Software Requirements Specification

for

Schlumberger Scheduling Assistant

Version 0.2

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1. Introduction

1.1 Purpose and Product Scope

Schlumberger Scheduling Assistant (henceforth referred to as SSA) is a software system that is intended to facilitate the scheduling of work by providing real-time alerts when issues arise that impact schedule work plans. The full system includes support for the creation and modification of route plans, flexibility to accept and process new data sources, coordination between route schedulers and field workers, and auditing capabilities. The system is designed to be secure, scalable, and extensible.

2. Overall Description

2.1 Product Perspective

Many factors, such as dangerous weather and resource availability, can cause safety concerns and delays when scheduling work-tasks. These factors cause inefficiencies when schedules cannot be adapted rapidly enough to changing conditions to fully utilize available resources. Currently, Schlumberger does not have a cohesive solution to this issue. The goal of SSA is to pull data from a variety of sources into a central system that can be used to recognize and alert interested users about existing or potential scheduling issues.

2.2 Product Functions

At a high level, SSA is based on a four-tiered publish-subscribe model. In some tiers it may be possible to bypass the full complexities of the publish-subscribe model. For example, each producer in Tier 4 could easily know the subscribers to which it publishes, effectively eliminating the need for a more-complicated publish-subscribe framework in that location.

 Tier 1: Processed-Data Creation
  - Content-based model based on the format and content of the raw-data.
  - Published: Raw-Data from Raw-Data-Sources
  - Subscribers: Processing-algorithms

 Tier 2: Route-Alert Creation
- Filtering based on locations-of-interest and work-resources.
- Published: Processed-Data from publishing-algorithms
- Subscribers: Route-Notifiers

Tier 3: Route-Alert Distribution
- Topic-based model where locations-of-interest and work-resources are the topics
- Published: Route alerts from Route-Notifiers
- Subscribers: Work-tasks

Route alerts are sent from route notifiers to the route plans containing affected work-tasks. Route plans can then be updated accordingly by the system. Work-tasks are notified of alerts pertaining to associated work-resources and locations-of-interest.

Tier 4: Route-Alert Notification
- Topic-based model where route-plans are the topics.
- Published: Route-alerts associated with specific route-plans
- Subscribers: Users interested in specific route-plans

2.3 Possible User Classes and Characteristics

SSA is designed with configurable permissions. It is possible for system users to define new user classes with custom permissions. Every endpoint action in our use cases (each bubble in a box with a name ending in ‘view’ in section 3) can be included or excluded in permissions granted to custom users. This is done through the interactions available in section 3.9 below.

Below are some sample user classes that can be included within the system. They are used in the use cases to aid the reader of these specifications in understanding possible uses of each system feature.

**Analyst**
Person who creates algorithms to process data and create alerts.

**Auditor**
Person who reviews past actions taken by users in the system and the root causes of those actions. They can views all types of data in the system, although they cannot modify any of the data.

**Field-Worker**
Person who uses the route-plan to complete work-tasks at locations-of-interest. They also update work-tasks as they are completed

**Manager**
Person who monitors the efforts of a route-scheduler and resource-manager and adds locations-of-interest to the system

**Raw-Data-Source**
A source of stream of Raw-Data into the system.

**Resource-Manager**
Person who manages and updates the work-resources listed in the system.

**Route-Scheduler**
Person who is responsible for creating and editing route-plans, and modifying them when issues arise.

**System-Admin**
Person who monitors and runs the overall system, including managing system users and their permissions, as well as checking system analytics.

## 3. **System Features**

Notes:

- Use case diagrams in this section only show interactions up to the database portion of the solution itself. Interactions between database elements are shown in the first diagram in Appendix B.
- The creation and deletion of objects are counted as modifications of those objects to streamline the notification process.
- All users will be required to log into the system (described in 3.10 below) before they will be allowed to take any other actions within the system. Once the user has been authenticated, they will only have access to the actions and resulting data they have permission to take. The ability to configure permissions is described at the beginning of section 2.3 above.
- All interactions between a view and the database wrapper (DB Wrapper) are subject to authentication to ensure that the user requesting to modify or retrieve data has the appropriate permissions to do so.

### 3.1 **Data Management Features**

#### 3.1.1 Description and Priority

Data Management features center around adding new sources of data and processing and storing the incoming data.

**Priority: Medium**
Data Management features allow the customer to dynamically add new raw-data-sources and new processing algorithms to the system. However, this feature is of medium priority as the necessary raw-data-sources and processing-algorithms could be coded directly into the system.
3.1.2 Use Case Diagram

![Data Management Use Case Diagram](image)

3.1.3 Functional Requirements

REQ-3.1-1: Add new raw-data-source
- Used by: System Admin
- Adds support for messages to be streamed in from a new raw-data-source.

REQ-3.1-2: Modify existing raw-data-source
- Used by: System Admin
- Modifies the raw-data source associated with the given raw-data-source stream.

REQ-3.1-3: Delete existing raw-data-source
● Used by: System Admin
● Deletes the support for data to be streamed in from the given raw-data-source.

REQ-3.1-4: Send data
● Used by: Sensors
● Allows raw-data to be streamed to the endpoint associated with the data-source’s endpoint. This raw-data must be processed by all processing-algorithms subscribing to the format of the raw-data.

REQ-3.1-5: Add new processing-algorithm
● Used by: Analyst
● Adds a new processing-algorithm to process data. Processing algorithm inputs must be specified, which can include raw-data, previously processed-data, and / or historical data.

REQ-3.1-6: Modify existing processing-algorithm
● Used by: Analyst
● Modifies the processing-algorithm and/or the inputs that the processing-algorithm accepts.

REQ-3.1-7: Delete existing processing-algorithm
● Used by: Analyst
● Deletes the processing-algorithm.

REQ-3.1-8: Retrieve existing processing-algorithm
● Used by: Analyst
● Retrieves the existing processing-algorithm requested by the Analyst.

3.2 Route-Notifier Features

3.2.1 Description and Priority
Route-Notifier features center around updating route plans as new information comes into the system and alerting relevant users as route-plans are modified.

Priority: High
Without route-notifiers and route-alerts, the system does not solve the customer’s problem. Route-Alerts are core to SSA’s ability to provide assistance when scheduling work-routes.
3.2.2 Use Case Diagram

3.2.3 Functional Requirements

REQ-3.2-1: Create route-notifier
- Used by: Analyst
- Adds a new route-notifier to the system.

REQ-3.2-2: Modify route-notifier
- Used by: Analyst
- Modify what processed-data sources the route-notifier subscribes to.

REQ-3.2-3: Remove route-notifier
- Used by: Analyst
- Deletes a route-notifier from the system.

REQ-3.2-4: Review route-alerts & their source
- Used by: Route-Scheduler, Auditor, Analyst
- Returns a set of route-alerts for the queried time-frame and route plan(s).
- If the user has appropriate permissions, this may also include historical data up to 5 years old, including previously deleted route-alerts.

REQ-3.2-5: Publish route-alert
- Received by: Field-Worker, Route-Scheduler
- Publishes a route-alert indicating the change in status of the associated route plan.

3.3 Work-Task Features

3.3.1 Description and Priority

Work-task features center around creating, modifying, and removing work-tasks. These work-tasks can then be used by route-schedulers when they create a route-plan.

Priority: High
Without the ability to manage and input work-tasks in the system, the ability to create route-plans in which these work-tasks are completed is severely limited. Being able to create work-tasks independent of route-plans allows for features to be developed to view and organize the work-tasks waiting to be assigned to a worker as part of a route-plan.

3.3.2 Use Case Diagram
3.3.3 Functional Requirements

REQ-3.3-1: Create a new work-task
   ● Used by: Field-Worker, Route-Schedulers
   ● Create a new work-task in the system.

REQ-3.3-1: Modify an existing work-task
   ● Used by: Field-Worker, Route-Schedulers
   ● Modify an existing work-task in the system. This may involve changing
details of the task such as the associated location-of-interest, the description,
the associated work-resource(s), or marking it as successful/unsuccessful
after completion along with a timestamp of its completion.

REQ-3.3-1: Delete an existing work-task
   ● Used by: Field-Worker, Route-Schedulers
   ● Delete an existing work-task from the system.

REQ-3.3-1: View a work-task
   ● Used by: Field-Worker, Route-Schedulers, Auditors
   ● View details of an existing work-task.
   ● If the user has appropriate permissions, this may also include historical data
     up to 5 years old, including previously deleted / completed work-tasks.

3.4 Route-Plan Features

3.4.1 Description and Priority

Route-plan features center around creating, modifying, and managing route-plans.

Priority: High
Without route-plans it is impossible to receive alerts regarding when scheduling
issues arise.
3.4.2 Use Case Diagram

![Route Plan Use Case Diagram]

3.4.3 Functional Requirements

REQ-3.4-1: Modify Route-plan
- Used by: Schedulers, Managers
- Modifies the route-plan. This may include asking the automated-scheduler for recommended modifications.

REQ-3.4-2: Create New Route-plan
- Used by: Schedulers, Managers
- A new route-plan is created on the system. One or more existing work-tasks are marked as being included in the new route.

REQ-3.4-3: Review Route-plan
- Used by: Schedulers, Managers, Auditors, Field Workers
- If the user has appropriate permissions, the system returns the queried route-plan for the users to review.
● If the user has appropriate permissions, this may also include historical data up to 5 years old, including previously deleted route-plans.

REQ-3.4-4: Delete Route-plan
● Used by: Schedulers, Managers
● The route-plan is deleted.
● All allocated and unused work-resources are unallocated.

REQ-3.4-5: View Route-Plan Analytics (Low Priority)
● Used by: Scheduler
● View information regarding the effectiveness of previously planned route-schedules.

3.5 Resource Management Features

3.5.1 Description and Priority
The view is used for managing the work-resources used in work-tasks. The primary goal is for all users to be up-to-date regarding the availability of work-resources.

Priority: Medium
These features enable our users to dynamically add work-resources to assist in route planning.

3.5.2 Use Case Diagram
3.5.3 Functional Requirements

REQ-3.5-1: Add new Work-Resource
- Used by: Resource-Manager, Manager
- Create a new work-resource type on the system with its associated meta-data, such as the time of its availability.

REQ-3.5-2: Update Work-Resource Availability
- Used by: Resource-Manager, Manager
- Modify a work-resource to indicate how much of the resource is available at a location (either permanently or during a specified time-interval)

REQ-3.5-3: Remove Resource
- Used by: Resource-Manager, Manager
- The work-resource type is deleted on the system.

REQ-3.5-4: View Work-Resource Availability
- Used by: Resource-Manager, Manager, Route-Scheduler, Auditors
- The availability of the queried work-resource is returned to the user.
- If the user has appropriate permissions, this may also include historical data up to 5 years old, including previously deleted work-resources.

REQ-3.5-5: View Work-Resource-Analytics
- Used by: Resource-Manager, Manager
- Aggregated information about work-resources is made available to the user.

3.6 Locations of Interest Features

3.6.1 Description and Priority

Locations-of-interest features are central to scheduling route-plan as route-plans comprise a sequence of locations-of-interest. This set of features allows managers to create, update, and remove locations-of-interest from the system. Meta-data for a location-of-interest includes availability over time.

Priority: High.
Route-planning cannot be performed without the ability to manage locations-of-interest.
3.6.2 Use Case Diagram

Locations of Interest Use Case

3.6.3 Functional Requirements

REQ-3.6-1: Add a location-of-interest
- Used by: Managers
- Create a new location-of-interest.

REQ-3.6-2: Update a location-of-interest
- Used by: Managers
- Modify the meta-data associated with a specific location-of-interest.

REQ-3.6-3: Remove a location-of-interest
- Used by: Managers
- Remove a location-of-interest from the system.

REQ-3.6-4: View locations-of-interest
- Used by: Managers, Auditors
- View the meta-data associated with specific locations-of-interest.
- If the user has appropriate permissions, this may also include historical data up to 5 years old, including previously deleted locations-of-interest.
3.7 System Analytics Features

3.7.1 Description and Priority

System analytics features center around the ability of a system-admin to determine how well-behaved the system is, identifying the performance of data connections and databases in the system and viewing error and debugging logs.

Priority: Medium
System analytics features facilitate the identification of system issues and analysis of performance.

3.7.2 Use Case Diagram

3.7.3 Functional Requirements

REQ-3.7-1: View system performance
- Used by: System-Admin
- View statistics about system performance

REQ-3.7-2: Debug system
- Used by: System-Admin
● See any error and debug messages produced by the system, to diagnose errors or bottleneck issues.
REQ-3.7-3: Restart Database
● Used by: System Admin
● Delete items in the database that are no longer needed.

3.8 Logging Features

3.8.1 Description and Priority
Logging features are used to ensure auditability and accountability within this system by recording the actions of various users interacting with the system.

Priority: Medium
Logging adds the ability to trace user actions for auditing purposes.

3.8.2 Use Case Diagram

3.8.3 Functional Requirements
REQ-3.8-1: Log Data Entry
● Caused by: Raw-data-source
● Records whenever data arrives from a raw-data-source, along with its appropriate tags such as timestamp and raw-data-source identification.
REQ-3.8-2: Log Modification of Route Plan
● Caused by: Route-scheduler
● Records whenever a route-scheduler modifies a route-plan, along with its appropriate tags such as the modification type, route-plan modified, the modification, timestamp and user identification.

REQ-3.8-3: Log Modification of Work-Resource
● Caused by: Resource-manager
● Records whenever a resource-manager modifies a work-resource, along with its appropriate tags such as the modification type, work-resource modified, the modification, timestamp and user identification.

REQ-3.8-4: Log Modification of Location-of-Interest
● Caused by: Manager
● Records whenever a Manager modifies a location-of-interest, along with its appropriate tags such as the modification type, location-of-interest modified, the modification, timestamp and user identification.

REQ-3.8-5: Retrieve Log of Raw/Processed Data
● Caused by: Analyst
● Retrieves the records for the raw/processed-data requested by the analyst in order to find patterns and develop new processing algorithms and filters.

REQ-3.8-6: Retrieve Raw-Data Resulting in Processed-Data
● Used by: Auditor
● Retrieves the records for all raw-data resulting in a piece of processed-data, for auditing purposes.

REQ-3.8-7: Retrieve Processed Data Resulting in Route Alert
● Used by: Auditor
● Retrieves the records for all processed-data resulting in a given route-alert for auditing purposes.

REQ-3.8-8: Retrieve Actions Taken by A User Related to Route-Plan
● Used by: Auditor
● Retrieves the records for all logged route-plans modified by any user for a given time period for auditing purposes.

REQ-3.8-9: Retrieve Data Seen/Available to User in Given Time Period
● Used by: Auditor
● Retrieves the records for all logged data visible by any user for a given time period for auditing purposes.

REQ-3.8-10: Retrieve Route-Plans/Work-Resource Analytics
● Used by: Manager
● Retrieves the records for logged route-plans/ work records produced by route-schedulers and resource-managers for monitoring purposes.
3.9 User Management Features

3.9.1 Description and Priority

User management features center around the ability of a system administrator to create and manage user information and resource access permissions for each user.

Priority: High
User management is critical for SSA software system. Without proper permission management, users may maliciously access data they shouldn’t have access to.

3.9.2 Use Case Diagram

![User Manager Use Case Diagram]

3.9.3 Functional Requirements

REQ-3.9-1: Add a new user
- Used by: System-admin
- Add a new user to system, and set their permission to resources

REQ-3.9-2: Update user
- Used by: System-admin
- Update current existing user’s information or permissions

REQ-3.9-3: Remove user
• Used by: System-admin
• Delete a user’s information from the system

REQ-3.9-4: View user
• Used by: System-admin, Auditor
• View user information and permissions of queried user.
• If the user has appropriate permissions, this may also include historical data up to 5 years old, including previously deleted users.

3.10 Authentication Features

3.10.1 Description and Priority
Authentication allows the system to recognize users and ensure that they have the proper permissions before allowing them to modify or access data.

Priority: High
Security is our client’s highest priority, and without a way to verify users before giving them access to data, SSA is a failure from a security standpoint.

3.10.2 Use Case Diagram

[Authentication Use Case Diagram]
3.10.3 Functional Requirements

REQ-3.10-1: Login
- Used by: All users
- Users send their credentials to the system, allowing the system to determine which (if any) features they are allowed to access.

REQ-3.10-2: Logout
- Used by: All users
- Users notify the system that they have completed their session.

4. Other Nonfunctional Requirements

4.1 Security Requirements

Security is a major priority; at no point will a user be allowed to access data if they do not have the appropriate permissions. In order to accomplish this, SSA has two layers of security built in, one between a user and the views and actions that the user is allowed to take, and another layer between the views and the database storing all of the company’s information. In order to retrieve or modify data from the system, users would first need to have access to the views that would allow them to take such an action, and then their request would be checked against their permissions before finally potentially retrieving or modifying the data they are requesting.

In order to enable this, Azure offers its Active Control Service (ACS), which authenticates trusted users and allows them to use the system. Additionally, all connections to the cloud service will be via secure channels (such as HTTPS).

For sensitive parts of the system, such as the addition and removal of processing algorithms or the modification of user permissions, approvals from a manager or another party may be required. In this case, a value will be added to the object in question (user or algorithm), indicating whether the object is pending approval or has already been approved. Objects pending approval will not be used by the database. The ability to grant approvals can be changed along with user permissions.

4.2 Performance Requirements

The system must be able to consistently process incoming raw-data at a rate of one packet per second per raw-data-source.

4.3 Scalability Requirements

The system must be able to scale up to concurrently process hundreds of thousands raw-data-sources.
4.4 Reliability Requirements

All received raw-data packets must be logged and eventually processed. Data must be available for auditing for at least 5 years.

Appendix A: Glossary

User Role Definitions

**Analyst**
Person who creates algorithms and route-notifiers to process raw-data and create route-alerts.

**Auditor**
Person who reviews past actions taken by users in the system and the root causes of those actions. They can views all types of data in the system, although they cannot modify any of the data.

**Field-Worker**
Person who uses the route-plan to complete work-tasks at locations-of-interest. They also update work-tasks as they are completed.

**Manager**
Person who monitors the efforts of a route-scheduler and resource-manager and adds locations-of-interest to the system.

**Raw-Data-Source**
A source of stream of Raw-Data into the system.

**Resource-Manager**
Person who manages and updates the work-resources listed in the system.

**Route-Scheduler**
Person who is responsible for creating and editing route-plans, and modifying them when issues arise.

**System-Admin**
Person who monitors and runs the overall system, including managing system users and their permissions, as well as checking system analytics.

Item Definitions

**Automated-Scheduler**
An algorithm that suggests a route-plan.
**Locations-of-Interest**
A location involved in a work-task or route-plan. Examples include well sites, work-resources storehouses, route stops, etc.

**Processed-Data**
The result of processing raw-data using processing-algorithms.

**Processing-Algorithms**
Algorithms that convert inputs into processed-data. These inputs to these algorithms may include raw-data, processed-data, and/or historical (previously computed and stored) data. These algorithms may have predictive elements. Examples include the impact of weather on locations-of-interest or the availability of work-resources.

**Raw-Data**
External Data added to the system. Examples include weather data, military activity, etc. Processed using Processing-Algorithms to generate Processed-Data.

**Route-Alert**
Indications of a change in a status within a route plan. These are added by route-notifiers and are forwarded from route-plans to users. They includes a timestamp and a reference to the processed data that caused it to be generated.

**Route-Analytics**
Statistics and summaries of the effectiveness and accuracy of route-plans

**Route-Notifier**
Stream processor that modifies route plans by adding route alerts. Subscribes to processed-data associated with specific work-resources or locations-of-interest. Updates the work-resources and/or locations-of-interests to reflect the existing or predicted change of status according to the processed-data and sends route-alerts to work-tasks to notify them of these changes.

**Route-Plan**
A sequence of scheduled work-tasks and the locations-of-interest traveled to complete these tasks.

**System-Analytics**
Data about how well the system is performing. Examples include query times, db capacity, debug info, etc.

**Work-Resources**
People & objects allocated to complete work-tasks. These may or may not be consumed by the work-task. Examples include vehicles, raw materials, field-workers.

**Work-Resource-Analytics**
Statistics and summaries of the usage and utilization of work-resources.
Work-Task
A job to be completed at a location-of-interest along with the necessary associated work-resources. These tasks can be assigned to field-workers.

Appendix B: Analysis Models
Overall System:

[Diagram of System Overview]
DB Interactions Model: