

# CDF Offline Initiative Closure Report

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## **Initiative Overview**

### ***Introduction***

The CDF Offline Initiative is an umbrella project to achieve a broad set of goals by providing management consultation, adding effort to handle transition demands, and applying a modest level of project management formalism to track and sustain progress. The Initiative helps plan, prioritize, and coordinate work amongst the existing personnel and groups, with an eye towards identifying and reducing the long-term maintenance and support requirements of RUN2 experiments.

### ***CD Charge to the Initiative***

The charge to the Initiative from the Computing Division can be summarized by “do what is important in six months to get CDF Offline Computing up to production grade”. Based on consultation with the major stakeholders, existing work plans, and consideration of the CDF CAF Task Force Interim Report (v4.02) recommendations and associated status document (2/27/2008), a number of highest priority objectives were identified to support this charge. The Initiative Objectives are:

1. CAF Adaptation to FermiGrid (added March 2008)
2. Critical Node Upgrades
3. Issues Tracking System
4. Monitoring Framework
5. CDF Offline Architecture
6. CDF Offline Operations (added April 2008)

The Initiative started by capturing all of the known upcoming work of CDF Offline in a high-level work list that itself was a deliverable to help guide long-term planning. Realistic estimates of task durations and staff availability indicated that, as expected, not all of the envisioned work could be fit into the Initiative. Tasks were either accepted into the work scope of the Initiative (“scheduled” tasks) or not (“unscheduled” tasks). Major high priority tasks were identified and scheduled in finer detail.

### ***Project Team***

Director: Margaret Votava (CD ILC/DAQ Deputy Dept Head, now REX Dept Head)  
Manager: Robert D. Kennedy (CD OPMQA)

The Advising Committee consisted of the Project Director, Project Manager, and:

- Jerry Guglielmo (CD ILC/DAQ Dept Head, now LSC Quad Assoc. Leader)
- Rick Snider (CD REX Dept Head, now REX Deputy Dept Head; CDF Collab and co-leader of CDF Offline)
- Donatella Lucchesi (INFN – Padua, CDF Collab and co-leader of CDF Offline)

Later joined by:

- Dennis Box (on assignment to Initiative and REX Dept)
- Joe Boyd (on assignment to Initiative, in REX Dept)

The CDF Offline Computing liaison role was performed largely by Rick Snider and Donatella Lucchesi as co-leaders of CDF Offline Computing during this Initiative.

### ***Project Repository***

Project Management and some subject matter documentation are maintained in the Google Group "[CDF Offline Initiative](#)". This is organized into several distinct areas, the most useful of which may be the "[Pages](#)". Some examples include:

- [Initiative Schedules](#): MS Project plans and related reports tracking the Initiative.
- [Work Lists](#): All tasks in CDF Offline that might be done. Led to the first WBS.
- [JIRA Configuration](#): Notes on configuring JIRA for CDF Offline.

The [Fermilab JIRA Issue Tracker](#) contains operations and development issue tracking information dating back to its deployment in April (beta)/May (production) 2008.

We chose to use standing CDF Offline meetings as-is to track progress in the Initiative since one of the initial concerns was the high workload of the CDF people involved in supporting Offline. The CDF meetings used, the CDF Offline Operations and the CDF Offline Development meetings, are [documented in WebTalks](#).

### ***Project History***

#### **Offline Issues Evaluation: January 2008 – February 2008**

- January 2008: Jerry Guglielmo, Margaret Votava interview CDF Offline team.
- February 2008: Rob Kennedy joins Initiative team, drafts CDF Offline work lists.
- February 2008: Initiative project concept developed: 6 month Umbrella Project
- February 2008: CDF CAF Task Force Interim Report with status annotations

#### **Initiative Planning, Product Evaluation: February 2008 – May 2008**

- February – May 2008: Furloughs and “forced vacations” complicate staffing.
- February 2008: Jira and Zabbix product evaluations
- March 10, 2008: First full “CDF Offline Work List” v0.7 released for comment.
- March 19, 2008: Executive presentation of Initiative plan to CD leadership.
- April 9, 2008: Initiative Introduction presented at CDF Offline Operations Mtg.
- April 10, 2008: First resource-loaded schedule draft v0.5.0, with Work List v1.0 embedded. Scheduled tasks are in-scope, unscheduled tasks are out. Execution begins.
- April 18, 2008: Joint CDF-CD Executive Mtg with overview of Initiative.
- April 28, 2008: Baseline Planning Meeting (using plan v0.8.3)
- May 10, 2008: Baseline Project Plan v1.0.0 project released.

#### **Execution: April 2008 – October 2008**

- April 2008: Jira evaluation and initial integration into Offline support processes.
- April 2008: Offline Project draft re-org released. Some future roles unclear.
- May 2008: Shadow CAF setup. High Priority KCA Upgrade work all month.

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- Staff issues and repeated little problems in head node task chain.
- Mid-June 2008: FermiGrid Head Node progress deemed unacceptable. Task force formed to re-organize the work, one group to create a tagged “CAF” software release and the other to undertake FermiGrid CAF scale tests. CDF effort redirected from monitoring objectives to the task force work. Production and Ntuple coordinators begin basic operations tests on FermiGrid CAF.
  - July 2008: Offline Project re-organization fully implemented.
  - July 2008: Jerry Guglielmo leaves Initiative. Low-Level Monitoring work ends.
  - Early August 2008: Dennis Box and Joe Boyd join Initiative.
  - September 2008: CafCondor Config v2.0: First formal tagged release, able to be wiped and re-installed with high reproducibility. Final testing by production users.
  - October 2008: New CAF head node with tagged release in production. Begin shifting nodes and production users to upgraded FermiGrid CAF. (a.k.a. CdfGrid)

### **Close-Out: October 2008 – November 2008**

- October 15, 2008: Enough objectives judged by Initiative Advising Committee to be accomplished or on a smooth path to completion. Close-out is a transition of responsibility to new Line Management and existing Offline Management with the opportunity to take stock of the Initiative experience.
- October 31, 2008: Executive Meeting of Initiative Advisory Committee with CD and CDF Heads on Close-Out. Well received overall.
- November 7, 2008: Drop-dead date for task completion to be documented by Initiative.

#### Status at Completion:

- 19 of 32 Major Milestones completed or will be completed by drop-dead date.
- 8 of 32 Major Milestones are in progress, but unlikely to finish by drop-dead date.
  - Miles 10,17: GlideinWMS integration and deployment
  - Mile 22: GroupCAF to FermiGrid CAF Migration
  - Miles 3, 7, 15: CDF Offline Architecture documents
  - Miles 23, 24 (SL4 Migration): Reduced in priority, after FNAL support for SL3 was extended, removing migration urgency. Work is continuing.
- 5 of 32 Major Milestones are “Closed, Incomplete”:
  - Miles 5, 20 (Low-Level Monitoring – Zabbix): Closed to free up resources for higher priority work. May have saved effort globally to do so since this overlapped with work that was done on a later time-scale by FEF.
  - Miles 9, 21 (User Monitoring Framework): Replanned to free up resources for higher priority work. Alternative proof of concept delivered Nov 2008.
  - Mile 19: Multiple schedd hosts for FermiGrid CAF: Slipped to mid-2009 until work in progress on FermiGrid CAF is completed. The need for this work at that time should be re-evaluated before it is undertaken though.

### ***Reasons for Closing the Project***

The CDF Offline Initiative was defined to be a time-limited project to achieve what was possible in six months, effectively beginning in April 2007. In mid-October, it became apparent that three of the four high priority initiative objectives were accomplished or on a low-risk path to completion in the near future, though the fourth (user monitoring) was not completed as originally intended. Since the active Initiative leader became the REX department head, it became apparent that the Initiative could transfer its remaining charge smoothly to the existing line management and experiment project management structures for completion of the remaining work. On 31 October 2008, we presented the Initiative accomplishments and a close-out plan to the CDF spokespeople and Computing Division Head at an executive meeting. The Initiative will just track the “GroupCAF to FermiGrid CAF Migration” and “GlideinWMS Migration” task chains to completion, which are expected to be completed by mid-December 2008.

## State of the Initiative Objectives

### 1. CAF Adaptation to FermiGrid

This objective consisted of three main components necessary to achieve the envisioned future CAF system based on FermiGrid technology and having sufficient capacity to absorb existing CAFs on-site and meet long-term production and analysis demands.

#### 1a. (WBS 4.5) Deploy New FermiGrid CAF Head Nodes

Goals:

- Deploy new, more performant hardware in the critical head node role to replace aging hardware.
- Create and use, for the first time in a while, stable tagged releases of CAF service software capable of reliable, reproducible installation.
- Demonstrate the new FermiGrid CAF system can manage the anticipated demand in the immediate future of 5k WN slots.
- Demonstrate the new FermiGrid CAF system can be used reliably by current production users of GroupCAF (Production, Ntupling, Calibrations, etc).

State at Closing: DONE

Deliverables:

- CafCondorConfig v2.0 released and v2.1 is about to be released at this writing.
- Scale tests successfully completed on the ShadowCAF, albeit at a reduced 3k to 4k WN slot level emulation.
- Fcdfhead10 in production as head node of new CdfGrid CAF instance

Outstanding Risks (including Operations, Support):

- The node head11 failed to operate reliably after several repair attempts, a potentially serious blow to the original 2-head node configuration. It was determined, however, that all services could be run on head10 and doing so would in fact reduce the number of SPOF by one node. The integration system head nodes are prepared to be used as a replacement if head10 should fail badly too.
- If head11 is repaired, since it is no longer needed in its originally envisioned role, then it might be deployed to further reduce operational risk by acting as a back-up host to non-singleton services in the FermiGrid/GlideinWMS CAF system.
- The ShadowCAF (a.k.a. sleeper pools) approach to testing the new CAF system at scale failed to operate at sufficiently large scale due to a Condor bug, reportedly fixed in Condor 7.1.4 (a development version made available in late November, after the Initiative closure). The pace of the WN migration will be sufficiently slow to permit the greater vigilance required in the transition to full-scale production to catch and resolve any unexpected at-scale limitation. After this bug is fixed, the ShadowCAF scale-testing will be revisited to prepare for GlideinWMS testing (see 1c, below).

## **1b. (WBS 4.5) Migrate GroupCAF Nodes into FermiGrid CAF**

### Goals:

- Migrate all worker nodes (WNs) and users from the GroupCAF to the new FermiGrid CAF in order to support a CAF system built from fewer experiment-specific components.

State at Closing: IN PROGRESS, MIDWAY TO COMPLETION (early Nov 2008)

We expect smooth execution of this task chain from November to mid-December 2008. The plan is well-documented and considered to have low technical risk.

### Deliverables:

- [WN migration plan for CdfGrid, completion by December 08, 2008](#) (see p.3)

### Outstanding Risks (including Operations, Support):

- While this task is open, the CAF operations team will have to support both the old and the new CAFs. This is likely to increase stress on the team for a time with more distinct services having to be supported.

## **1c. (WBS 4.6) Adopt GlideinWMS**

### Goals:

- Adapt to using the GlideinWMS model for job workflow management.
- Demonstrate the new FermiGrid CAF system using GlideinWMS can manage the anticipated demand in the future of 10k WN slots.
- Migrate all WNs and users from the non-GlideinWMS FermiGrid CAF to the GlideinWMS FermiGrid CAF in order to support greater demand in the future.

State at Closing: IN PROGRESS, AT EARLY STAGE (early Nov 2008)

Recovering the past proof-of-concept implementation, planning integration of change required to the code base with modern tagged releases, and preparing an integration testbed.

### Deliverables:

- CdfGrid migrated to use GlideinWMS
- GlideinWMS monitoring available to operations and users.

### Outstanding Risks (including Operations, Support):

- GlideinWMS adoption carries with it some risks:
  - Does not operational simplify the system
    - Increase from 2 to 3 condor pools
    - Increase number of production head nodes from 1 to 3
  - First time installs need an expert now. Knowledge transfer in progress.
  - May miss goal of being in production for winter conference use since starting behind: the head10 replacement took much longer than planned
- While this task is open, the CAF operations team will have to support both the old and the new CAFs. This is likely to increase stress on the team for a time with

more distinct services having to be supported.

- Long-term support for the GlideinWMS component will be addressed in a briefing being organized by Eileen Berman.

## **2. Critical Node Upgrades**

Goals:

- Replace unreliable out-of-warranty servers with new more-performant servers, thus improving reliability and reducing operations effort.

Areas of Work:

- 2a. (WBS 6.1) Critical Node Upgrades: ICAF Nodes
- 2b. (WBS 7.5) Critical Node Upgrades: dCache File Servers
- 2c. (WBS 3.4) Critical Node Upgrades: Code Server

State at Closing: DONE.

Deliverables:

- The new nodes are in service, and the replaced nodes out of service.

Outstanding Risks (including Operations, Support):

- The CDF Offline Infrastructure group should have a plan to upgrade the few remaining nodes on the original [posted list](#). The FY09/FY10 procurement plans have not been checked for this by the Initiative.

## **3. Issue Tracking System**

Goals:

- Move issue reporting from an ad hoc set of e-mail lists to an organized issue tracking system integrated into existing CDF Offline support systems.
- The issue tracking system should enable the following capabilities [LINK: Margaret's presentation June 19, 2008 CDF Week]:
  - Gain metrics to understand how to best utilize limited development time
  - Analyze trends
  - Load balance open issues across available staff
  - Set priorities of open issues
  - Support a well-defined workflow for issue resolution
- Deploy across CDF Offline. Insure it is used exclusively in place of old system.

Areas of Work:

- 3a. (WBS 2.2) Issue Tracking System (JIRA)

State at Closing: DONE.

Deliverables:

- [Production JIRA system hosted by Atlassian](#)
- CDF Offline is represented by a JIRA Category, and broken down into its historical sub-projects with each sub-project mapping to a single JIRA Project. There are ten Projects at this writing, ranging from operations-oriented to development-oriented, such as:
  - [CDF CAFS](#)
  - [CDF Code Management](#)
  - [CDF Data Handling](#)
  - [CDF Offline Development](#)

Outstanding Risks (including Operations, Support):

- The Atlassian external hosting solution has its positives as well as its negatives:
  - Positive: External hosting allowed rapid, inexpensive large-scale deployment that enabled the Initiative to see JIRA in use by CDF Offline for months instead of taking months in procurements and deployments.
  - Positive: The included long-term support has freed up effort in our organization to address domain-specific issues like the CAF Migration, since we avoided having to add staff to support JIRA.
  - Negative: A recent Jira “email interface feature” downtime revealed that the host’s pre-deployment testing may be less than complete.
  - Negative: The service contract limits the number of users permitted to a rather coarse-grained scale, requiring potentially a large expense to increase user limits at some point in time.
  - Neutral: Two features become complicated by external hosting and were not achieved: an e-mail plug-in feature and LDAP strong authentication integration. The latter would have been delayed in any case due to CD Central Services schedules. Nevertheless, the JIRA system has been very successful without these features, so they are not critical requirements.
- As with any external hosting solution, we have to plan how to get a copy of our data if the hosting business were to close. Since the JIRA software itself is freely available, we should technically be able to get a snapshot of the underlying database on short notice and be able to reload it into a local database with a local JIRA service running against it.

## **4. Monitoring Framework**

This objective consisted of two distinct and independent lines of work: low-level monitoring in the role of NGOP, and the much higher-level user monitoring intended to complement the job management systems in OSG and LCG.

### **4a. (WBS 2.1) Low-Level Monitoring Framework (Zabbix)**

Goals:

- The low-level monitoring framework is to play a similar role as NGOP, but
  - Be scalable to 10k’s of monitored components
  - Lack some limitations of NGOP revealed in the past few years, such as an isolated change requires a time-consuming restart of the entire service

State at Closing: CLOSED, INCOMPLETE AS ORIGINALLY DEFINED.

Explanation:

Work was begun on this task chain, and a CDF-independent proof of concept developed. Resources were removed from this task chain and re-assigned to the higher-priority Head Node Upgrade task chain. After a short time, it became clear this had to be a permanent re-assignment and this task chain was closed.

Outstanding Risks (including Operations, Support):

- Lacking a low-level monitoring service that can scale to the number of monitoring points anticipated in the future CDF CAF system will make the system unmanageable as hardware begins to age and fail at a non-trivial rate.
- Much of the planned infrastructure was developed a little later by the FEF Department anyway. Thus, redirecting effort away from this objective may actually have avoided some redundancy in the long run.

#### **4b. (WBS 4.3) User Monitoring Framework for Grid Infrastructure**

Goals:

- Create a database-backed monitoring framework for user jobs that can be used with OSG Condor-based systems as well as LCG systems.

State at Closing: CLOSED, INCOMPLETE AS ORIGINALLY DEFINED.

Deliverables:

- [March 5, 2008 CAF Monitoring Presentation by Hans Wenzel](#)
- [October 2008 Draft of CAF Monitoring CDF Note](#)
- [November 4, 2008 CAF Monitoring Presentation by Hans Wenzel](#)

Explanation:

Work was begun on this task chain, and two main underlying components (Postgres, Zabbix) were deployed on a development machine. The installation and testing of Quill++ (RDB-backed Condor status information system) stalled however due to a CDF-specific authentication problem. Then, resources were removed from this task chain and re-assigned to the higher-priority Head Node Upgrade task chain. After a short time, when it became clear this re-assignment was to be long-term, a new less ambitious plan was drawn up to demonstrate the concepts of the framework using other customer systems already deployed. This too ran into problems, and alternative components were evaluated. A working model was demonstrated in the last week of the Initiative.

Outstanding Risks (including Operations, Support):

- Lacking an RDB-backed user monitoring framework means CDF will continue to use its “logfile scraping”-like approach.
- Lacking crisp requirements from CDF for the user monitoring, it is unclear whether the delivered proof-of-concept required a small or large amount of effort to become a production-quality solution.

- The time required to investigate problems will continue to impact operations personnel while the low-level and user-level monitoring and associated tools are developed and deployed into production.

## **5. CDF Offline Architecture**

### Goals:

- Document the high-level architecture of the CDF Offline system in order to clarify roles and responsibilities among the services and tools.
- Document the strategies applied to the major areas of the CDF Offline system.
- Document the organization structure and responsibilities in CDF Offline.

### Areas of Work:

- 5a. (WBS 1.1) Strategy Sheets
- 5b. (WBS 1.2) Offline Services Design Document
- 5c. (WBS 1.3) Project Organization Chart

State at Closing: IN PROGRESS (early Nov 2008)

### Deliverables:

- [Grid and CAF-Grid Instances strategy sheets](#)
- Strategy sheets for Disk Space, Offline Infrastructure, and Data Handling are in the plan but not yet delivered.
- Initial draft of services system diagrams posted, to be done after CAF migration.
- Project organization chart done, though lacks list of responsibilities per box/role

### Outstanding Risks (including Operations, Support):

- With short-term goals capturing most of the attention in the Initiative, addressing these documents has been a challenge since they are seen as mostly delivering value in the long-term.
- Strategy sheets: risks of not completing or using for CDF Offline planning
- System Diagrams: risks of not completing
- Project organization chart: risks of unclear responsibilities, same name in many boxes.

## **6. CDF Offline Operations**

### Goals:

- Support the CDF Offline Project Leaders in the management of operations.
- Help in the planning and tracking small projects necessary to maintain operations.

The following are some examples of the topics covered under this objective.

### Topic 6a. (WBS 3.5) SL4 Migration

- Goal: Upgrade CDF Offline to use SL4

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- State at Closing: SLOWED DUE TO LOWER URGENCY (early Nov 2008)
- Description: This task chain was executed by the CDF Offline Infrastructure group. After support in offline development for SL4 was achieved, the task chain dropped in priority considerably as FNAL CD extended SL3 support through mid-2010. CDF Offline chooses to continue slowly ahead with SL4 deployment and then force migration only when mid-2010 approaches or when the effort to support SL3 and SL4 together becomes too much, whichever comes first.
- Risks: What metric triggers this decision? How is SL5 transition impacted?

### Topic 6b. (WBS 4.4) FNAL KCA Upgrade

- Goal: Upgrade CDF Services globally to use the upgraded FNAL KCA
- State at Closing: DONE
- Description: This task chain was led by Donatella Lucchesi and executed within the CDF Offline Project context. The Initiative consulted during the planning stage and helped track the effort as the major challenges were uncovered.
- Risks: None identified.

### Topic 6c. (WBS 5.7) Operations Shifts, Incident Management, and Effort Reduction

- Goal: Reduce operations load, reduce stress of support personnel, clear process and responsibilities, no user requests “lost”
- State at Closing: IMPROVED
- Description: Operations internal meeting, JIRA, workflow, shift rotation, etc.
- Risks:
  - The estimated reduction in staff effort to operation CDF CAF systems from 4.0 to 3.5 FTEs is less than expected, though the systems are still in transition to the long-term solution. The available tools can be used to study the issues leading to the greatest operations load and prioritize their resolution.
  - Lacking monitoring tools will lead to greater operations work per incident resolution and less pro-active work overall than would be possible.

### Topic 6d. Management Consulting

- Goal: Advise on improving effectiveness of Offline Project where process and personnel were involved.
- State at Closing: IMPROVED
- Description:
  - Process introduced for development to integration to production in “development”
  - Process for workflow, ticket prioritization, etc. in operations
  - Brought in a more experienced developer and a more experienced operator to provide leadership and guide-by-example within Offline.
  - Helped improve match of personnel to roles in re-organized Offline Project.
- Risks: Need to plan for transition of Initiative added staff out of the Offline project at some point in the future. For example: Dennis Box.

## Lessons Learned

### **Successes**

- Issue Tracking with Jira was a big step forward. It was leveraged well by being delivered early in the Initiative to have the most impact on operations.
- Restored the use of tagged releases in the CDF CAF system.
- The CAF head nodes were replaced with a new node, running a tagged release.
- The critical node upgrades did happen, after a long hiatus. Fewer critical node deaths containing analysis data led to fewer unexpected fires for operations to treat and reduced threat of lost productivity for scientists.
- Strategy documents are being written, with first priority given to documents guiding work in progress.
- Restored the dev→int→prd development discipline to the CDF CAF system.
- Payoffs
  - No more fear of reinstalls (many, many have happened over the last several weeks)
  - No more fear of shutdowns (systems brought back same day as outage)
  - Operations personnel are less stressed (but not stress free yet!)
  - Better user job efficiency – some long standing, nagging problems fixed
  - CAF effort is functional and support people are productive.
  - Customers have lower anxiety level about issue resolution

### **Opportunities for Future Improvements**

- Once a re-organization is drafted and announced, it needs to be finalized quickly to avoid staff becoming confused about responsibilities, having to make choices between current and uncertain future responsibilities. This led to reduced productivity and reduced ownership of objectives by personnel. In some cases, people were disappointed when their roles were clarified to be something other than what they had first heard or had imagined due to the lack of information.
- If a person with many roles and responsibilities leaves the project or organization, then each role should be clearly defined as well as to whom each role is transferred with acknowledgement from the receiving person.
- When one or more people are in many boxes of an organizational chart:
  - There need to be clear responsibilities for each group to link to priorities.
  - Managers need to be clear about task priorities to avoid confusion.
- More status requests by managers or progress reports from the developer might have reduced the surprise level when a User Monitoring prototype was delivered.
- The User Monitoring project should have first generated a requirements document with experiment sign-off. The deliverables could be judged against a static reference point rather than against possibly shifting priorities of the day.

### **Personnel Issues**

- Personality clashes and/or strained personnel relations have a much larger effect on a project than is visible to the people immediately involved. One overly harsh

e-mail can generate hours of fence-mending by project managers, line managers, and even the experiment spokespeople/division head (much of which happens behind the scenes) as well as the people involved.

- There were instances of clearly reduced productivity as some personnel refused to talk to others on certain topics for whatever reason in a knowledge transfer task.
- Repeatedly, people interpreted e-mail in the worst possible light and did not take the time to ask for clarification before rallying allies and responding. At times, even relatively innocent e-mail set off unproductive clashes where no undue criticism was intended, sapping effort and breaking down team productivity.
- It took a long time to figure out the right combinations of people that could work together effectively. How fragile is this?

### **Other Comments**

- Furloughs had an especially harsh impact on operations personnel as rotations were hard to schedule/balance/maintain and there were nearly always fewer people than needed (hired for) who were available for peak periods... which then impacted their development fraction as well.
- Architectural Diagrams: not immediately valuable to operations staff intimately familiar with system, but helps managers and other groups re-acquaint themselves with the service design quickly for more meaningful discussion.

### **Next Steps**

While the Lessons Learned section covers a broad set of topics, long-term and short-term, the next steps that we believe may have the greatest impact are:

- Complete the WN migration to CdfGrid, now in progress.
- Complete GlideinWMS adoption in progress, and clarify its support.
- Address the User Monitoring objective and assemble a consistent monitoring suite exploiting the GlideinWMS monitoring as well.
- Reduce operations load with more automation and “Low-Level Monitoring” via Zabbix as now supported by the FEF department.
- Leverage JIRA as much as possible to prioritize which areas of operations to automate and/or monitor first.

## Summary

Despite being pushed significantly behind schedule by technical and personnel issues, the CDF Offline Initiative accomplished its higher priority goals and laid a foundation for future work. The JIRA issue tracking system has been deployed and adopted by CDF collaborators for CDF Offline operations, replacing the use of e-mail lists for incident management. This transition also led to [online ticket metrics](#) tools, [a CAF feature release roadmap](#) support for managed development, as well as reduced stress for operations personnel and reduced anxiety for users concerned about their issues being reporting to unattended e-mail lists. The CDF CAF portion of the Offline project has been re-organized to use a mature development cycle process and produce tagged releases in CVS that can be reliably and quickly installed. This has led to rapid and managed progress towards a production quality GlideinWMS-based CAF system to be deployed in the near future, in parallel with GroupCAF worker nodes undergoing overdue OS upgrades and being migrated to the new CdfGrid CAF. Critical servers have been upgraded with new hardware, helping to insure more stable Offline operations in the near future. While the overall operations effort has not yet been reduced significantly, we are confident it will begin to decrease more noticeably after the planned CAF transitions are completed. The monitoring-related objectives were not achieved due in part to effort starvation and in part due to unclear requirements. These objectives should be pursued once effort is available on concentrate on this area of work. While not all that was originally envisioned was accomplished, CDF Offline has progressed significantly towards its goal of more stable and less effort-intensive operations as RUN2 winds down.