Agenda

- 30-40 mins: Overview of (CI) Project by Ed
  - –Big picture
  - –Cooperative Agreement “Highlights”
  - –Project structure and app scenarios
- 45 mins each: Discussions led by 4 WP leaders
  - –Describe tasks
  - –Get input from science drivers, iterate
  - –Refine tasks
  - –Clarify/refine personnel
- Summarize, plan for all-hands meeting

CyberTools

Infrastructure

Advancing Science through co-development of Cyberinfrastructure and Applications

Overall Goals

- Develop Advanced CI Tools for LONI
- Science Drivers Guide, Test, Co-Develop Tools
- Deploy Across LONI
- Train State Research Base to Use
- Bring Users, Tools to National Level
  - TeraGrid, Track 2, Track 1, etc…
- Goals for Today: Define teams, refine deliverables, get project rolling
  - Many more meetings of WP/Science Drivers to follow!

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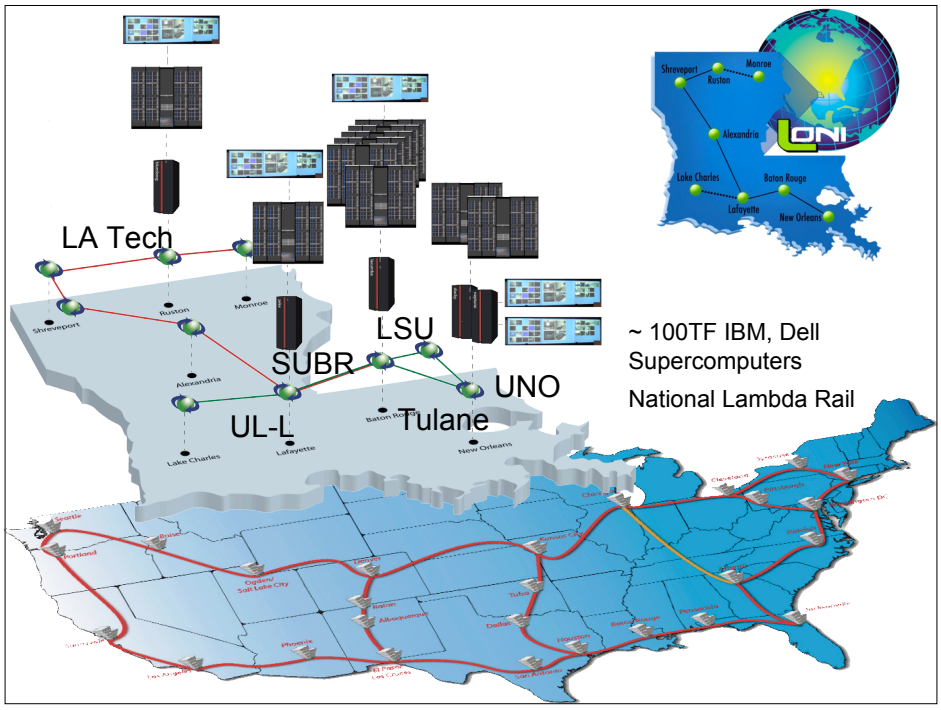
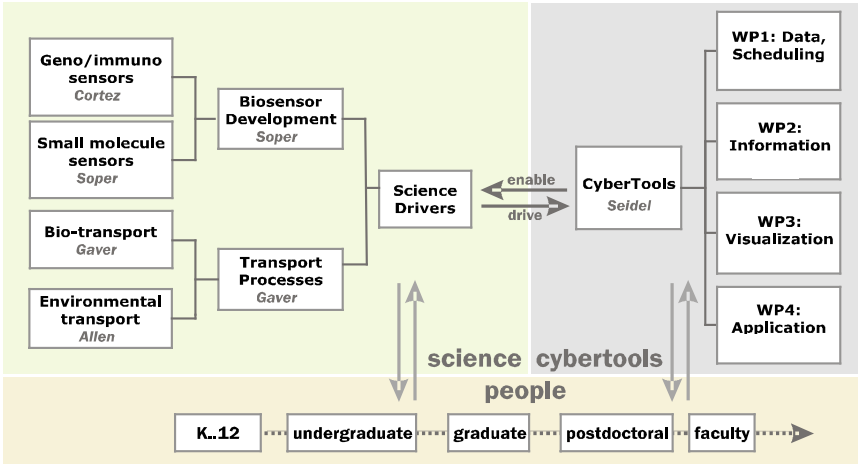


Tools for LONI Integrated with Science Drivers



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Synergistic Projects

- NSF CFD IGERT
- PKSFI LONI Institute
- NSF TeraGrid
- DOE/BOR UCOMS
- DoD/BOR Epscor
- NSF DynaCode
- DOE UCoMS
- NSF XiRel
- NSF Alpaca
- NSF Track 1
- Maybe NSF Track 2?

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Building on our Strengths in Enabling Software

- Cactus Framework
- HARC Co-allocator
- PetaShare Data Management
- Parallel CFD Toolkit
- HA-Oscar Cluster Solution
- SAGA Grid Toolkit
- GridSphere Portal Framework

Leveraging New and Existing Collaborations:

- SPRUCE Urgent Computing
- Charm++
- Globus
- Condor

PetaShare

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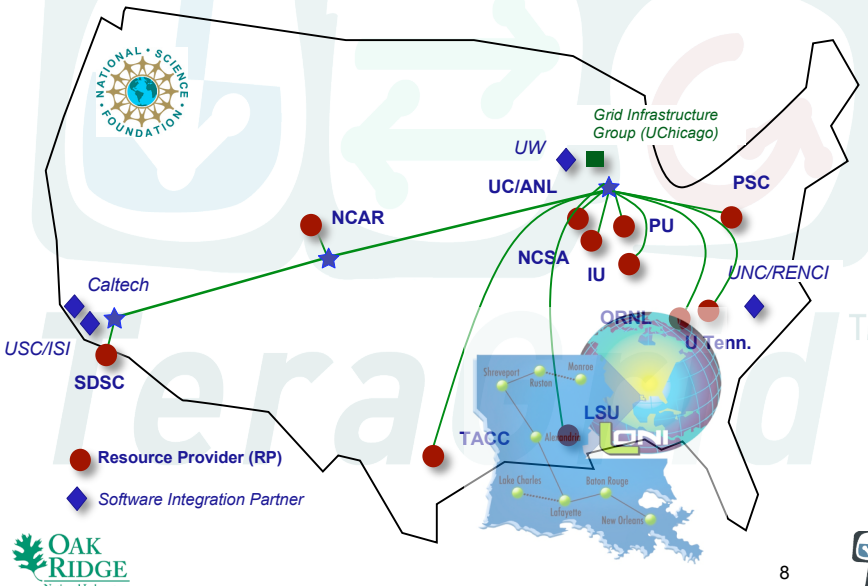
LONI and TeraGrid



OAK RIDGE National Laboratory

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TeraGrid

Project Goals (Cooperative Agreement)

- The focus is the development of a multi-functional cyberinfrastructure (CyberTools) to broadly enable significant advances in modern science and engineering. CyberTools will improve methods to manage data, foster development of complex simulations, improve visualization, and mine data. They will also enable co-scheduling of network, data, computational, and visualization resources for complex tasks. The goals of the proposal are to:
- Enhance the scientific capabilities of researchers by linking experimental and computational investigation;
- Enable scientific investigation through the use of advanced computational CyberTools;
- Drive CyberTools development by directly linking to prototype scientific projects.

CA

- Team Leaders for the science drivers and CyberTools components will hold biweekly meetings with the faculty, postdoctoral researchers, and graduate or undergraduate students involved in specific multi-institutional projects to gauge progress against quantifiable milestones and to redirect efforts when required.

CA

- The Director of the Center for Computation and Technology at Louisiana State University (LSU) will:
- be in charge of the development of CyberTools and associated work packages;
- coordinate the implementation and performance of the toolkit codes on the LONI network;
- ensure that the research teams help in the development of tools that directly impact their research applications.

CA

- The Director of the Center for Bio-Modular Multiscale Systems (CBM2) at LSU, and the Director of the Center for Computational Science at Tulane University will lead the science drivers component.
- The CBM2 Director will
  - ensure the completion of the projects at that center (e.g., genetic analyzer, high-throughput screening) and the systematic integration of computational methods into the research endeavors at CBM2;
  - coordinate data collection used for validation of simulations;
  - coordinate the outreach efforts in the areas of physical sciences and engineering;
  - develop industrial partnership programs in conjunction with the CBM2's Industrial Liaison.

CA

- The Director of the Center for Computational Science at Tulane University will be responsible for the biosensor design and fabrication research project, which includes investigators from Tulane University and Louisiana Tech, as well as collaboration with the University of New Orleans and Xavier University of Louisiana.

CA

- PI will submit an annual progress report specifying major accomplishments according to the project's goals,objectives,and deliverables identified in the "Three-Year Strategic Plan for the Louisiana's Research Infrastructure Improvement Strategy"
  - Future funding will be based, in part, on progress...
  - The project's annual report must include evidence of linkages, coordination, and collaboration with other NSF-funded projects in Louisiana that enhance the proposed RII activities...
  - The PI will submit a special written report for the first six months during the first and second years of implementation on the progress made in specific areas, such as...progress on the science and cybertools development components; and effective coordination among the science research and cybertools development

In the following...

- Remember, all this is built on other projects...don't freak out :-)
- As we go through each WP
  - –Refine what each task really is
  - –Discuss how the science drivers can really take advantage, and how the WP tasks should be clarified to be useful
  - –Be as concrete as possible
  - –Define the toy problem and final goal
  - –Who is hired/needs to be hired?
  - –Who from CCT, LONI, LI is tasked?

Scenarios: Coastal

- From 2003: Sensor networks deployed on buoys, drilling platforms,and aircraft across the Gulf of Mexico collect high resolution spatio-temporal data on ocean temperature, current velocity, wave height, wind direction and temperature. A suddenly strengthening tropical depression tracked by satellite changes direction, worrying forecasters and public officials.Snapshots of collected data are now fed into models every 30 minutes, each restarted with freshly updated input data. Due to uncertainties in data reliability (bad data or lost sensors) and model fidelity, ensembles of dozens of medium resolution simulations are run and monitored in real time, as are sensor networks themselves. Scarce computational resources are requested and allocated on demand, and certain model events trigger special software components to be dynamically loaded from a community repository. Fine grained ocean and atmosphere models run on separate resources, coupled through networks, receiving boundary conditions from large scale continental models. Studying ensemble data from remotely monitored simulations, researchers steer computations to ignore faulty or missing input data. Comparison with current actual data is made with ensemble model data to determine in real time which models/components are most reliable, and a final high resolution model is run to predict 2 hours in advance the detailed location and severity of the storm surge.Louisiana Office of Emergency Preparedness sends out maps of the projected storm surge and orders the National Guard to make last minute preparations for evacuations and road closures.

Scenarios: Coastal

- From 2003: Sensor networks deployed on buoys, drilling platforms and aircraft across the Gulf of Mexico collect high resolution ocean temperature, current velocity, wave height, wind direct[illegible]d temperature. A sudde[illegible]session tracked by satel[illegible] changes direction, worrying fo[illegible]ers and public officials.Snapshots of collected data are now fed into mode[illegible]very 30[illegible]reshly updated input data. Due to uncertainties in data rela[illegible]ad data or lost sensors[illegible] ensembles [illegible] simulations are [illegible]d monitored in real time, as are sens[illegible]works themselves. Scarce computa[illegible]al resources are requested and [illegible]ated on demand, and certain model events trigger special software components to be dynamically loaded from a community repository. Fine grained ocean and atmosphere models run on separate resources, coupled through networks, receiving boundary conditions from large sca[illegible] Studying ensemble data from remotely monitored simulations, researchers steer computations to ignore faulty or missing input data. Comparison with current actual data is made with ensemble model data to determine in real time which models/components are most reliable, and a final hig[illegible] predict 2 hours in advance the detailed location and seve[illegible] of the storm surge.Louisiana Office of Emergency Preparedness sends out maps of the projected storm surge and orders the National Guard to make last minute preparations for evacuations and road closures.

Data Fusion/Assimilation
Application Manager
HARC
Cactus Toolkit/Cactus 5
DEPSCOR Grant
PetaShare/Info Services
Viz (GIS/CLEAR)

Scenario: CFD (or any app!)

- Grad student codes new evolution scheme; assembles parallel/optimized CFD Toolkit modules for application to biotransport problem
- Goes to portal, finds results of all previous simulations stored across LONI, including 2 currently running
- Submits job to resource broker, which assigns it to 512 processors of QB
- Job starts, contacts app manager; registers with portal; groups at LA Tech, Tulane, LSU notified
- Professor logs on to portal, chooses 3D streamed viz, rendered at Lafayette, to Tulane workstation
- Job completes; data are archived; portal retains links to output via logical file names; metadata tags generated for later searches
- Analysis shows petascale run needed; 100x higher resolution job started on Track 2 machine, GPGPUs accelerate by 11x

Refine Tasks, Personnel

- Personnel: define team!
  - Who is hired? Who needs to be hired?
  - Who from CCT/other sites will work on this?
  - Who from LONI?
  - Who from LI?
- NSF, LONI projects
  - What other projects augment this? XiRel? Alpaca, Ucoms, etc?
- Tasks: what to do by April 1? what is already done?
  - Clearer breakdown of all tasks
  - Meetings of WP and Science drivers
  - Meetings between WP leaders to coordinate
  - Training by LONI staff on tools we develop

WP4: Application Toolkits
S Jha, M Tyagi et al

- The scientific work in this project depends on sophisticated simulations to be carried out on large scale and distributed computing environments. Complex simulation codes must be developed by collaborating teams across the State that enable modularity of code design, scalability on systems towards the petascale, incorporation of complex multiphysics modules, incorporation of adaptive methods, coupling of codes which handle different scales and/or physical domains, automatic data archiving, resource discovery, and access to information systems, portals, and visualization services to be developed and deployed across LONI.
- With a set of common code development tools, **researchers involved in the science drivers...will be able to develop advanced codes** that enable them to work collaboratively to solve the complex problems in sensor design and transport, utilize advanced LONI infrastructure and services under development, and to work on larger systems under development for the NSF petascale computing initiative. The two key research areas...are computational fluid dynamics (CFD) and molecular dynamics (MD), with coupling where appropriate

WP4 Deliverables

- Cactus-based Toolkits (1 WP4 postdoc, 1 WP4 (CFD-TK) GA, 1 WP4 (MD-TK) GA, .5 Acharya postdoc, .5 Acharya GA, .5 Gaver GA, .5 Cortez GA)
  - CFD Toolkit. The CFD toolkit will be based on work started for the coastal modeling project. This will be expanded to support different fluid systems, structured and unstructured meshes, and application domains. In addition to the effort outlined (0.5 WP4 postdoc, 1 WP4 (CFD-TK) Grad), 0.5 Acharya postdoc, 0.5 Grad from Acharya and Tulane will be assigned to work on this project.
    - PD: Heinzl (50%); CFD-TK GA?; 0.5 Acharya PD: Anvar?; 0.5 Acharya GA: ?, 0.5 Tulane GA?
  - MD Toolkit. MD toolkit will be developed based on needs of the projects. First phase will be design and assessment of Charm++ as a driver for Cactus. In addition to the effort outlines (.5 WP4 postdoc), CCT's Jha and 0.5 grad from Tulane will work together to develop this toolkit in three releases, as shown
    - PD: Heinzl (50%); MD-TK GA ?; 0.5 Tulane GA: ?
- Application manager. An application manager will be developed to collect information from running codes, and deployed on LONI, for interfacing with information services. This will be developed by CCT staff and students funded by CCT
  - CCT/LONI staff: Kaiser, ?

WP4 Deliverables

- SAGA adaptors and Cactus-based SAGA thorns (1 Allen GA, 1 SAGA GA)
  - Cactus Thorns as needed by science projects. SAGA libraries, developed by CCT and external projects (OMII), will be linked into Cactus by 1 Allen GA (?), and used in codes developed for CFD and MD projects.
    - CFD-TK?, MD-TK GA?; Allen GA?; CCT/LONI staff
  - Adaptors for all services deployed across LONI, Teragrid. Adaptors needed for interfacing to services deployed on LONI and TeraGrid will be developed by 1 SAGA GA: Globus adaptors will be completed in Y1, adaptors for services developed in other WPs in Y2, and others as needed in Y3.
    - SAGA GA: Joao

WP4: Personnel (1)

- Personnel
  - Who is hired?
    - WP4: Post-doc Rene Heinzl (01 March)
    - SAGA GA: Joao Abecasis
  - Who needs to be hired?
    - CFD-TK GA
    - MD-TK GA
    - Allen GA (?)
    - SUBR WP4 Post-doc for Y(2,3)
  - Who from CCT/other sites will work on this?
    - Hartmut Kaiser (Application Manager)
    - Material World RA5

WP4: Personnel (2)

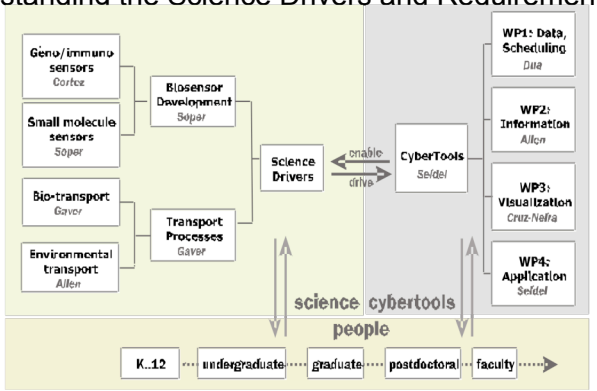
- Personnel
  - Who from LONI will work on this?
    - LONI Grid Admin (SAGA)
    - Others via WP1-3
  - Who from LI?
    - LSU and SUBR CS, but also others..
- NSF, LONI projects
  - What other projects augment this?
    - UCOMS, SCOOP
    - In pipeline: NSF Nanopore proposal (Jha), TG-GIG

Agenda

- 30 mins: Overview of Project by Ed
  - Cooperative Agreement "Highlights"
  - Project structure and app scenarios
- 45 mins each: Discussions led by 4 WP leaders
  - Describe tasks
  - Get input from science drivers, iterate
  - Refine tasks
  - Clarify/refine personnel
- Summarize, plan for all-hands meeting

WP4: Tasks (1)

- Understanding the Science Drivers and Requirements



WP4: Tasks (2)

•For each Science Driver:

– Understand science problem and scope:

• Define simplest problem capturing “most crucial physics”, i.e. Toy problem & derive Toy Model

• Define Grand Challenge Problems?

• Prioritize requirements in between

•...

– Understand current computational methods:

•Describe current code & usage mode? Current tools?

•How effectively are these deployed on LONI?

•Extensible? Scalable? Amenable to coupling with other codes ?

– Multi-physics, multi-scale simulation ready?

•...

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WP4: Tasks (3)

- What can WP4 do for you?
- WP4 (or even WP1-3) is not about writing CFD and MD codes!
  - e.g., NAMD ~ 50/100+ person-years (PY) effort
  - e.g., LAMMPS ~ 25 PY effort
- WP4 Cybertools is about:
  - Developing frameworks for coupling codes
  - Embedding range of codes into this framework
  - Enabling the deployment of codes & framework to exploit high-end and distributed environments
  - Bringing WP1-3 to the SD via APIs and frameworks
  - Help to add more...?

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WP4: Tasks (4)
Refine Tasks

- UC for each Science Driver:
- Is there a multi-physics, multi-scale scenario?
  - If so, for every scenario outline:
  - Coupling requirements, exchange of info/control, codes used, problem sizes, challenges...
- Prioritization and time-lines
- Any Other Info?
- ...
  - Q: Would SMS require/involve CFD-MD Coupled Simulations? Or Uncoupled CFD and MD? Does GIS require/involve coupled CFD-MD simulations? If so, how different from SMS?
- Refine WP4 tasks:
- Add here based upon discussions

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Agenda

- 30 mins: Overview of Project by Ed
  - Cooperative Agreement "Highlights"
  - Project structure and app scenarios
- 45 mins each: Discussions led by 4 WP leaders
  - Describe tasks
  - Get input from science drivers, iterate
  - Refine tasks
  - Clarify/refine personnel
- Summarize, plan for all-hands meeting

30

WP4: By Next Meeting

- Tasks: what to do by April 1? what already done?
- Clearer breakdown of all tasks
  - Use Case draft to be sent out to SD leads
  - First pass (return & analysis) by next monthly mtg
  - Progress with toy problem and model
- Clarify Personnel:
  - Listed WP4 contributions
  - List personal (if possible names!) from SD working with WP4? And roles?
  - Similarly for other Cybertools WP1-3 w.r.t. WP4
- Meetings of WP4 and Science drivers
  - Proposed dates: 07 Feb and 07 March?
- Meetings between WP leaders to coordinate
- Training by LONI staff on tools we develop
  - Too early?

WP1: Scheduling and Data

Tevfik Kosar/Sumeet Dua, et al

- Develop/deploy scheduling and information services, working closely with WP4 and the science groups to ensure that their needs are met, and the tools they use provide easy access to the services of this WP

WP1 Deliverables

- Infrastructure Deployment. (1 Katz grad) Work with LONI staff to deploy fundamental grid services needed to support all activities in WP1-WP4. Deploy global file system spanning all LONI institutions (e.g. GPFS/Lustre), core Grid software (e.g., Globus Toolkit, Condor, GSI, etc) and extended Grid software (e.g. GRMS, SAGA, SPRUCE, Stork, HARC, etc).
  - GA: Promita/Swathi; CCT/LONI staff: Charlie, Jarek, Honggao, Prats, Archit...Need meeting to refine
- Data Archival and Retrieval Services. (0.5 Kosar/Allen PD; .5 Soper GA) Develop a LONI-wide distributed data archive, drawing on ongoing activities at the CCT, which utilizes the Reliable On-line ARchive (ROAR) and NSF funded PetaShare infrastructures for all CFD/MD simulation, experimental CBM2, hurricane/surge modeling, real-time data, and on-demand scheduling, and services to automatically archive data derived from the simulations and experiments. Develop services to efficiently and reliably retrieve the archived data.
  - PD: Mehmet Atkas?; Soper GA?; CCT/LONI staff: ?
- Scheduling Services. (.5 Kosar/Allen PD) Enhanced scheduling services will be developed in the support of automated, on-demand simulations needed, using SPRUCE, (e.g., for hurricane/surge forecasting) or for co-allocated or coupled jobs needed, using HARC, (e.g. for simultaneous CFD and/or MD simulations or coupled simulation/visualization processes). A generic task farm manager will be developed, providing a framework for task farming ensembles of scientific applications through both simple interactive interfaces, and in a fully-automated responsive mode.
  - PD: Mehmet Atkas?; CCT/LONI staff: Andrei?; Science Drivers: ??

WP1 Deliverables continued

- High Availability. (1 Box grad (LA Tech)) Uninterrupted availability must be ensured across LONI for mission-critical applications and downtime-sensitive services. High Availability Open Source Cluster Application Resource (HA-OSCAR) will be extended to address reliability, availability, and serviceability issues by automatically handling software and hardware faults. This will significantly improve the resource utilization and sustainable data services to provide a 24/7 operation.
  - GA?; LONI staff?
- Metadata Extraction and Indexing. (.5 Dua/Box PD (LA Tech), 1 Iyengar grad)) The volume and complexity of scientific data generated by LONI projects requires not only effective storage and retrieval mechanisms, but metadata descriptions and data mining algorithms. LSU and LATech researchers will work with international colleagues in Manchester and AEI (Potsdam), active in the use of ontologies, to develop metadata services specifically for the science projects, so that archived simulation, experimental, and observational data can be searched, discovered, and retrieved for analysis and comparison.

WP2: Information Services

Gabrielle Allen, et al

- We will develop a monitoring infrastructure on LONI with up-to-date relevant information for our applications, and provide generic and application-specific portals to provide scientific gateways into LONI:
- Information services. Review different information services (e.g., MonaLisa, GPIR, NWS) and production HPC services (e.g., Nagios, IPM, Big Brother), deploy as needed for CFD, MD, experimental projects and general applications, and devise mechanisms populated with reliable, up-to-date information. Provide services, schema and interfaces to store and query application monitoring information and to query other information services, to enable DDDAS applications, to allow collaborators to interact in real time with their simulations and experiments, and to prototype and develop new application scenarios.
- Portals. Generic portal interfaces and services with GridSphere that simplify the development, deployment, and reuse of complex application software and new Grid technologies will be developed. A LONI portal, with portlets for HPC (machine, service, job monitoring, job deployment), application specific interfaces (CFD, MD, Coastal) as well as advanced grid services (interacting with metadata, scheduling, data, information, task farming services) will be developed and deployed.

WP2 Deliverables

- Information Services (.5 Dua/Box postdoc (LA Tech))

  –Information services. Review existing software options for monitoring and information provision in the context of the project resources, partners and applications. With WP1 deploy chosen solutions across the LONI environment, and devise mechanisms to populate systems with reliable up to date information. Incorporate application information into the monitoring and information infrastructure.

  –Schema and interfaces. Develop the appropriate services and schema to store, query, and retrieve information about resources and applications.

  –Application scenarios. Work with applications to integrate real time information with simulations.

  –PD?; CCT/LONI/ITS: Anthony? Science Drivers?

- Portals (1 Allen Grad, .5 Soper grad, .5 Acharya Grad)

  –LONI Portal. Develop a general LONI portal integrating monitoring information about resources and applications, and build new portlets to integrate with new LONI services.

  –Application Portals. Build application specific portals for LONI. This task will include 50% effort from two graduate students from the science WPs (Soper/Acharya)

  –GA: Kate Stamou, Soper/Acharya GA?; CCT/LONI: Prats, Honggao, Michael, Archit, other Science Drivers?

Refine Tasks, Personnel

- Personnel
  - –Who is hired? Who needs to be hired?
  - –Who from CCT will work on this?
  - –Who from LONI?
  - –Who from LI?
- NSF, LONI projects
  - –What other projects augment this?
- Tasks
  - –Clear breakdown of all tasks
  - –Meetings of WP and Science drivers
  - –Meetings between WP leaders to coordinate
  - –Training by LONI staff on tools we develop

WP3: Visualization Services

- WP3 objective is to provide tools, APIs, and services for the science applications to be able to visualize their data. Our team will integrate, leverage, and build on our combined visualization activities, helping drive LONI-based research and education. We will work closely with other WPs and science projects to ensure that visualization services are used to advance the science and education collaborations across the State. WP3 has deliverables in four main components.

WP3 Deliverables

Brygg, Shalini, Carolina…

- Data and Visualization integration (1 Cruz-Neira grad (ULL), 1 Ullmer grad)
  - –Base architecture. We will create a base data integration architecture converting scientific data formats into a visualization format for front-end visualization.
  - –Integration. This will be integrated into the HD streaming visualization service to enable scientists to share and discuss their results over LONI.
  - –Automation. We will also develop and integrate automation for providing front-end visualization as a network service.
  - ULL GA? LSU GA?
- HD streaming visualization (1 Venkataraman grad, .5 Jana/Ullmer postdoc (SUBR), .5 Cruz-Neira postdoc (ULL))
  - –HD services will be provided for use for scientific visualization and analysis as well as for pedagogical use (e.g. classes) across LONI.
  - –Co-scheduling. HD visualization services will be available and supportive of WP4, and may be co-scheduled with computation or data resources using HARC.
  - –Bandwidth Optimization. Development and implementation of techniques to reduce bandwidth needs for HD
  - –Ullmer/Jana PD? ULL PD? GA: CCT/LONI staff: Cornelius, Andrei, Shalini, Jinghua

WP3 Deliverables continued

- Leveraging of advanced visualization and interaction facilities (.5 Cruz-Neira postdoc (ULL), .5 Jana/Ullmer postdoc (SUBR))
  - –Scalable Visualization. We will focus on providing visualization services that allow applications to scale from desktops to the most advanced systems with minimal effort.
  - –Training. We will also provide training and support to foster Louisiana's expertise and usage of visualization technologies at all involved sites. (0.5 Jana/Ullmer postdoc, 0.5 Cruz-Neira postdoc).
  - –Integration of advanced interaction devices (e.g., tangibles) with core, advanced Viz facilities (0.5 Jana/Ullmer postdoc, 0.5 Cruz-Neira postdoc)
  - –ULL PD? Ullmer/Jana PD? CCT/LONI staff: Jinghua, ...
- Integration of techniques with Application Toolkits (1 Iyengar/Karki grad)
  - –Implementation of algorithms into general CyberTools infrastructure (e.g. Visit interface to the Cactus CFD Toolkit).
  - –New Iyengar/Karki GA? CCT/LONI staff: Werner, Fareed; Science Drivers?

WP3 Deliverables
Brygg, Shalini, Carolina…

- Data and Visualization integration (1 Cruz-Neira grad (ULL), 1 Ullmer grad)
  - –Base architecture. We will create a base data integration architecture converting scientific data formats into a visualization format for front-end visualization. This will cover all the complex data types in WP4 (multi-patch, curvilinear etc etc)
  - –Integration. This will be integrated into existing viz tools eg OpenSG, Floviz, VISH, Visit etc
  - –Automation. We will also develop and integrate automation for providing front-end visualization as a network service. (More of a workflow)
  - –ULL GA? LSU GA?
- Scalable & Adaptive visualization (1 Venkataraman grad, .5 Jana/Ullmer postdoc (SUBR), .5 Cruz-Neira postdoc (ULL))
  - – Strategies for Data management, transport protocols (UDT, RBUDP), cacheing (RemoteRAM)
  - – Parallel, GPU-based rendering (eg CUDA+MPI)
  - – Streaming visualizations (Ultragrid, SAGE)
    - Bandwidth Optimization. Development and implementation of techniques to reduce bandwidth needs for HD
  - – Co-scheduling using HARC & resource selection for data, rendering based on user constraints (eg frame rate, resolution, etc)
  - –Ullmer/Jana PD? ULL PD? GA: CCT/LONI staff: Cornelius, Andrei, Shalini, Jinghua

WP3 Deliverables continued

- Leveraging of advanced visualization and interaction facilities (.5 Cruz-Neira postdoc (ULL), .5 Jana/Ullmer postdoc (SUBR))
  - –Scalable Display. We will focus on providing visualization services that allow applications to scale from desktops to the most advanced systems with minimal effort.
  - –Training. We will also provide training and support to foster Louisiana's expertise and usage of visualization technologies at all involved sites. (0.5 Jana/Ullmer postdoc, 0.5 Cruz-Neira postdoc).
  - –Integration of advanced interaction devices (e.g., tangibles) with core, advanced Viz facilities (0.5 Jana/Ullmer postdoc, 0.5 Cruz-Neira postdoc)
  - –ULL PD? Ullmer/Jana PD? CCT/LONI staff: Jinghua, ...
- Integration of techniques with Application Toolkits (1 Iyengar/Karki grad)
  - –Implementation of algorithms into general CyberTools infrastructure. Eg rendering techniques for vector/tensor fields for multi-block data in WP4 (focus on qualitative aspects rather than performance)
  - –New Iyengar/Karki GA? CCT/LONI staff: Werner, Farid; Science Drivers?

Next Steps

- Refine Evaluation Plan by Jan 10
- Define Scenarios from Apps groups
- Develop toy problems
- Prepare for All Hands Meeting next week (Monday?)
- Much iteration will be required!
  - Individual WP meetings will be needed
    - Most important to define teams (including science drivers, LONI, CCT, other), get meeting!
  - Cross coordination meetings of WP leaders, science drivers
  - Need very clear tasks for goals for everyone asap