

## **Appendix A**

# **Project Plan**

## **Texas Internet Grid for Research and Education (TIGRE)**

Rice University,  
Texas A & M University,  
Texas Tech University,  
University of Houston, and  
The University of Texas at Austin

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# 1. Introduction

The Texas Internet Grid for Research and Education (TIGRE) is a project to provide a grid computing infrastructure that enables integration of computing systems, storage systems and databases, visualization laboratories and displays, and even instruments and sensors across Texas. The overall goal of this project is to facilitate new modalities for academic-government-private research partnerships, fostering collaborations and partnerships among universities and industries by dramatically enhancing both computational capabilities and collaborative research infrastructure. The TIGRE project is targeted to address research areas of interest to the State of Texas where manifold increase of computing power, data access, and collaboration would be necessary.

The TIGRE project consists of institutional participants comprising Principal Investigators (PIs) and TIGRE-funded personnel at each of five universities: Rice University, Texas A&M University, Texas Tech University, the University of Houston, and the University of Texas at Austin. Collectively these will be referred to in this document as the “TIGRE Institutions”.

The scientific goal of TIGRE is to provide an operational grid software that enables leading-edge applications in at least three at least three areas of importance to the state of Texas. As a starting point, one example application will be selected each in the areas of bio-sciences and medicine, energy, and environmental modeling. TIGRE will bring researchers together at multiple institutions into coordinated grid application development communities towards this objective, and will demonstrate new, preferred, enhanced or increased computing and storage handling capabilities offered by a statewide grid infrastructure.

This project plan provides the objectives, scope, organization, milestones, schedule and other details of TIGRE. This document further provides a comprehensive layout of the planned implementation path for TIGRE and will be updated as necessary with the progress of the project.

## 2. Objectives

The high-level objective for this project is to deploy a collaborative grid infrastructure and set up working grid services architecture (GSA). TIGRE will promote collaboration among Texas research institutions and companies, thereby allowing them to compete nationally and internationally in science and engineering research and for large multi-institution programs and awards. We plan to pursue this with the explicit goal to support extensibility of these grid services to additional institutions in Texas as the project proceeds.

The lower-level objectives of this project are to:

1. Provide client- and server-side software with capabilities for resource sharing and coordination that enhances what any single institution can contribute.
2. Create and distribute a software stack that primarily supports the three driving applications of interest to the State of Texas and is easily extensible to a variety of applications.
3. Provide the service infrastructure for TIGRE such as services for authentication and authorization, scheduling work, customer relations management, and a web portal.
4. Provide the operational infrastructure for TIGRE such as a defined organization, policies and procedures, and documentation.

### **3. Scope**

The goal of TIGRE is to deploy an extensible architecture for grid computing in Texas. As currently funded, the project includes support for development activities at the five founding TIGRE institutions. It will require significant effort to create support conditions under which a large number of such institutions could adopt this architecture. The purpose of this project is to prepare for this eventuality and to demonstrate that such expansion is practical.

This project covers extensive development and deployment activities, but does not at present include operational support for a large user community. It should be made clear that providing such support takes a significant amount of effort, and we do not currently have the funding to do this on an ongoing basis. Instead, TIGRE intends to develop and deploy required grid middleware and demonstrate their practicality on driving target applications as outlined above.

The TIGRE project also does not provide explicit funding for a large amount of dedicated computational resources. As an initial step, the TIGRE members are volunteering a limited number of computational and storage resources for users to access so that we can evaluate software, services, and operational approaches. It is a goal of the project to ensure that the software, including grid middleware and client tools, support center tools, and other developed resources are capable of handling large operational loads when deployed. If and when, as a further development, the user base and/or number of participating institutions were to grow, it will be necessary to explore ways to enhance the available grid resources substantially in the future.

### **4. Project Management**

#### **4.1 Organization and Leadership**

The TIGRE project is organized into two primary components: a project Steering Committee (SC), and a project Development Team (DT).

The SC is a group consisting of the Principal Investigator (PI) or his or her representative from each TIGRE institution. This committee provides strategic direction and high-level leadership for the project by making decisions regarding major project directions. These decisions are made through unanimous agreement among the five institutional participants. Functions of the project explicitly under the control of the SC include establishing procedures regarding usage allocations, policies and usage priorities, selection of the initial project application areas, and working interactively with researchers and educators to stimulate, formulate, and guide applications development for TIGRE.

The DT consists of TIGRE-funded staff at each of the institutions organized into a body that constructs and operates TIGRE. This consists of a range of technical tasks such as selecting, testing, and deploying software, defining and carrying out operational policies, providing documentation, providing user support and working with the pilot application deployment. The DT operates by identifying tasks that need to be performed and creating activities to perform them. The primary organizational paradigm used by the DT is to group its effort and work closely with the SC in meeting the quarterly milestones of the project.

Either of these organizational components may choose to elect an internal lead member or chair to coordinate its activities, convene and call meetings, and serve as a central point of contact for further activity.

## **4.2 Roles & Responsibilities**

The SC is responsible for making high-level decisions and is ultimately responsible for the success of the TIGRE project. The SC is also responsible for providing status reports quarterly to DIR.

The DT is responsible for satisfying milestones and deliverables and reporting progress to the Steering Committee. To assist in satisfying milestones and deliverables, the DT will form activities that are responsible for performing specific pieces of work. Each activity has a lead and one or more members. The lead for the activity is responsible for reporting on the status of the activity and ensuring that the activity completes successfully. A set of internal web pages will be maintained for each activity or sub-activity. The responsible lead of the activity or sub-activity, in question, will oversee the management of these web pages pertaining to the progress of his or her group's activity.

## **4.3 Tracking and Control**

Current and upcoming milestones will be reviewed on a regular basis among the members of the DT through telephone or video-conferences. This group typically meets weekly. The lead and his or her team on each activity will report the progress and/or problems to the DT as a whole. The completed milestones within each quarter will be reported to the SC. The SC will meet via telephone or video-conferences and/or exchange e-mail as required to review the progress of the project and to provide feedback to the DT. Internal TIGRE web pages will be updated as needed to reflect the progress and upcoming activities for common reference by the DT and SC.

The DT and SC will hold face-to-face meetings as required when there are discussions needed or tasks to perform that are best accomplished in person. Potential users may be involved in these meetings to gather their feedback as well as to identify new applications that could gainfully exploit the TIGRE grid services architecture.

## **4.4 Status Reporting**

The SC has appointed Prof. Philip W. Smith of Texas Tech University to disseminate the quarterly status reports to the DIR with consensus from all the TIGRE institutions.

The main internal mechanism for reporting status is the project web site. This web site provides information about milestones and deliverables for the project, activities that are ongoing or have been completed, and will serve as a repository for meeting minutes.

A secondary mechanism for status reporting and discussion is through the use of TIGRE internal email lists.

## **4.5 Project Assessment and Control**

We will use the following procedures to control and document the project to ensure adherence to project goals and a high standard of performance:

- Project documents such as the project plan, requirements documents, an architecture description and a reference software implementation will be written and maintained. These documents will be version controlled for subsequent refinements in line with the progress of the project.

- We expect to adopt or modify software or create new software in an iterative manner to satisfy our deliverables and meet user needs. Such progressive refinements will be introduced in a controlled way. We will define processes and procedures to operate TIGRE with the explicit goal of establishing initial criteria and then gathering user feedback.

### **4.5.1 Change Control**

Change control mechanisms will be used to ensure that any changes to work products under change control are made with the knowledge and approval of stakeholders. In large-scale projects, it is sometimes decided to have a change control board perform this task, but given the relatively small size of TIGRE, we choose to have the DT act as the change control board with significant decisions reviewed and approved by the SC. All approved revisions of work products defined to be under change control by the above two bodies will be managed accordingly. For documents, we expect to simply store each approved revision on the internal TIGRE web site using content management tools. For software(s) we develop and/or deploy, this will be accomplished by storing versions of software on the TIGRE web site and/or by using a version control system such as CVS or Subversion. Specific procedures for selection of software set to be deployed will be developed by the DT. We may also deploy a monitoring system to record information about the environment that exists on each TIGRE institution/system/resource and store this information as an aid to user selection of resources.

### **4.5.2 Quality Assurance**

We will use a number of techniques to assure the quality of our work products. The work products include documents (including the thinking behind the documents), software, processes and procedures. Examples of ways we assure quality are:

- The DT and SC project participants will examine the change control status of project items periodically, at minimum when each of the affected items is part of a milestone report.
- The DT will solicit internal comment on each of its ongoing activities by other members who are not part of the activity effort, and will also solicit feedback from members of the SC and/or from external experts as appropriate.
- Developers will test software on a variety of hardware and software environments. Automated tests will typically be used so that testing is as easy as possible. We will have a pre-deployment testbed for testing TIGRE software in use before it goes in to production. We will also monitor and test the software that is running on the production quality TIGRE to ensure that TIGRE is operating correctly.
- We will solicit user feedback via web forms, e-mail and face-to-face meetings as appropriate.

### **4.5.3 Risk Management**

Our risk management approach will be to create a definite list to identify potential risks, assess the probability of their occurrence and impact on deliverables, and to develop proposed mitigation strategies. Potential risks identified so far include staff recruitment and retention, difficulty in locating driving applications, or changes in institutional policies on compute and data sharing which may affect the progress of the project either directly or indirectly.

The project risks are summarized in a “top risks” list to be maintained by the DT in consultation with the SC. These risks will be examined periodically by the SC and DT as a part of their ongoing milestone review to determine whether any of the associated problems have occurred and if so, whether mitigation

strategies should be put in to effect. For reference, the list will be maintained on the project internal web site.

## 5. Statement of Work

This section presents the milestones and deliverables for the project along with the work breakdown structure, resources, and schedules to satisfy the milestones and deliverables.

### 5.1 Milestones

TABLE I shows the quarterly milestones of the TIGRE contract with the State of Texas.

### 5.2 Deliverables

TABLE II shows TIGRE project deliverables along with their timeline. The indicated deadlines were derived from the TIGRE project milestones (see TABLE I) described in the previous section. Further, as we described in a previous letter to DIR, we have selected a start date for the TIGRE project as December 1, 2005. This leads to the due dates specified in TABLE II.

### 5.3 Work Breakdown Structure

A Work Breakdown Structure (WBS) is used to categorize and track project work components, and revised by the project as necessary. As the primary organization of the technical work of the project will be by milestones, deliverables, and project activities, the WBS will be kept in a state that is reflective of these project activities. The current version of the WBS is below.

1. **Project management.** The creation of an initial project plan document, one of the deliverables during the first quarter of the project will be carried out. Periodic iteration of the project plan throughout the duration of the project with emphasis on the vision of immediate, near and future goals of TIGRE helps in laying stronger foundation in the project management task.
  - 1.1. **Create initial project plan.** This element provides deliverable Y1Q1.1
  - 1.2. **Revise project plan at the end of Y1Q3.**
  - 1.3. **Revise project plan at the end of Y2Q1.**
  - 1.4. **Revise project plan at the end of Y2Q3.**
2. **Software.** This module consists of identifying initial software stack for at least three driving applications of interest to the State of Texas. The chosen software stack will be adopted or modified, new software tools will be written for transparent deployment of these applications using GSA. Important steps involved in this process include:
  - 2.1. **Gather initial requirements.** These requirements will be used to evaluate software packaging and distribution technologies as well as determine which software should be included in the initial TIGRE software stack.
  - 2.2. **Select packaging/distribution technology.** The packaging technology will allow TIGRE software components to be bundled into easily installable packages. The distribution technology will allow TIGRE users and administrators to easily download and install TIGRE software packages. This task will provide deliverable Y1Q3.2.



4. **Operations.** This module offers operations to interface basic services of TIGRE that includes providing policies and procedures for joining TIGRE, utilization of TIGRE resources, monitoring services, policies and procedures for establishing site support.
  - 4.1. **Deployment.** This element contains the effort to deploy the TIGRE software stack onto TIGRE resources.
    - 4.1.1. **Identify minimum testbed requirements.** This element provides deliverable Y1Q1.4.
    - 4.1.2. **Deploy the initial software stack.**
    - 4.1.3. **Deploy the second software stack.**
    - 4.1.4. **Deploy the final software stack.**
  - 4.2. **Monitoring and testing.** This element identifies requirements and deploys a software system to monitor and test TIGRE resources.
    - 4.2.1. **Deploy initial monitoring and testing system.**
    - 4.2.2. **Deploy final monitoring and testing system.**
  - 4.3. **User support.** This task performs various user support activities including working with users to resolve problems and creating documentation.
    - 4.3.1. **Author user guide.**
    - 4.3.2. **Author application porting guide.**
  - 4.4. **Site support.** This element defines and documents the procedures for a site to be part of TIGRE.
    - 4.4.1. **Document the minimum software and services needed to join TIGRE.** This element provides deliverable Y2Q3.2.
    - 4.4.2. **Document how to join TIGRE.** The documents that result from this element will describe what a new site needs to do to join TIGRE. This element partially provides deliverable Y2Q4.3.
    - 4.4.3. **Document TIGRE operational policies and procedures.** This element partially provides deliverable Y2Q4.3.
5. **Application porting.** Many potential TIGRE users will have legacy serial or parallel codes. Porting such codes to a distributed environment, such as TIGRE, can be difficult. This element will provide assistance to users to port their applications to TIGRE. The primary effort will be on working with selected pilot applications.
  - 5.1. **Select initial three applications.** This element provides deliverable Y1Q1.5.
  - 5.2. **Port first application.** For each application, we identify the interfaces and functionality the application will provide, design how the application will operate in TIGRE, identify the interfaces and functionality the application needs from TIGRE, enhance TIGRE to provide these interfaces and functionality, implement the application design, measure and tune performance, and finally document successes, failures, and any additional functionality that TIGRE and the application could provide to make the application more successful.
  - 5.3. **Port second application.** The second application will be ported to TIGRE using the same procedures as used to port the first application.
  - 5.4. **Port third application.** The third application will be ported to TIGRE using the same procedures as used to port the first application.

- 6. Demonstrations.** The TIGRE project will perform a number of demonstrations. The purposes of the demonstrations are to demonstrate that TIGRE is operational to the state and to demonstrate to potential users and member sites the benefits of joining TIGRE.
- 6.1. Provide initial demonstration.** For each demonstration we define the demonstration, prepare it, provide the demonstration, and then document how the successes and failures of the demonstration. This element provides deliverable Y1Q3.3.
  - 6.2. Provide second demonstration.** This task provides deliverable Y2Q1.2.
  - 6.3. Provide third demonstration.** This element provides deliverable Y2Q3.3 and Y2Q3.4.
  - 6.4. Provide final demonstration.** The final demonstration of the TIGRE project will be performed at the SC conference. This task provides deliverable Y2Q4.4.

## 6. Schedule

A GANTT chart that describes our schedule for working on and completing the elements of our work breakdown structure is shown in **FIGURE 1**.

## 7. Resources

The resources available to TIGRE through direct State funding are almost entirely in the form of staff support. The participating institutions have typically provided two full-time equivalent personnel through project funding. In some cases, TIGRE institutions have ramped up their staff and activity in order to make project progress before the official project start date, but most have synchronized their overall project activity to be fairly close to the project time line. Each institution is responsible for its own staffing plan to meet project goals.

## 8. Budget

Out of the \$9.8 million Texas Enterprise Fund award for LEARN and TIGRE, \$500,000 is allocated for each of the five TIGRE institutions, amounting to a total of \$2.5 million, to deploy grid computing infrastructure that enables the integration of resources at Texas institutions.

# APPENDIX

## A. Definitions

Alpha quality	Software that is not feature complete and may be known to have bugs is considered alpha quality. Alpha quality software is occasionally provided to users that have an urgent need for some of the features in the software.
Beta quality	Software that is feature complete, ready for regular users, thought to be mostly bug free, and in final stages of testing is considered to be beta quality. Beta quality software is provided to users to help with the final testing of the software.
Grid	A network that coordinates distributed compute and data resources using standard, open, general-purpose protocols and interfaces to deliver nontrivial quality of service.
Middleware	Software that interfaces two separate and often already existing application programs. It is neither a part of the operating system nor application programs.

## B. Glossary

CA	Certificate Authority
DIR	Department of Information Resources
DT	Developers Team
GSA	Grid Services Architecture
HiPCAT	High Performance Computing Across Texas
LEARN	Lonestar Education and Research Network
RA	Registration Authority
SC	Steering Committee
TIGRE	Texas Internet Grid for Research and Education

TABLE I: Quarterly Milestones of the TIGRE contract with the State of Texas

Quarter	Milestone
Y1Q1	Present a project plan and scope of work in a mutually acceptable format to Department of Information Resources (DIR). Establish a common web site, shared Certificate of Authority (CA) service and minimum testbed requirements within the first quarter of the first year. This will enable TIGRE institutions to immediately perform outreach activities by publishing lessons learned and experience papers to the community and the public at large. Select three driving applications of importance to the State that will be used to derive grid software stack requirements for construction, as well as provide a set of applications for testing, verification and assessment of success.
Y1Q2	A prototype alpha quality portal service will be deployed within the second quarter of year 1 to facilitate requirement gathering of application and site specific resource submission characteristics amongst the varied scientific and educational communities that will be using the portal.
Y1Q3	Within the third quarter of year 1, a site service software stack will have been defined. A distribution mechanism, possibly using packaging technologies like <i>pacman</i> , will be agreed upon and customized for TIGRE. Demonstrate, on a small scale, basic functionalities of TIGRE capabilities using at least one of the driving applications.
Y1Q4	A prototype alpha-quality client tools package will be distributed to friendly users by the end of year 1. This client tools package will allow friendly users to start using site resources earlier on to identify missing components, and harden tools which will eventually be released to the wider TIGRE user community.
Y2Q1	An alpha-quality customer management services system will be deployed in the first quarter of year 2 to enable testing and site specific customization. Demonstrate across resources from the majority of the TIGRE institutions capabilities using all three driving applications.
Y2Q2	In the middle of year 2, a global grid scheduler service will be deployed. This grid scheduler will enable sites to advertise resources, and TIGRE user jobs to be routed to the most appropriate site for execution.
Y2Q3	In the third quarter of year 2, the alpha-quality packages will be upgraded with bug fixes and new feature requirements and a cool down period will be enforced. During this period only critical changes to the infrastructure will be done, allowing a stable environment to be migrated into production at the end of year 2. Also the minimum set of services needed to use and/or join TIGRE production grids will be defined. Prepare and execute a major demonstration of TIGRE software capabilities using the three driving applications and evaluate ease of use and success.
Y2Q4	During the final quarter, the software hardening will be completed and the installation and support documentation will be prepared. Procedures and policies for joining TIGRE and sharing resources will be developed and documented, and posted to the TIGRE web sites. Demonstrate TIGRE at the national supercomputing conference.

TABLE II: Quarterly Deliverables of the TIGRE contract (from TABLE I)

<b>ID</b>	<b>Date</b>	<b>Metric</b>	<b>Description</b>
Y1Q1.1	02/28/2006	Project plan document to DIR	Project Plan. Create and present a project plan and scope of work to the Department of Information Resources (DIR).
Y1Q1.2	02/28/2006	Public TIGRE web site accessible	Web site. Establish a common web site to publish lessons learned and experience papers.
Y1Q1.3	02/28/2006	CA service available	Certificate Authority. Establish a shared Certificate Authority.
Y1Q1.4	02/28/2006	Requirements document available	Testbed requirements. Define the minimum requirements.
Y1Q1.5	02/28/2006	Three applications identified	Driving applications. Select three driving applications of importance to the State to derive selection of software stack and for testing, verification, and assessment.
Y1Q2.1	05/30/2006	Portal deployed and usable	Portal. Deploy a prototype alpha-quality portal service.
Y1Q3.1	08/31/2006	Software stack identified	Software stack. Deliver alpha quality version of middleware service software stack to be deployed at each site.
Y1Q3.2	08/31/2006	Distribution mechanism identified	Distribution mechanism. Deploy a software distribution mechanism for TIGRE and perform any needed customization.
Y1Q3.3	08/31/2006	Demonstration performed	Small-scale demonstration. Perform a demonstration, on a small scale, of basic TIGRE capabilities using at least one driving application.
Y1Q4.1	11/30/2006	Client tools distributed	Client tools. Prototype alpha-quality client tools distributed to users.
Y2Q1.1	02/28/2007	Customer management system available for use	Customer management. Deploy an alpha-quality customer management system.
Y2Q1.2	02/28/2007	Demonstration performed	Demonstration. Demonstrate using TIGRE capabilities to execute all three driving applications on resources from the majority of the TIGRE institutions.
Y2Q2.1	05/30/2007	Grid scheduler available	Grid scheduler. Deploy a global grid scheduler that enables sites to advertise resources and routes TIGRE jobs to the most appropriate sites.
Y2Q3.1	08/31/2007	Client and server packages available.	Stable packages. Provide stable client and server packages.
Y2Q3.2	08/31/2007	Document describing the minimum services	Minimum services. Define the minimum software services needed to use/join TIGRE.
Y2Q3.3	08/31/2007	Demonstration performed	Major demonstration. Provide a major demonstration of TIGRE capabilities using the three driving applications
Y2Q3.4	08/31/2007	Document describing ease of use and success	Evaluation. Evaluate the ease of TIGRE using the major demonstration and the success of the demonstration.

TABLE II: Quarterly Deliverables of the TIGRE contract ... (Continued)

<b>ID</b>	<b>Date</b>	<b>Metric</b>	<b>Description</b>
Y2Q4.1	11/30/2007	Final software packages available	Final grid middleware packages. Harden the software packages to create release-quality stable versions of these packages.
Y2Q4.2	11/30/2007	Documentation available	Documentation. Release production-quality installation and support documentation.
Y2Q4.3	11/30/2007	Documents prepared and posted to TIGRE web site	Procedures and policies. Prepare procedures and policies for joining TIGRE and sharing resources.
Y2Q4.4	11/30/2007	Demonstration performed at SC	SC demonstration. Demonstrate TIGRE at the national supercomputing conference.

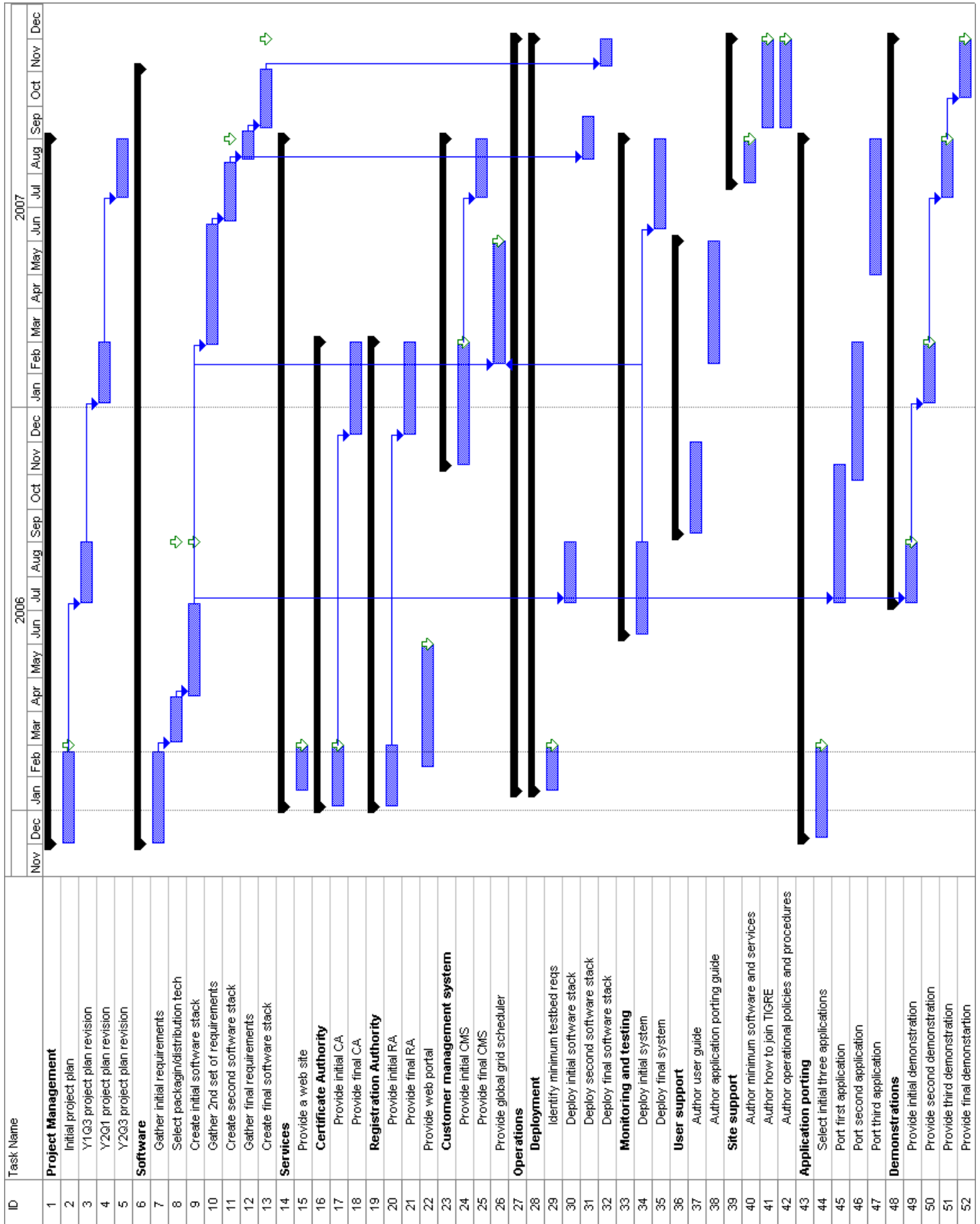


FIGURE 1: The project schedule