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Emergency Air Operations Project

Aviation Management Interoperability for Emergency Response and Recovery : System Architecture

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SELKIRK SYSTEMS INC.

EMERGENCY AIR OPERATIONS PROJECT

(AVIATION MANAGEMENT INTEROPERABILITY FOR EMERGENCY RESPONSE AND RECOVERY)

CSSP-2014-CP-2005

System Architecture

Selkirk Systems Inc.

Version: Emergency Air Operations Project - System Architecture V 3.4

Contents

Introduction and Background

This document is the Strike-Slip system architecture developed for the Air Operations Project. It outlines the architecture as built for Phase 4 (Milestone #3), as well as identifying additional architectural considerations for upcoming milestones.

This project provides a suite of web tools and a highly scalable, highly available, interoperability hub that enables the flow of information between cooperating emergency responses agencies in how they manage requesting and allocation of scarce aviation resources.

Technical Goals for Phase 4 (Milestone #3)

- The technical goals for this Phase of the project were the:
    - Addition of new web tools that were identified in the requirements process
    - Addition of access management to secure the API
    - Migration from reliance on specific (EC2) cloud technologies to platform independence cloud solutions

System Overview

Interoperability Exchange

Strike-Slip provides a set of services as an interoperability exchange for information flow between collaborating systems involved with aviation resource requesting and prioritization. These services are currently built using an existing and emerging standards for self-describing APIs, specifically: REST Level-3 (HATEOAS / HAL) over HTTPS.

Integration Polling Interfaces

E Team, the incident management system in use by EMBC (and also EHS) is deployed in BC with an E Team-specific web-facing API. A standalone instance of E Team was established for use in this project, and configured to match EMBC's current training and production environments for resource requesting related items.

Two polling services were developed to poll the E Team web interface and provide the results to the Strike-Slip API, and the reverse, polling the Strike-Slip API and provide the results to the E Team web API.

Migration to the production and training instances of EMBC E Team is potentially in the backlog for future project milestones. Replacement of the polling or adapting the polling to accommodate EDXL-RM messaging is also a potential goal for future milestones.

Web Tools

Strike-Slip also provides a set of web tools that exercise and display information from the same API as the Interoperability Exchange.

Resource Request UI

This web tool allows resources requests to be created, updated, and cancelled.

Resource Approve / Prioritize UI

This web tools allows users to approve a resource request, and to change the automatic prioritization that is performed as a business process within the Exchange.

Aircraft Inventory UI

This tool allows users to create, edit, and delete individual aircraft resources.

Aircraft Assignment UI

This tool allows user to assign aircraft that are in the aircraft inventory to individual resource requests.

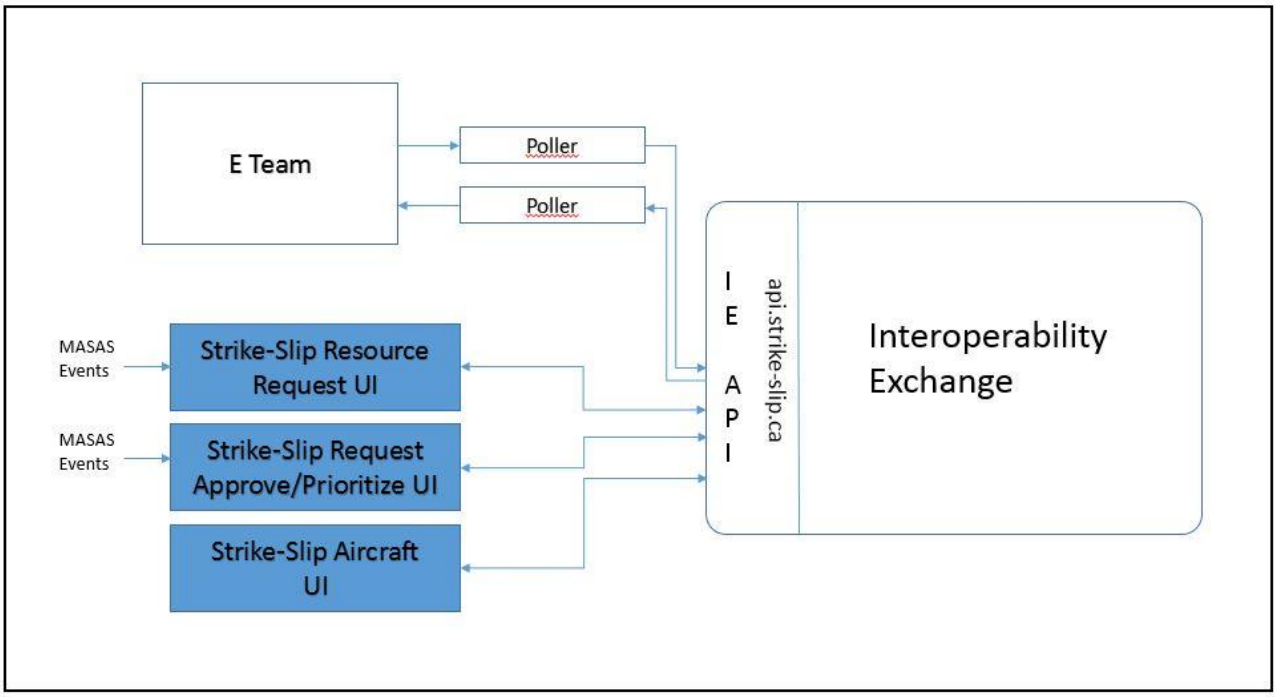

Figure 1 - High-level System Overview

System Architecture

The current architecture for the project is shown in Figure 2. The architecture for Strike-Slip was chosen to be highly available and highly scalable, and fast to refactor throughout the life of the project.

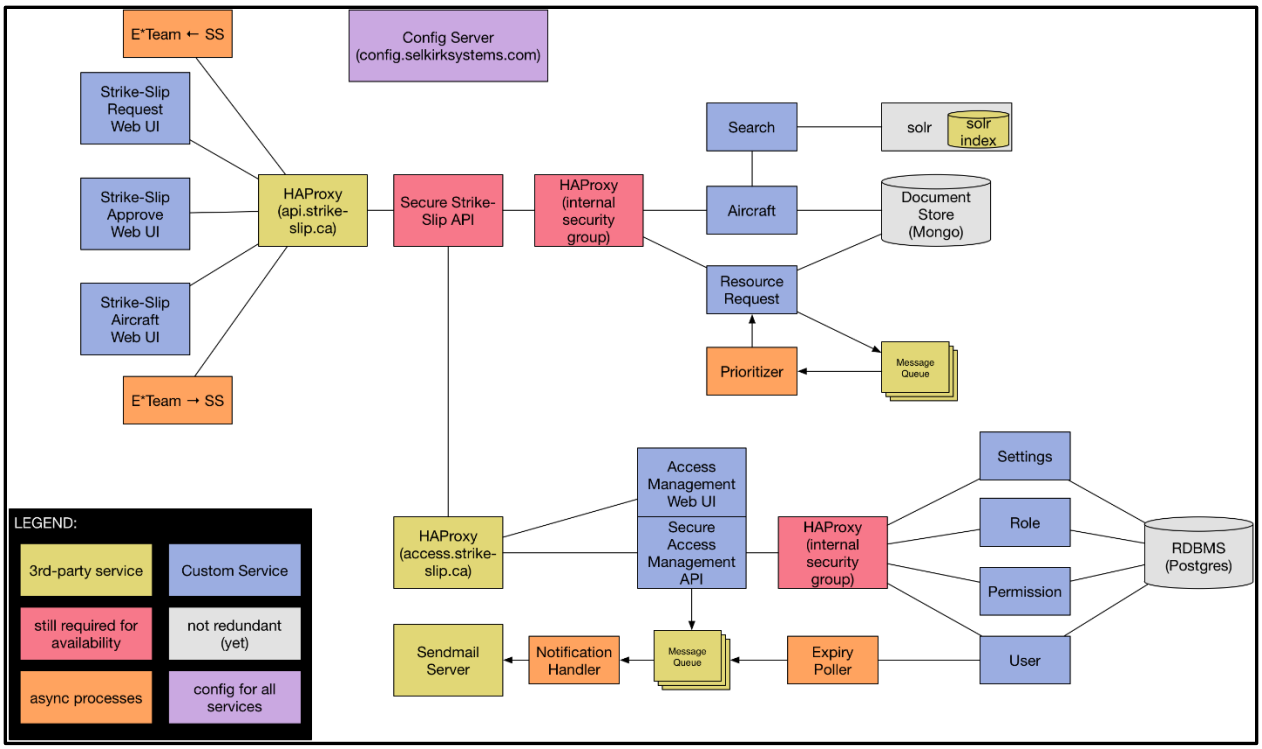

Figure 2 - Detailed Deployment System Architecture

Interoperability API (api.strikeslip.ca)

Strike-Slip Interoperability Exchange API provides a set of services to support information flow between collaborating systems involved with aviation resource requesting and prioritization. These services are currently built using an existing and emerging standards for self-describing APIs, specifically: REST Level 3 (HATEOAS / HAL) over HTTPS. The API is self-describing. Nonetheless, the following sections provide details of the API for the purposes of this document.

Roles

The API supports the 3 roles identified in the Project Requirements, and the corresponding actions these roles can perform on a request. The roles are:

- Requester : Create, read, update, submit, and complete or cancel requests
- Approver/Prioritizer : Approve/reject, prioritize, and complete or deny requests
- Implementer : Decline, assign/unassign aircraft to a request, complete or abort requests

Workflow

Statusing

Based on those roles, the API can support the workflow and related actions shown in Figure 3.

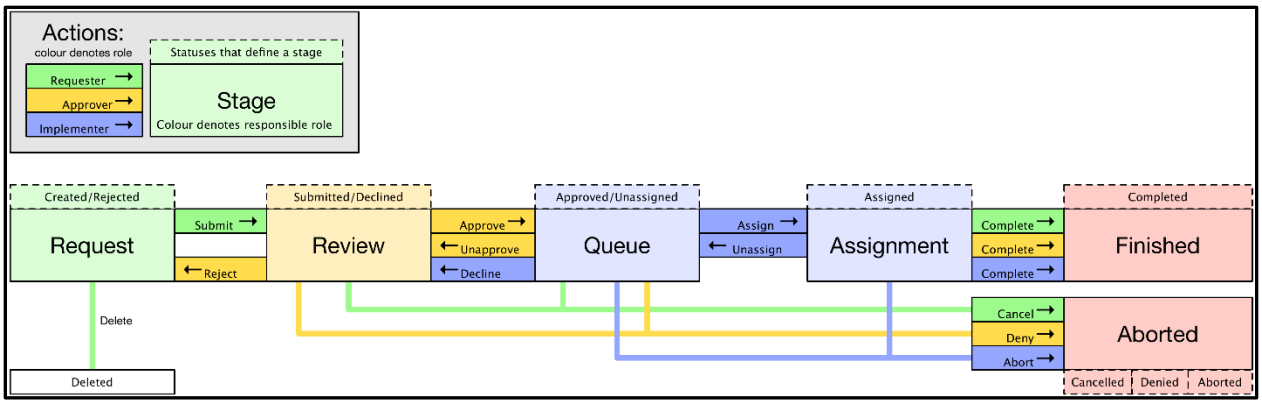

Figure 3 - API supported workflow

Auto-prioritization

The exchange currently executes a business process that applies a prioritization process to the requests, providing an auto-prioritized version of the resource request.

API Data Elements

The API data elements currently available are described in Table 1 below with specific permissions defined as Create (C), Read (R), and Update (U). The status change permissions are defined in further detail in Table 2. For illustration, the data elements are mapped to Strike-Slip Web UI fields.

Data Element in Strike-Slip Web UI	API Data Element	API Subobject	Definition	Request	Approval	Implement	System
none	id		unique id	X	X	X	CR
none	eteamId			X	X	X	CR
Unique Number	displayName		Unique number identifier	R	R	R	CR
Date/Time Created	creationTimestamp		Date and Time Request was created (system generated)	X	X	X	CR
none	createdByUser		User name of request creator	X	X	X	CR
Last Modified	lastEntityUpdate		Last date and time the request was updated	R	R	R	CR
none	lastUpdateUser		User name of last user to update the request	X	X	X	CR
Pickup Description	locationDescription		Description of the requested pickup location	CRU	R	R	R
Pickup Latitude	latitude		Latitude of the requested pickup location	CRU	R	R	R
Pickup Longitude	longitude		Longitude of the requested pickup location	CRU	R	R	R
Requesting Agency/Org	requestingAgency		Agency submitting the request to the system	CRU	R	R	R
Primary Field Contact: Name	groundContactName		The name of the field contact that requested the aircraft	CRU	R	R	R

Data Element in Strike-Slip Web UI	API Data Element	API Subobject	Definition	Request	Approval	Implement	System
Primary Field Contact: Cell	groundContactCell		The cell number of the field contact that requested the aircraft	CRU	R	R	R
Primary Field Contact: Radio Freq	groundContactRadioFreq		The radio frequency to be used to contact the field person requesting the aircraft	CRU	R	R	R
Primary Field Contact: Email	groundContactEmail		The email of the field contact that requested the aircraft	CRU	R	R	R
none	respondingAgency		Currently not used				
Date of Request	requestingTimestamp		Date and Time the Request was created (user controlled)	CRU	R	R	R
Resource is required	requiredByTimestamp		Date and Time the aircraft is required for response	CRU	R	R	R
Resource Type	resourceType		Rotor-wing, fixed-wing, or drone	CRU	R	R	R
Mission Type	missionType		Category of mission as defined by dropdown list	CRU	R	R	R
Urgency	urgency		Timeframe for response (dropdown list)	CRU	R	R	R
Mission Description	missionDescription		Description of the mission	CRU	R	R	R
Number of Passengers	passengerNum		Number of passengers to be transported	CRU	R	R	R
Payload	payloadLBs		Number of pounds of cargo to be transported	CRU	R	R	R
Specialized Equipment	specializedEquipment		Description of equipment required to be included in the mission	CRU	R	R	R
Requesting EOC	eoc		The name of the EOC submitting the request to the system	CRU	R	R	R
Primary EOC Contact: Name	eocContactName		The name of the primary contact at the EOC placing the request	CRU	R	R	R
Primary EOC Contact: Phone	eocContactPhone		The cell number of the primary contact at the EOC placing the request	CRU	R	R	R
Primary EOC Contact: Email	eocContactEmail		The email of the primary contact at the EOC placing the request	CRU	R	R	R
Primary EOC Contact: Position	eocContactPosition		The position of the primary contact at the EOC placing the request	CRU	R	R	R
none	ordinalValue		Numeric identifier assigned to Mission Type	X	X	X	CR
BCEMS Goal	bcermsValue		BCEMS goal that will be accomplished through this request	CRU	R	R	R

Data Element in Strike-Slip Web UI	API Data Element	API Subobject	Definition	Request	Approval	Implement	System
none	priorityValue		Numeric identifier for auto-priority based on Mission Type and Goal	X	X	X	CR
none	priorityOverride		Indicates the auto-priority should not replace the existing value	X	X	X	CR
Priority	priority		High, medium, or low priority auto-calculated from priorityValue	R	RU	R	CR
Destination Description	destinationDescription		Description of the requested destination location	CRU	R	R	R
Destination Latitude	destinationLatitude		Latitude of the requested destination location	CRU	R	R	R
Destination Longitude	destinationLongitude		Longitude of the requested destination location	CRU	R	R	R
Status Changed: Submit; Delete; Approve; Reject; Deny; Cancel; Complete	statusProcess	id	System generated id for status change	X	X	X	CR
		status	Name of status	CRU	R	R	R
		comment	Reason for status change	CRU	R	R	R
		when	Date and time of status change	R	R	R	CR
		who	User name of person changing status	X	X	X	CR
Status displayed on timeline	currentStatus		Current status of the request	R	R	R	R
Comment displayed on timeline	currentStatusComment		Comments associated to the change in status of the request to the current one	R	R	R	R
EMBC Task Number	embcTaskNumber		Task number assigned by EMBC	CRU	R	R	R
Aircraft ETA	eta		Estimated time of arrival for aircraft to pickup location	R	CRU	CRU	R
Aircraft Assigned	aircraftID		Registration number of aircraft assigned to the request	R	CRU	CRU	R
Aircraft Reason	assignComment		Comments about the aircraft assigned to the request	R	CRU	CRU	R

Table 1: Data exchanged with permissions

Data Element in Strike-Slip Web UI	API Data Element	API Subobject	Definition	Request	Approval	Implement	System
Status Changed: Submit	statusProcess	id	System generated id for status change	X	X	X	CR
		status	Name of status	C	R	R	R
		comment	Reason for status change	C	R	R	R

Data Element in Strike-Slip Web UI	API Data Element	API Subobject	Definition	Request	Approval	Implement	System
		when	Date and time of status change	R	R	R	CR
		who	User name of person changing status	X	X	X	CR
Status Changed: Delete	statusProcess	id	System generated id for status change	X	X	X	CR
		status	Name of status	C	R	R	R
		comment	Reason for status change	C	R	R	R
		when	Date and time of status change	R	R	R	CR
		who	User name of person changing status	X	X	X	CR
Status Changed: Approve	statusProcess	id	System generated id for status change	X	X	X	CR
		status	Name of status	R	CU	R	R
		comment	Reason for status change	R	CU	R	R
		when	Date and time of status change	R	R	R	CR
		who	User name of person changing status	X	X	X	CR
Status Changed: Reject	statusProcess	id	System generated id for status change	X	X	X	CR
		status	Name of status	R	C	R	R
		comment	Reason for status change	R	C	R	R
		when	Date and time of status change	R	R	R	CR
		who	User name of person changing status	X	X	X	CR
Status Changed: Deny	statusProcess	id	System generated id for status change	X	X	X	CR
		status	Name of status	R	C	R	R
		comment	Reason for status change	R	C	R	R
		when	Date and time of status change	R	R	R	CR
		who	User name of person changing status	X	X	X	CR
Status Changed: Cancel	statusProcess	id	System generated id for status change	X	X	X	CR
		status	Name of status	C	R	R	R
		comment	Reason for status change	C	R	R	R
		when	Date and time of status change	R	R	R	CR
		who	User name of person changing status	X	X	X	CR
Status Changed: Complete	statusProcess	id	System generated id for status change	X	X	X	CR
		status	Name of status	R	C	C	R
		comment	Reason for status change	R	C	C	R
		when	Date and time of status change	R	R	R	CR
		who	User name of person changing status	X	X	X	CR
Status Changed: Assign	statusProcess	id	System generated id for status change	X	X	X	CR
		status	Name of status	R	C	C	R
		comment	Reason for status change	R	C	C	R
		when	Date and time of status change	R	R	R	CR
		who	User name of person changing status	X	X	X	CR

Table 2: Specific permissions for Status Changes

Access Management and Security

For this milestone, we built an access management system that allows permissions to be mapped to roles, and roles to users. The permissions will be verified and enforced on the API in order to ensure that the resource-request workflow is being progressed by a user with the correct role. This same security model will also be used to enforce security for the access management system itself.

The web tools will require a log-in as will the pollers. Most of the web UIs already enforce the workflow, so it is not anticipated that there will be many changes required by the tools beyond handling security exceptions.

Persistence

Currently, persistence is being provided by Mongo document store. The only deletion policy being maintained is ad hoc – as and when required for exercises.

Determining the required persistence policy is anticipated in the next phases of the project.

Operations, Deployment, and Hosting

The highest priority from the technical operations is to remove the technical dependence to deploy in an Amazon EC-2 environment. While the Project has already been using Docker containers to provide process isolation for most of the services, we were using some off-the-shelf Amazon Machine Images and load balancers to provide scalability. It was determined that Docker-Cloud nee Tutum would provide a path to cloud independence, and the Project was migrated from the previous Ansible deployment tools to Docker-Cloud. As result, Project has migrated pivotal components from being Amazon dependent to more platform-independent analogs.

As Figure 2 denotes the architecture is almost fully redundant with the database replication being the only technical hurdle remaining before we can support both complete redundancy and scalability.

Conclusions and Future Considerations

With minor changes and deployment considerations, the system as it is built will be highly available and scalable. There are still tooling requirements around monitoring and maintaining the running system that will be required for production use.

Potential next technical goals have been identified:

- Use of EDXL-RM or a subset thereof to connect additional participating systems to the exchange
- Implementation of System access, data segregation, and data retention policy
- Redundancy and backup of document stores and persistence.
- Addition to existing web tool.
- Tooling to allow more configurability of workflows, roles and participant systems/agencies potentially on an event-by-event basis. This would necessitate an expansion of the access management capabilities, and another layer of security around the API

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Aircraft are key assets during response and recovery from large scale emergency events. A critical gap exists in multiagency response to emergency events due to the silo nature of how each responding and affected organization manages their aerial resource needs. For example, a major seismic natural disaster in the BC Lower Mainland is forecast to cause extensive damage to critical infrastructure, disrupt all major ground transportation routes and produce mass casualties. While many organizations have emergency response plans, few are coordinated, and dependence on the same scarce aviation resources is common. Prioritization of use of the resources across different needs will be paramount to maximizing the effectiveness of response and recovery operations. Therefore, the goals of this interoperability technology demonstration project are to: enable a provincial plan and systems interoperability to ensure aviation resources are coordinated and used to maximum efficiency for response and recovery operations; create governance, procedures, and enabling technologies for interoperability between all involved agencies for managing aviation resources; leverage aviation management expertise within the provincial government and experienced response agencies for the benefit of all; maximize the integration of the governance, standard operating procedures (SOP), and enabling technologies developed and proven in this Project into the daily business operations of the organizations involved; with seamless scalability for emergency management (EM) events; create a model for emergency aviation management that can be expanded to other jurisdictions and also nationally; and establish an open, standards-based emergency aviation interoperability architecture for use in British Columbia (BC) and in other jurisdictions -- for example nationally via Multi-Agency Situational Awareness System (MASAS).

This document contains the system architecture for the Emergency Management System.