National Weather Service

Developing a Pragmatic Vision for Evolving the NWSRFS

Presented to:

Gary Carter, Director, Office of Hydrologic Development (OHD)

George Smith, Chief, Hydrology Laboratory (HL)

Jon Roe, Chief, Hydrologic Software Engineering Branch (HSEB)

Edwin Welles, Hydrologist, Hydrologic Software Engineering Branch (HSEB)

November 13, 2002

APEX DIGITAL SYSTEMS

Meeting Purpose

- Outline a pragmatic vision for evolving the National Weather Service River Forecasting System (NWSRFS) over the coming 5 years

- Describe core features essential to further developing NWSRFS for the coming 24 months

- Define specific next actions to begin implementation of needed upgrades and enhancements to NWSRFS in the coming 12 months

Presentation Outline

- Our Approach to HL's Needs

- Background: Apex has delivered for HSEB

- Three interrelated, concurrent processes are needed to evolve the NWSRFS

  – Process 1: Develop a vision for evolving NWSRFS over the next 5 years

  – Process 2: Define a development strategy for the next 24 months

  – Process 3: Decide on features for implementation during the next 12 months

- Conclusions

- Next Steps

Our Approach to HL's Needs

- Long-term strategy development should be balanced with short-term results

- We favor rapid implementation of software features to be able to evaluate and demonstrate value

- We assume that the NWSRFS will undergo core platform, repository and architecture changes in the coming years

- RESULT: Enhance the NWSRFS over the coming years with short-term implementation projects that complement the emerging longer-term feature and technology vision.

Background: Apex has delivered for HSEB

- HSEB engaged Apex for two projects with NWSRFS

- Priority: "Success is Measured by Implementation"

- Project 1: Messaging API

  – Purpose: Improve and centralize system messaging, error logging and tracing to standardize system output and prepare foundation for concurrent and distributed processing

  – Activity

    • Intensive collaboration with HSEB staff to define specific current needs and additional short-term requirements

    • Collaborative design of software components with HSEB staff

    • Collaborative implementation of components with HSEB staff

  – Result: Messaging API deployed in the recently released NWSRFS version 22

Background: Apex has delivered for HSEB…

- Project 2: Record Locking & Concurrent Processing
  - Purpose: determine requirements for implementing improved record locking and concurrency management
  - Activity
    - Develop concept of "Data Spaces" to manage record locking processes with RDMS-based data structures and transaction management capabilities
    - Develop conceptual framework for concurrent and distributed processing in a data environment with locking services provided by Data Space management functions
  - Result: Implementation path for currently unsupported features is defined and awaiting further requirements discovery to determine scope of implementation

Three interrelated, concurrent processes are needed to evolve the NWSRFS

- NWSRFS…
  - Has been improved and extended for many years
  - Uses a single-thread model and a flat-file repository architecture
  - Functions as a cohesive "in-house" system without the need for componentized delivery or functionality

- To further develop NWSRFS, HL should
  - Outline a longer-term development strategy and consider repository choices
  - Define specific large feature sets to be developed in the coming two years
  - Begin implementation with specific features

- Result: The three processes should run concurrently to achieve solutions in a meaningful time frame

- Challenge: Defining sufficient detail for long-term vision to begin the intermediate and short-term processes effectively

Process 1: Develop a vision for evolving the NWSRFS over the next 5 years

- Key Concern: Parts of the vision are clear today; others remain to be defined
- Some change requirements are already clear
  - Increase system performance
  - Enable concurrent and distributed processing and reduce long exclusive data access locks
  - Implement new data formats
    - Grid-based data structures, built on RDMS structures
    - Grid-based processing capabilities
  - Need to facilitate simpler and quicker system extensions and customizations
  - Need to improve maintainability of NWSRFS
    - Code base
    - Methodology and tools
- Challenge: NWSRFS must be developed further now, but in ways compatible with a more consistent long-term strategy which is emerging slowly

Process 1: Known Themes

- Consider needs of software user community
  - RFCs, WFOs
  - OHD, HL and HSEB management, staff
  - Academic and industry collaborators
- Consider providing greater variety of data products to new customers
  - Users of a future National Digital Forecast Database
- Need to review and re-implement parts of NWSRFS's architecture
  - Data repository (storage, access methods, performance criteria, security)
  - Data manipulation (data preparation, forecast applications, data output)
- Need to anticipate (and potentially shape) platform shifts
  - RDMS, OS, Hardware
- Development Team
  - Development methodology and tools
  - Documentation standards

Process 1: Recommendations

- Evaluate and Confirm or Modify the Known Themes

- Launch effort to define and evaluate additional Key Themes
  - Hold quarterly 1-day seminars to define and further develop Key Themes

- Improve current documentation standards and document core areas of the current system

- Evaluate development methods and define changes, if needed

- Formulate and document official choices and decisions on Known Themes

- Recommend and schedule defined features for implementation

Process 2: Define a development strategy for the next 24 months

- Key Themes for an Intermediate Strategy
  - Select several core features that are important for overall development direction yet achievable in intermediate future
  - Define specific technological platforms and components on which the new features will be built
  - Determine needed resources to deliver the features
  - Assess impact of development and deployment of the core features on the various groups in the user community

Process 2: Known Core Features

- Known Core Features
  - Process control for basic level of multi-threaded execution
  - Data space locking for basic level of multi-process data access
  - Grid-based repository capabilities, built on RDMS data structures
  - Grid based processing capabilities
- Known core features affect all aspects of NWSRFS
- Process
  - Re-use as much as possible from existing architecture and previous modeling efforts
  - Review several data models based on relational architecture
  - Build temporary connectors to synchronize existing data ("scaffolding") to support uninterrupted NWSRFS functioning
    - Due to large impact of any development effort, careful isolation of data repositories behind APIs is critical
    - Temporary connectors should be built in semi-permanent fashion to allow re-use for the next few years

Process 2: Recommendations

- ## Next Steps

  – Perform requirements discovery to determine ideal functional areas for implementation of Process Control and Data Spaces

  – Re-implement data repositories where necessary

  – Create comprehensive architecture to create well-isolated functional components, as well as stable "system scaffolding" for synchronizing current data

  – Construct "scaffolding"

  – Construct new application framework

- ## Important Considerations

  – Use relational database

  – Early development phases require significant "scaffolding" effort

Process 3: Decide on features for implementation during next 12 months

- **Key Actions**
  - Define specific deliverables for specific releases
  - Define specific features for each deliverable
  - Achieve agreement on items to be delivered by whom, when, and in what context
  - Determine roles of members of HL and Apex teams
  - Define costs and timelines for each release

- **Important Considerations**
  - Current work load for HL staff
  - Long-term priorities will need to evolve constantly to inspire and drive current development work

Process 3: Recommendations

- Known Actions
  - Carry out requirements discovery on interaction between NWSRFS functional components and various NWSRFS databases
  - Evaluate existing data models and data flow diagrams for affected components and databases
  - Carry out requirements discovery for process control requirements for specific functional components
  - Prototype data space management functions
  - Design and prototype "scaffolding" functions

- Implementation Process: 6 weeks per release
  - Define development priorities
  - Describe use cases ("Stories")
  - Define development tasks and assemble tasks into releases
  - Build features defined by tasks
  - Unit and system test
  - Integration and acceptance testing

Conclusions

- All 3 processes must proceed concurrently

- Each process should pursue an achievable, pragmatic scope

- Due to the focus on implementation as a measure of success, re-factoring will occur periodically

- Due to the focus on implementation, HL will be able to deliver significant improvements of NWSRFS in unusually short release cycles

- The result of all 3 processes proceeding concurrently will be state-of-the-art implementation of new features

Next Steps

- **For Process 1**
  - Design and plan first one or two quarterly seminars on Key Themes

- **For Process 2**
  - Begin focused requirements discovery for implementation of data spaces, concurrent and distributed processing, and "scaffolding" capabilities

- **For Process 3**
  - Build work plans for implementation of data spaces on an RDMS, potentially with grid-compatible data structures
  - Build work plans for implementation of "scaffolding" capabilities