritized manpower requests cognizant of funding realities are being presented in the areas in which an early ramp is most vital
- We are working within the ATLAS computing organization and following ATLAS directions, but in key areas are playing a large role in setting those directions and leading the way in real-world applications

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