GridOps Management Suite 3.10

Workforce Management Interface

Functional Specification

Document Version: 1.1

Updated: June, 2024

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1. REFERENCES

#	Title	Description
1.	EcoStruxure GridOps Management Suite 3.10 Enterprise Integration Platform - Functional Specification	The document represents a set of common integration principles applied to all baseline integration adapters.
2.	EcoStruxure GridOps Management Suite 3.10 Crew Management - Functional Specification	The document describes functionalities related to the crew management module. It provides an overview of the functionalities for the crew data management and the crew assignment management.
3.	EcoStruxure GridOps Management Suite 3.10 File Claim Check Interface - Functional Specification	The document describes an out-of-the-box integration adapter designed for importing the files in the EcoStruxure GridOps. It follows the Claim Check integration pattern.
4.	EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface	EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface zip file contains essential configuration information, as well as web service definitions complemented with message examples.

2. ASSUMPTIONS AND PREREQUISITES

WFM integration is designed with the following assumptions:

- Message format exchanged between the EcoStruxure GridOps and client's systems will be in accordance with the "CIM-CrewModel".
- Since crew management functionality is highly configurable, the appropriate types (enumerations such as the crew member types, vehicle types, etc.) that need to be exchanged with the external systems must be defined during the design sessions.

3. INTRODUCTION

EcoStruxure GridOps Management Suite is a family of solutions designed to help electric utilities in the operations and management of their grid. It is offered as EcoStruxure ADMS, EcoStruxure Grid Operation, EcoStruxure DERMS or EcoStruxure Energy Transmission Operation solutions, which share the same technology platform.

NOTE: The functionality described in this document applies to all solutions.

NOTE: Most images presented in this document are related to the EcoStruxure ADMS solution and should be used as an example. The images for other solutions may differ slightly.

WFM integration is designed as an interface used to transfer the workforce data from different client owned systems to the EcoStruxure GridOps. After the initial migration, the WFM interface can also be used for additional data maintenance.

The entities that are most important in the Crew model will be the centerpieces in the WFM integration. Those entities are:

- Crew – groups several members into the singular team.
- Vehicle – the motorized vehicle used by the crew.
- Member – the member of a crew.
- Skill – defines working capabilities of each crew member.

Crew Model is hosted by the Crew Management Service (CRS), one of the services which is integral part of the RealTime service.

Besides the crew model maintenance, WFM Interface also provides capability to dynamically, in near real-time update crew's, member's, vehicle's and assignment's data.

The client can also use the DMD application to manually maintain the Crew model. Parties interested in using the DMD to manage a crew model can find more details in the *EcoStruxure GridOps Management Suite 3.10 Crew Management - Functional Specification* document [2].

3.1. General Architecture

Described in the *EcoStruxure GridOps Management Suite 3.10 Enterprise Integration Platform - Functional Specification* [1].

4. INTERFACE OVERVIEW

WFM integration is implemented through the WFM Adapter component. The aforementioned adapter implements (hosts) several SOAP based Web Services with the appropriate set of operations:

- *ReceiveCrewModelService* – used for aligning crew data with WFM system data:
  - *CreatedCrewModel* operation
- *ReceiveCrewAssignmentsService* – used for crew assignment management:
  - *CreatedCrewAssignments* operation – initial creation of the crew assignment.
  - *ChangedCrewAssignments* operation – two modes of execution (more details are given in ChangedCrewAssignments Operation chapter):
    - Incremental mode: update of the existing crew assignment. Used when external system sends the changes of individual crew assignments only.
    - Bulk mode: generation of delta (incremental crew assignment model update). Used when external system sends the snapshot of all assignments per crew, when one of the crew assignments changes.
  - *DeletedCrewAssignments* operation – deletion of the crew assignment.
- *ReceiveCrewsService* – used for updating crew data (availability and connection status)
  - *ChangedCrews* operation
- *ReceiveVehiclesService* – used for updating vehicle data:
  - *ChangedVehicles* operation

The following chapters provide more details regarding these interfaces (web services) and the appropriate web service operations, data mappings (CIM Profiles → Crew Model), error handling scenarios, etc.

The use case diagram that represents common participants (actors) and users of the aforementioned interfaces in the WFM integration is given in Figure 4.1.

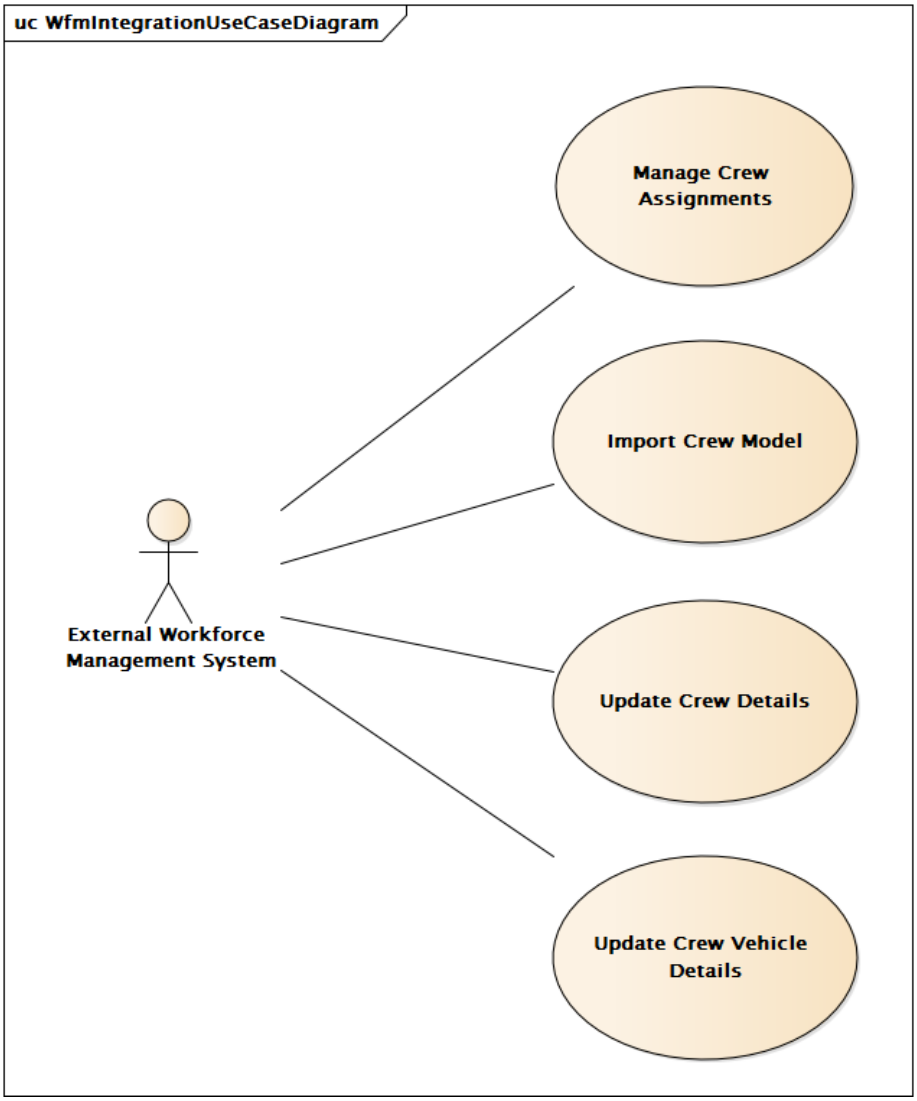

Figure 4.1 – The WFM integration use case diagram

5. RECEIVECREWMODEL SERVICE

5.1. CreatedCrewModel Operation

5.1.1. Overview

In the EcoStruxure GridOps product, crew data is stored within the Crew Management Service. Crew data, in short, is a collection of the information about utility's technical personnel (crew members), their skills, vehicles, types, locations and statuses, crews, their types, availabilities, composition in form of assigned members and vehicles, etc.

Initial migration and later maintenance of the crew data is available through the WFM Interface. Depending on the workforce management (crew) data size, there are two available approaches how crew data can be delivered to EcoStruxure GridOps from WFM:

- Claim Check Adapter: for utilities that contain considerable number of crew data entities, external system can deliver entire crew model in form of a file. Once the file is uploaded to shared location, external system needs to send notification message to Claim Check Adapter, to inform it which file to consume. File needs to be formatted in accordance with the CrewModel CIM profile and it must contain snapshot of the crew model from the external system. Precondition for this approach is purchased license for Claim Check Adapter.
- Web Service Integration: for utilities where the number of crew data entities is smaller, dedicated CIM compliant web service (*ReceiveCrewModelService*) exposed within the WFM Adapter can be utilized.

Regardless of the approach once the dataset is delivered to WFM Adapter, it performs initial validation of the received data. All use cases and validation steps that are performed during the validation stage are described within Use Cases chapter. After the data is validated successfully, WFM Adapter transforms it into the appropriate internal format and applies it to the DMZ system. The second level of the validation is performed on the CRS during the application of received data. All changes introduced to the CRS in the DMZ system are asynchronously replicated to the CRS in the CORE system.

Following figures show above described sequence of events:

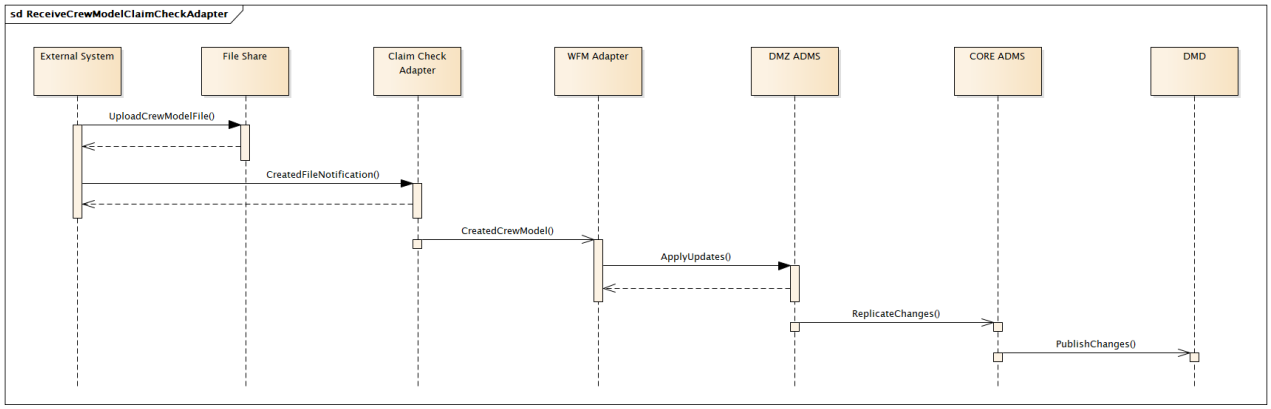

Figure 5.1 – WFM (crew) data import via Claim Check Adapter

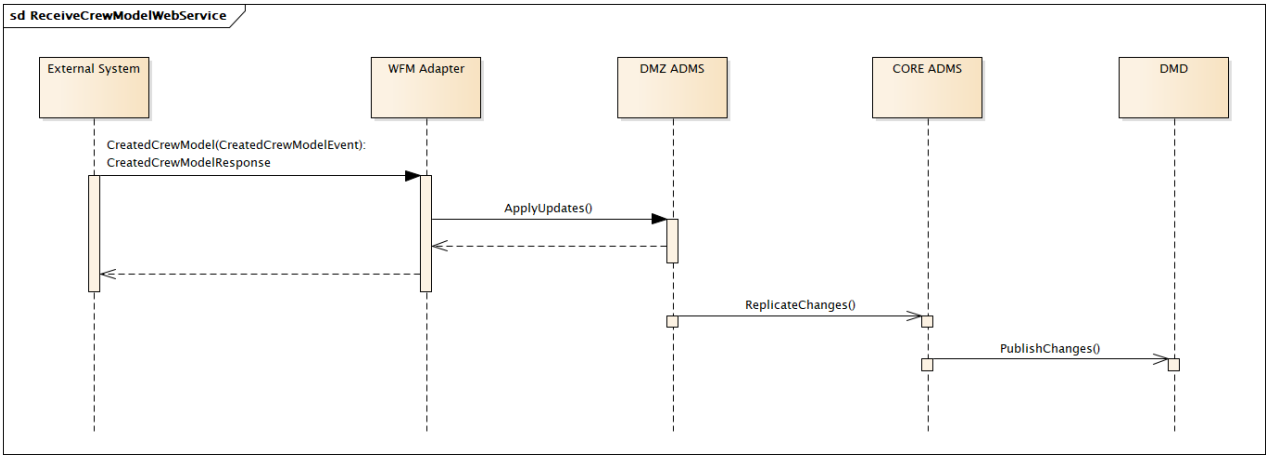

Figure 5.2 – WFM (crew) data import via WFM Adapter

5.1.2. Use Cases

The list of possible use cases and corresponding faults is given in Table 5.1.

Table 5.1 – CreatedCrewModel operation use cases

Use Case	Message Mapping			Action
	Property	Type	Value	
In situations when WFM (crew) data is delivered through FILE integration, behavior of the Claim Check adapter is described within corresponding functional specifications.				
Invalid Verb	Result	String	FAILED	The external system sends the request message with the invalid Verb. The response message is sent by the WFM Adapter with the FAILED result and the message is discarded.
	Error.code	String	2.9	
	Error.level	String	FATAL	
	Error.reason	String	InvalidVerb	
	Error.details	String	Invalid verb: {0}.	
Invalid Noun	Result	String	FAILED	The external system sends the request message with the invalid Noun. The response message is sent by the WFM Adapter with the FAILED result and the message is discarded.
	Error.code	String	2.5	
	Error.level	String	FATAL	
	Error.reason	String	InvalidNoun	
	Error.details	String	Invalid noun: {0}.	
Unable to process the request	Result	String	FAILED	The external system sends the request message, but for some reason the message processing fails due to the various internal server error. The fault response message is sent by the WFM Adapter.
	Error.code	String	5.3	
	Error.level	String	FATAL	
	Error.reason	String	InternalServerError	
	Error.details	String	{0}.	
Created CrewModel –	Result	String	OK	External system sends CreatedCrewModel message where update is attempted for all entities that are associated to a pre-configured organization (mRID). Crew model
	Error.code	String	N/A	

Use Case	Message Mapping			Action
	Property	Type	Value	
Crew model is successfully updated	Error.level	String	N/A	is aligned with the data from external (WFM) system. Crew model data that is associated to a different organization is left unchanged. Response message is sent by the WFM Adapter with OK result.
	Error.reason	String	N/A	
	Error.details	String	N/A	
Created CrewModel – Partial crew model update	Result	String	OK	Adapter is configured to import a subset of crew model elements via registry configuration file. External system sends CreatedCrewModel message with only those elements. Crew model for those elements is aligned with data from external (WFM) system. Crew model elements that are not the subject of alignment are left unchanged. Response message is sent by the WFM adapter with OK result.
	Error.code	String	N/A	
	Error.level	String	N/A	
	Error.reason	String	N/A	
	Error.details	String	N/A	
Created CrewModel – Duplicate mRIDs	Result	String	FAILED	The external system sends the CreatedCrewModel message where some WFM data entities (crews, members, organizations, vehicles, skills, licenses) have duplicate mRIDs. The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	DuplicateMrIds	
	Error.details	String	There are duplicate mRIDs in the message: {0}.	
Created CrewModel – Missing mRIDs	Result	String	FAILED	The external system sends the CreatedCrewModel message where some WFM data entities (crews, members, organizations, vehicles, skills, licenses) do not have mRID specified. The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	MissingMrIds	
	Error.details	String	{EntityType} mRID is missing.	
Created CrewModel – Duplicate names	Result	String	FAILED	The external system sends the CreatedCrewModel message where some WFM data entities (crews, members, organizations, vehicles) have duplicate names. The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	DuplicateNames	
	Error.details	String	There are duplicate names in the message: {0}.	

Use Case	Message Mapping			Action
	Property	Type	Value	
Created CrewModel – Missing names	Result	String	FAILED	The external system sends the CreatedCrewModel message where some WFM data entities (crews, members, organizations, vehicles) do not have name specified. The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	MissingNames	
	Error.details	String	{EntityType} name is missing.	
Created CrewModel – Invalid Crew mRID	Result	String	FAILED	The external system sends the CreatedCrewModel message where some WFM data entities (members, vehicles) have an association to an invalid crew (mRID). The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	InvalidCrewMRID	
	Error.details	String	Invalid member/vehicle crew mRID(s): {0} for entities: {1}.	
Created CrewModel – Invalid Organization mRID	Result	String	FAILED	The external system sends the CreatedCrewModel message where some WFM data entities (crews, members, vehicles) have an association to an invalid organization (mRID). The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	InvalidOrganisationMrId	
	Error.details	String	Invalid crew/member/vehicle organization mRID(s): {0} for entities: {1}.	
Created CrewModel – Invalid Organization name	Result	String	FAILED	The external system sends the CreatedCrewModel message where some WFM data entities (crews, members, vehicles) have an association to an invalid organization (name). The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	InvalidOrganisationName	
	Error.details	String	Invalid crew/member/vehicle organization name(s): {0} for entities: {1}.	
	Result	String	FAILED	

Use Case	Message Mapping			Action
	Property	Type	Value	
Created CrewModel – Non-unique Crew Member username	Error.code	String	2.7	The external system sends the CreatedCrewModel message where some crew members have the same username. The response message is sent by the WFM Adapter with the FAILED result.
	Error.level	String	FATAL	
	Error.reason	String	MemberUsernameIsNotUnique	
	Error.details	String	Username: {0} is not unique for crew members: {1}.	
Created CrewModel – Invalid Entity Type	Result	String	FAILED	The external system sends the CreatedCrewModel message where some WFM data entities (crews, members, vehicles) have an invalid type. The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	InvalidType	
	Error.details	String	Invalid crew/member/vehicle type: {0} for entities: {1}.	
Created CrewModel – Invalid Region	Result	String	FAILED	The external system sends the CreatedCrewModel message where some crews have an invalid region. The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	InvalidRegion	
	Error.details	String	Invalid crew region(s): {0} for entities: {1}.	
Created CrewModel – Invalid License Skill association	Result	String	FAILED	The external system sends the CreatedCrewModel message where licenses have an association to an invalid skill (mRID). The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	InvalidSkill	
	Error.details	String	Invalid license skill(s): {0} for entities: {1}.	
Created CrewModel – Invalid Member License association	Result	String	FAILED	The external system sends the CreatedCrewModel message where members have an association to an invalid license (mRID). The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	InvalidLicense	

Use Case	Message Mapping			Action
	Property	Type	Value	
	Error.details	String	Invalid member license(s): {0} for entities: {1}.	
Created CrewModel – Invalid Skill Hazard association	Result	String	FAILED	The external system sends the CreatedCrewModel message where skill have an association to an invalid hazard (mRID). The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	InvalidHazards	
	Error.details	String	Invalid skill hazard(s): {0} for entities: {1}.	
Created CrewModel – Invalid Vehicle Status	Result	String	FAILED	The external system sends the CreatedCrewModel message where several vehicles have an invalid status. The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	InvalidStatus	
	Error.details	String	Invalid vehicle status(s): {0} for entities: {1}.	
Created CrewModel – Member and Crew Company Mismatch	Result	String	FAILED	The external system sends the CreatedCrewModel message where several crews and corresponding members have different organization. The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	MemberAndCrewCompanyMismatch	
	Error.details	String	Invalid member organization MRID for entities: {0}. Member organization MRID must match its crew's organization MRID.	
Created CrewModel – Vehicle and Crew Company Mismatch	Result	String	FAILED	The external system sends the CreatedCrewModel message where several crews and corresponding vehicles have different organization. The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	VehicleAndCrewCompanyMismatch	

Use Case	Message Mapping			Action
	Property	Type	Value	
	Error.details	String	Invalid vehicle organization MRID for entities: {0}. Member organization MRID must match its crew's organization MRID.	
Created CrewModel – Skill Invalid Voltages	Result	String	FAILED	The external system sends the CreatedCrewModel message where skills have maximum voltage smaller than minimum voltage. The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	SkillInvalidVoltages	
	Error.details	String	Skill maximum voltage must be greater than minimum voltage. Affected skills: {0}.	
Created CrewModel – Crew has existing Assignment	Result	String	FAILED	The external system sends the CreatedCrewModel message where several crews, that are marked for deletion, are assigned to an entity (incident, switching plan, safety document, etc.). The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	CrewIsAssigned	
	Error.details	String	Could not perform crew model update. Crew's marked for deletion have assignments: {0}.	
Created CrewModel – Duplicate License mRIDs within Crew Member	Result	String	FAILED	The external system sends the CreatedCrewModel message where several crew members have duplicate license mRIDs. The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	DuplicateLicenseMrIdsWithinCrewMember	
	Error.details	String	Crew member(s): {0} cannot have duplicate license mRID(s).	
Created CrewModel – License is not Unique for Crew Member	Result	String	FAILED	The external system sends the CreatedCrewModel message where several crew members share the same license (mRID). The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	

Use Case	Message Mapping			Action
	Property	Type	Value	
	Error.reason	String	LicenseIsNotUniqueForMember	
	Error.details	String	License mRID: {0} is not unique for crew members: {1}	
Created CrewModel – License not Paired to a Crew Member	Result	String	FAILED	The external system sends the CreatedCrewModel message where there are licenses that are not assigned to any of the crew members. The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	LicenseNotPairedToMember	
	Error.details	String	License mRID(s): {0} is(are) not paired with any crew members.	
Created CrewModel – Update of not permitted entities	Result	String	FAILED	The external system sends the CreatedCrewModel message where update is attempted for entities that are assigned to an organization which is not configured (not permitted). The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	NotPermittedCrewModelUpdate	
	Error.details	String	Crew model update attempted for not permitted organization: {0} for entities {1}.	

6. RECEIVECREWASSIGNMENTS SERVICE

6.1. CreatedCrewAssignments Operation

6.1.1. Overview

When crew assignment needs to be done from the WFM or some other utility' system, the *ReceiveCrewAssignments* service offers mentioned functionality. Creation of crews' assignments to appropriate entities (incidents, switching plans, safety documents) is done through the *CreatedCrewAssignments* operation.

CreatedCrewAssignments operation is used only when external system keeps track of the newly created assignments, that is when *ChangedCrewAssignments* operation is used in incremental mode. In this case the *CreatedCrewAssignments* operation needs to be invoked only when new assignment for a certain crew is created (that is, when the crew is assigned to a new work).

The WFM Adapter performs initial validation of the received data, transforms it into the appropriate internal format and applies it to the DMZ system. The second level of the validation is performed on the CRS during the application of received data. All changes introduced to the CRS in the DMZ system are asynchronously replicated to the CRS in the CORE system.

Depending on the both stages of validation, the WFM Adapter returns the appropriate *CreatedCrewAssignmentsResponse* or *CreatedCrewAssignmentsFault* with the detailed explanation of the occurred error. Figure 6.1 provides the visual representation for the described sequence of events.

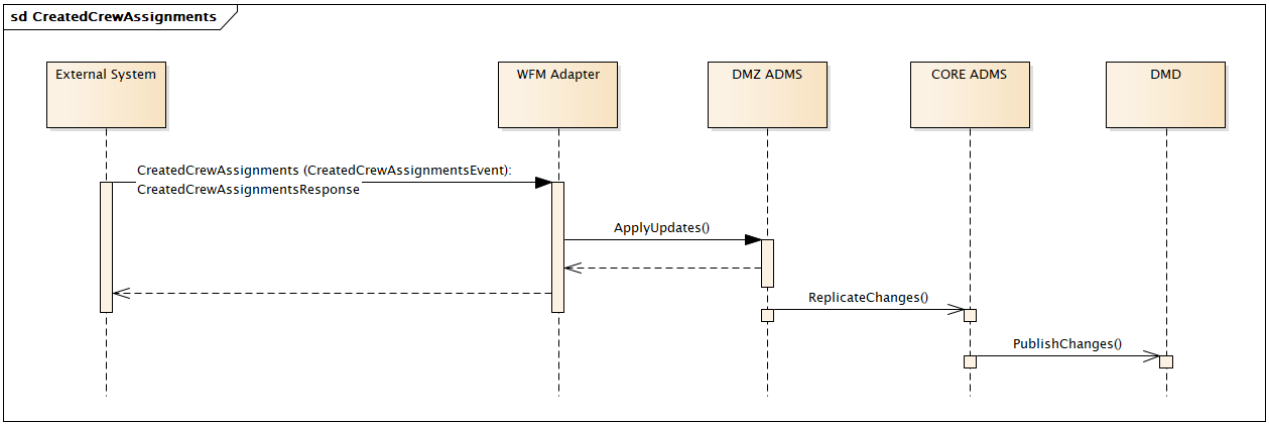

Figure 6.1 – The CreatedCrewAssignments operation execution

6.1.2. Use Cases

The list of use cases and corresponding faults is given in Table 6.1. Common use cases such as *Invalid Verb, Invalid Noun, Mandatory Element Missing, Non-active site fault* and *Unable to process the request* are described only in this table.

Table 6.1 – The CreatedCrewAssignments operation use cases

Use Case	Message Mapping			Action
	Property	Type	Value	
Invalid Verb	Result	String	FAILED	The external system sends the request message with the invalid Verb. The response message is sent by the WFM Adapter with the FAILED result and the message is discarded.
	Error.code	String	2.9	
	Error.level	String	FATAL	
	Error.reason	String	InvalidVerb	
	Error.details	String	Invalid verb: {0}.	
Invalid Noun	Result	String	FAILED	The external system sends the request message with the invalid Noun. The response message is sent by the WFM Adapter with the FAILED result and the message is discarded.
	Error.code	String	2.5	
	Error.level	String	FATAL	
	Error.reason	String	InvalidNoun	
	Error.details	String	Invalid noun: {0}.	
Mandatory Element Missing	Result	String	FAILED	The external system sends the request message in which some of the mandatory elements are missing. The response message is sent by the WFM Adapter with the FAILED result and the message is discarded.
	Error.code	String	1.8	
	Error.level	String	FATAL	
	Error.reason	String	InvalidMessage	
	Error.details	String	Received message is invalid against XSD schema. Reason: {0}.	
Unable to process the request	Result	String	FAILED	

Use Case	Message Mapping			Action
	Property	Type	Value	
	Error.code	String	5.3	The external system sends the request message, but for some reason the message processing fails due to the various internal server error. The fault response message is sent by the WFM Adapter.
	Error.level	String	FATAL	
	Error.reason	String	InternalServerError	
	Error.details	String	{0}.	
Created CrewAssignments – Message contains valid entity and Crew mRIDs	Result	String	OK	The external system sends the CreatedCrewAssignments message where all entity and crew mRIDs are valid. The crews are assigned to the appropriate entities (incidents, switching plans, safety documents) and all fields are updated (reason, timestamp, etc.). The response message is sent by the WFM Adapter with the OK result. NOTE: If the status of an incident, before the crews were assigned to it was New, the status is changed to the Dispatched, otherwise the status remains the same. Crews can be assigned to the Incident with the status: New, Dispatched, Field Completed.
	Error.code	String	N/A	
	Error.level	String	N/A	
	Error.reason	String	N/A	
	Error.details	String	N/A	
Created CrewAssignments – Message contains invalid entity mRIDs	Result	String	PARTIAL/FAILED	The external system sends the CreatedCrewAssignments message where several entities (incidents, switching plans, safety documents) have invalid mRIDs. Crews are assigned to the entities that have valid mRIDs. Otherwise, the appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	EntityNotFound	
	Error.details	String	Invalid entity mRID(s): {0}	
Created CrewAssignments – Message contains invalid Crew mRIDs	Result	String	PARTIAL/FAILED	The external system sends the CreatedCrewAssignments message where several crew mRIDs are invalid. The crews with valid mRIDs are assigned to the appropriate entities (incidents, switching plans, safety documents), while for the crews with invalid mRIDs, the appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	EntityNotFound	
	Error.details	String	Invalid crew mRID(s): {0}	
Created CrewAssignments – Message contains invalid Crew Assignment statuses	Result	String	PARTIAL/FAILED	The external system sends the CreatedCrewAssignments message where several crew assignment statuses are invalid by name (not existing). The crews with the valid assignment statuses are assigned to the appropriate entities, while for crews with the
	Error.code	String	2.7	
	Error.level	String	FATAL	

Use Case	Message Mapping			Action
	Property	Type	Value	
	Error.reason	String	InvalidAssignmentStatus	invalid assignment statuses, an appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.details	String	Invalid Assignment status {0} for entities: {1}.	
Created CrewAssignments – Message contains new Crew Assignment without status	Result	String	OK	The external system sends the CreatedCrewAssignments message where several crew assignment statuses are not specified. The crews with the valid assignment statuses are assigned to the appropriate incidents, while for crews for which assignment statuses are not specified, initial assignment status is used. The response message is sent by the WFM Adapter with the OK result.
	Error.code	String	2.7	
	Error.level	String	WARNING	
	Error.reason	String	AssignmentStatusMissing	
	Error.details	String	Status(es) element not found in message for entities: {0}.	
Created CrewAssignments – Message contains new Crew Assignment without timestamp	Result	String	OK	The external system sends the CreatedCrewAssignments message where several crew assignment statuses do not have timestamp specified. The crews that contain timestamp are assigned to the appropriate entities (incidents, switching plans, safety documents). For the crews where assignment statuses do not have timestamp specified, time when message is received is used. The response message is sent by the WFM Adapter with the OK result.
	Error.code	String	2.7	
	Error.level	String	WARNING	
	Error.reason	String	AssignmentTimeStampIsNotProvided	
	Error.details	String	TimeStamp from request is not provided for crew assignment: {0}.	
Created CrewAssignments – Message contains new Crew Assignment with status other than initial	Result	String	OK	The external system sends the CreatedCrewAssignments message where several crews have new assignments which status is different from initial (Assigned). The crews with the valid assignment statuses are assigned to the appropriate entities (incidents, switching plans, safety documents), while for crews with assignments which statuses are different from the initial one, the assignment status is defaulted to initial (Assigned). The response message is sent by the WFM Adapter with the OK result.
	Error.code	String	2.7	
	Error.level	String	INFORM	
	Error.reason	String	StatusDefaulted	
	Error.details	String	Assignment: {0} status defaulted to initial.	
Created CrewAssignments – Duplicate Crew mRIDs	Result	String	PARTIAL/FAILED	The external system sends the CreatedCrewAssignments message where there are duplicate crew mRIDs. The crews with valid mRIDs are assigned to the appropriate incidents, while for crews with duplicate mRIDs, the appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	DuplicateCrewMrIds	

Use Case	Message Mapping			Action
	Property	Type	Value	
	Error.details	String	Duplicate crew mRID(s) {0}.	
Created CrewAssignments – Duplicate entity mRIDs	Result	String	PARTIAL/FAILED	The external system sends the CreatedCrewAssignments message where there are duplicate entity mRIDs for one crew. Crews are assigned to entities that do not have invalid (duplicate) mRID(s). Otherwise, the appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	DuplicateCrewAssignmentMrIds	
	Error.details	String	Duplicate assignment mRID(s) {0}.	
Created CrewAssignments – Multiple Leading Crews	Result	String	PARTIAL/FAILED	The external system sends the CreatedCrewAssignments message where there are multiple leading crews for one entity. Valid assignments are processed, while for invalid ones the appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	MultipleLeadingCrews	
	Error.details	String	Entity {0} has {1} leading crews assigned to it.	

6.2. ChangedCrewAssignments Operation

6.2.1. Overview

As stated above, *ChangedCrewAssignments* operation can be used in two modes:

- Incremental mode – is used when external system takes care of the creation and deletion of crew assignments. Whenever the crew is assigned to the new work, *CreatedCrewAssignments* operation is invoked. *DeletedCrewAssignments* operation is invoked when certain crew is deleted from the existing assignment, while *ChangedCrewAssignments* operation is used to update existing crew assignments.
- Bulk mode – is used when external system doesn't take care about created and deleted crew assignments. In that case, external system should publish data only for the crews whose assignments have changed. However, all assignments for that crew need to be specified within the request message since the logic for incremental data update is implemented on the EcoStruxure GridOps side (WFM Adapter):
    - If the crew was not assigned to the entity, the new assignment will be created with status provided in the request.
    - If the crew was assigned to an entity and received within the request message, its status will be updated, if there was a change.
    - If the crew was assigned to the entity and assignment (the crew-entity association) was not received within the request message, the same crew will be removed from the entity.

Since crew assignment management can differ from utility to utility, depending on the defined business process, WFM Adapter provides capability to configure certain entity types (incidents, switching plans, safety documents, etc.) for which assignments can be updated from external system. Next to the assignment update, crews can also update timestamp when the change occurred in the field, along with appropriate reason.

Regardless of the operating mode, when request message is received, the WFM Adapter performs initial validation of the received data, transforms it into the appropriate internal format and applies it to the DMZ system. The second level of the validation is performed on the CRS during the application of received data. All changes introduced to the CRS in the DMZ system are asynchronously replicated to the CRS in the CORE system.

Depending on the both stages of validation, the WFM Adapter returns the appropriate *ChangedCrewAssignmentsResponse* or *ChangedCrewAssignmentsFault* with the detailed explanation of the occurred error. Figure 6.2 provides the visual representation for the described sequence of events.

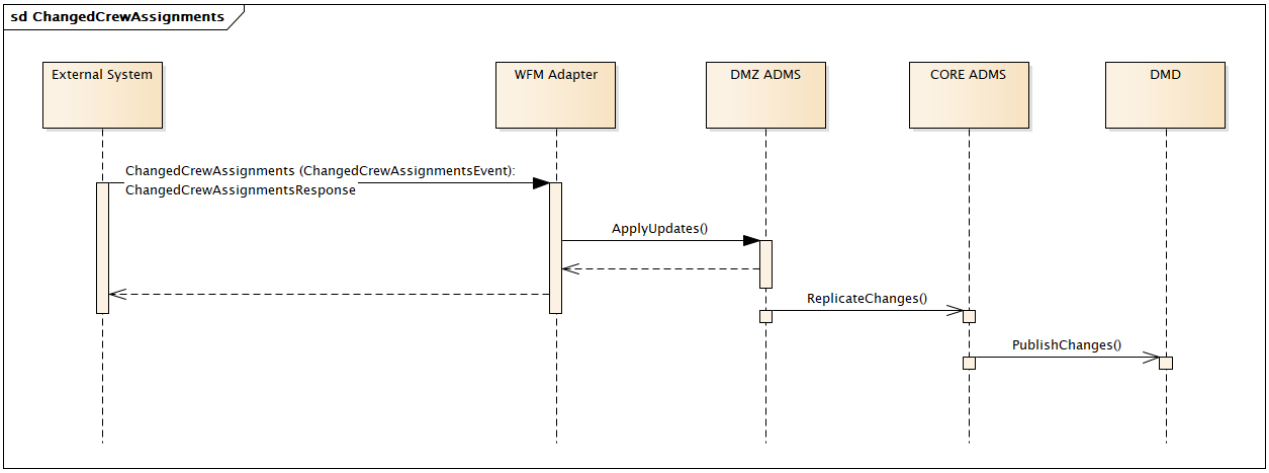

Figure 6.2 – The ChangedCrewAssignments operation execution

6.2.2. Use Cases

Common use cases for all three operations such as *Invalid Verb, Invalid Noun, Mandatory Element Missing, Non-active site fault* and *Unable to process the request* are described in Table 6.2.

6.2.2.1. Incremental Mode

Table 6.2 provides the list of use cases when *ChangedCrewAssignments* operation is used in incremental mode.

Table 6.2 – The ChangedCrewAssignments operation use cases – incremental mode

Use Case	Message Mapping			Action
	Property	Type	Value	
Changed CrewAssignments – Crew rejects assignment	Result	String	OK	The external system sends the ChangedCrewAssignments message where crew rejects certain assignment. Appropriate field is updated with provided reason why the assignment was rejected. The response message is sent by the WFM Adapter with the OK result.
	Error.code	String	N/A	
	Error.level	String	N/A	
	Error.reason	String	N/A	
	Error.details	String	N/A	
Changed CrewAssignments – Invalid Context	Result	String	FAILED	The external system sends the ChangedCrewAssignments message with invalid context value. Message is discarded and the response message is sent by the WFM Adapter with the FAILED result. Note: Valid values for context are defined in adapter registry configuration file and their values are: Incremental and Bulk. This use case is common for Incremental and Bulk mode
	Error.code	String	2.5	
	Error.level	String	FATAL	
	Error.reason	String	InvalidContex	
	Error.details	String	Invalid context: {0}	
Changed CrewAssignments – Crew updates assignment for preconfigured entity type	Result	String	OK	The external system sends the ChangedCrewAssignments message where crew updates an assignment for preconfigured entity type (e.g only incident). The response message is sent by the WFM Adapter with the OK result.
	Error.code	String	N/A	
	Error.level	String	N/A	
	Error.reason	String	N/A	

Use Case	Message Mapping			Action
	Property	Type	Value	
	Error.details	String	N/A	
Changed CrewAssignments – Crew rejects assignment without reason specified	Result	String	OK	The external system sends the ChangedCrewAssignments message where crew rejects certain assignment but without speficied reason. Crew assignment is updated, but reason field is not populated. The response message is sent by the WFM Adapter with the OK result.
	Error.code	String	2.7	
	Error.level	String	INFORM	
	Error.reason	String	StatusReasonIsNotProvided	
	Error.details	String	Assignment status reason is not provided for crews {0}.	
Changed CrewAssignments – Message contains invalid entity mRIDs	Result	String	PARTIAL/FAILED	The external system sends the ChangedCrewAssignments message where several entities (incidents, switching plans, safety documents) have invalid mRIDs. Crews' assignments with valid entity's mRIDs are updated. Otherwise, the appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	EntityNotFound	
	Error.details	String	Invalid entity mRID(s): {0}	
Changed CrewAssignments – Message contains invalid Crew mRIDs	Result	String	PARTIAL/FAILED	The external system sends the ChangedCrewAssignments message where several crew mRIDs are invalid. The crews' assignments with valid mRIDs are updated, while for the crews with invalid mRIDs, the appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	EntityNotFound	
	Error.details	String	Invalid crew mRID(s): {0}	
Changed CrewAssignments – Message contains invalid Crew Assignment statuses	Result	String	PARTIAL/FAILED	The external system sends the ChangedCrewAssignments message where several crew assignment statuses that are invalid. The crews' assignments with valid statuses are updated. Otherwise, an appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	InvalidAssignmentStatus	
	Error.details	String	Invalid Assignment status {0} for entities: {1}.	
Changed CrewAssignments –	Result	String	OK	

Use Case	Message Mapping			Action
	Property	Type	Value	
Message contains Crew Assignment without timestamp	Error.code	String	2.7	The external system sends the ChangedCrewAssignments message where several crews' assignments do not have a timestamp specified. For the crews' assignments with timestamp, value from the message is used. For the crews for which assignment statuses do not have timestamp specified, time when message is received is used. The response message is sent by the WFM Adapter with the OK result.
	Error.level	String	WARNING	
	Error.reason	String	AssignmentTimeStampIsNotProvided	
	Error.details	String	TimeStamp from request is not provided for crew assignment: {0}.	
Changed CrewAssignments – Message contains Crew Assignment with timestamp older than last update time	Result	String	PARTIAL/FAILED	The external system sends the ChangedCrewAssignments message where several crew assignment statuses have timestamp older than last update time. The assignment statuses with valid timestamps are updated. While for crews for which assignment statuses timestamp is older than last update time, appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	TimeStampLessThanLastUpdateTime	
	Error.details	String	Timestamp from request is lesser than last updated time for crew(s): {0} for entities: {1}.	
Changed CrewAssignments – Message contains Crew Assignment statuses with "On Site" semantics	Result	String	PARTIAL/FAILED	The external system sends the ChangedCrewAssignments message where there are several crew assignments with "On Site" semantics. Crew assignments with valid data are processed, while for crews with duplicate "On Site" semantics appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	DuplicatedOnSiteSemantics	
	Error.details	String	Multiple crew assignments: {0}, {1} with 'OnSite' assignment status semantic.	
Changed CrewAssignments – Duplicate Crew mRIDs	Result	String	PARTIAL/FAILED	The external system sends the ChangedCrewAssignments message where there are duplicate crew mRIDs. The crews with valid mRIDs are assigned to the appropriate incidents, while for crews with duplicate mRIDs, the appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	DuplicateCrewMrIds	
	Error.details	String	Duplicate crew mRID(s) {0}.	
Changed CrewAssignments –	Result	String	PARTIAL/FAILED	

Use Case	Message Mapping			Action
	Property	Type	Value	
Duplicate entity mRIDs	Error.code	String	2.7	The external system sends the ChangedCrewAssignments message where there are duplicate entity mRIDs for one crew. Crews are assigned to entities that do not have invalid mRID(s). Otherwise, the appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.level	String	FATAL	
	Error.reason	String	DuplicateCrewAssignmentMrIds	
	Error.details	String	Duplicate assignment mRID(s) {0}.	
Changed CrewAssignments – Invalid Assignment Status Transition	Result	String	PARTIAL/FAILED	The external system sends the ChangedCrewAssignments message where several assignments have invalid status transition. For assignments that have valid status transition data is updated. Otherwise, appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result. Note: Status transition is configurable per project requirements. Additionally, request for status transition to the same status will be interpreted as valid.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	InvalidAssignmentStatusTransition	
	Error.details	String	Assignment: {0} status transition to state: {1} is not allowed.	

6.2.2.2. Bulk Mode

Following table provides the list of use cases when *ChangedCrewAssignments* operation is used in bulk mode.

Table 6.3 – The ChangedCrewAssignments operation use cases – bulk mode

Use Case	Message Mapping			Action
	Property	Type	Value	
Changed CrewAssignments – Message contains valid entity and Crew mRIDs	Result	String	OK	The external system sends the ChangedCrewAssignments message where all entity and crew mRIDs are valid. The crews are assigned to the appropriate entities (incidents, switching plans, safety documents) and all fields are updated (reason, timestamp, etc.). The response message is sent by the WFM Adapter with the OK result. NOTE: If the status of an incident, before the crews were assigned to it was New, the status is changed to the Dispatched, otherwise the status remains the same. Crews can be assigned to the Incident with the status: New, Dispatched, Field Completed, Closed
	Error.code	String	N/A	
	Error.level	String	N/A	
	Error.reason	String	N/A	
	Error.details	String	N/A	
Changed CrewAssignments – Crew rejects assignment	Result	String	OK	The external system sends the ChangedCrewAssignments message where crew rejects certain assignment. Appropriate field is updated with provided reason why the assignment was rejected. The response message is sent by the WFM Adapter with the OK result.
	Error.code	String	N/A	
	Error.level	String	N/A	
	Error.reason	String	N/A	
	Error.details	String	N/A	
Changed CrewAssignments – Crew rejects assignment without reason specified	Result	String	OK	The external system sends the ChangedCrewAssignments message where crew rejects certain assignment but without speficied reason. Crew assignment is updated, but reason field is not populated. The response message is sent by the WFM Adapter with the OK result.
	Error.code	String	2.7	
	Error.level	String	INFORM	
	Error.reason	String	StatusReasonIsNotProvided	
	Error.details	String	Assignment status reason is not provided for crews {0}.	
Changed CrewAssignments –	Result	String	PARTIAL/FAILED	The external system sends the ChangedCrewAssignments message where several entities (incidents, switching plans, safety documents) have invalid mRIDs. Crews are
	Error.code	String	2.7	

Use Case	Message Mapping			Action
	Property	Type	Value	
Message contains invalid entity mRIDs	Error.level	String	FATAL	assigned to the entities that have valid mRIDs. Otherwise, the appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.reason	String	EntityNotFound	
	Error.details	String	Invalid entity mRID(s): {0}	
Changed CrewAssignments – Message contains invalid Crew mRIDs	Result	String	PARTIAL/FAILED	The external system sends the ChangedCrewAssignments message where several crew mRIDs are invalid. The crews with valid mRIDs are assigned to the appropriate entities (incidents, switching plans, safety documents), while for the crews with invalid mRIDs, the appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	EntityNotFound	
	Error.details	String	Invalid crew mRID(s): {0}	
Changed CrewAssignments – Message contains invalid Crew Assignment statuses	Result	String	PARTIAL/FAILED	The external system sends the ChangedCrewAssignments message where several crew assignment statuses that are invalid by name. The crews with the valid assignment statuses are assigned to the appropriate entities, while for crews with the invalid assignment statuses, an appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	InvalidAssignmentStatus	
	Error.details	String	Invalid Assignment status {0} for entities: {1}.	
Changed CrewAssignments – Message contains new Crew Assignment without status	Result	String	PARTIAL/FAILED	The external system sends the ChangedCrewAssignments message where several crew assignment statuses are not specified. The crews with the valid assignment statuses are assigned to the appropriate entities, while for the crews for which assignment statuses are not specified, assignments are discarded. The response message is sent by the WFM Adapter with the OK result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	AssignmentStatusMissing	
	Error.details	String	Status(es) element not found in message for entities: {0}.	
Changed CrewAssignments – Message contains new Crew Assignment without timestamp	Result	String	OK	The external system sends the ChangedCrewAssignments message where several crew assignment statuses do not have timestamp specified. The crews with the valid assignment statuses are assigned to the appropriate entities (incidents, switching plans, safety documents), while for the crews for which assignment statuses do not have
	Error.code	String	2.7	
	Error.level	String	WARNING	
	Error.reason	String	AssignmentTimeStampIsNotProvided	

Use Case	Message Mapping			Action
	Property	Type	Value	
	Error.details	String	TimeStamp from request is not provided for crew assignment: {0}.	timestamp specified, time when message is received is used. The response message is sent by the WFM Adapter with the OK result.
Changed CrewAssignments – Message contains Crew Assignment statuses with “On Site” semantics	Result	String	PARTIAL/FAILED	The external system sends the ChangedCrewAssignments message where there are several crew assignments with “On Site” semantics. Crew assignments with valid data are processed, while for crews with duplicate “On Site” semantics appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	DuplicatedOnSiteSemantics	
	Error.details	String	Multiple crew assignments: {0}, {1} with 'OnSite' assignment status semantic.	
Changed CrewAssignments – Duplicate Crew mRIDs	Result	String	PARTIAL/FAILED	The external system sends the ChangedCrewAssignments message where there are duplicate crew mRIDs. The crews with valid mRIDs are assigned to the appropriate incidents, while for crews with duplicate mRIDs, the appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	DuplicateCrewMrIds	
	Error.details	String	Duplicate crew mRID(s) {0}.	
Changed CrewAssignments – Duplicate entity mRIDs	Result	String	PARTIAL/FAILED	The external system sends the ChangedCrewAssignments message where there are duplicate entity mRIDs for one crew. Crews are assigned to entities that do not have invalid mRID(s). Otherwise, the appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	DuplicateCrewAssignmentMrIds	
	Error.details	String	Duplicate assignment mRID(s) {0}.	

6.3. DeletedCrewAssignments Operation

6.3.1. Overview

DeletedCrewAssignments operation is used when crew needs to be de-assigned from the existing assignment. *DeletedCrewAssignments* operation is used only when external system keeps track of the newly created/deleted assignments, that is when *ChangedCrewAssignments* operation is used in incremental mode.

The WFM Adapter performs initial validation of the received data, transforms it into the appropriate internal format and applies it to the DMZ system. The second level of the validation is performed on the CRS during the application of received data. All changes introduced to the CRS in the DMZ system are asynchronously replicated to the CRS in the CORE system.

Depending on the both stages of validation, the WFM Adapter returns the appropriate *DeletedCrewAssignmentsResponse* or *DeletedCrewAssignmentsFault* with the detailed explanation of the occurred error. Figure 6.3 provides the visual representation for the described sequence of events.

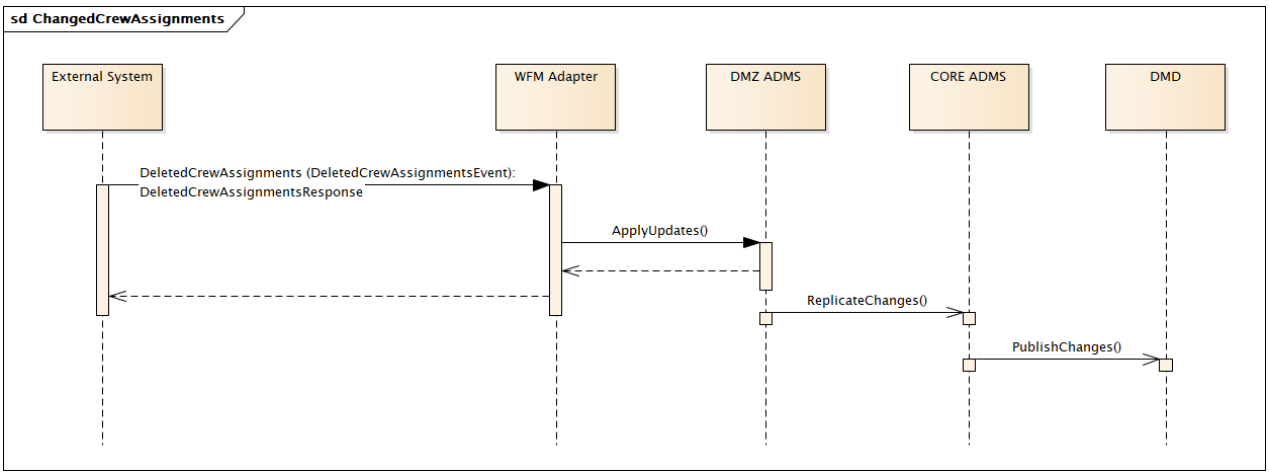

Figure 6.3 – The DeletedCrewAssignments operation execution

6.3.2. Use Cases

The list of common use cases and corresponding faults is given in Table 6.4. Common use cases such as *Invalid Verb, Invalid Noun, Element not found in message, Unsupported message revision in Header, Mandatory Element Missing, Non-active site fault* and *Unable to process the request* are described only in this table.

Table 6.4 – The DeletedCrewAssignments operation use cases

Use Case	Message Mapping			Action
	Property	Type	Value	
Deleted CrewAssignments – Message contains valid entity and Crew mRIDs	Result	String	OK	The external system sends the DeletedCrewAssignments message where all entity and crew mRIDs are valid. The crews are de-assigned from the appropriate entities (incidents, switching plans, safety documents) and all fields are updated (reason, timestamp, etc.). The response message is sent by the WFM Adapter with the OK result.
	Error.code	String	N/A	
	Error.level	String	N/A	
	Error.reason	String	N/A	
	Error.details	String	N/A	
Deleted CrewAssignments – Message contains invalid entity mRIDs	Result	String	PARTIAL/FAILED	The external system sends the DeletedCrewAssignments message where several entities (incidents, switching plans, safety documents) have invalid mRIDs. Crews are de-assigned from the entities that have valid mRIDs. Otherwise, the appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	EntityNotFound	
	Error.details	String	Invalid entity mRID(s): {0}	
Deleted CrewAssignments – Message contains invalid Crew mRIDs	Result	String	PARTIAL/FAILED	The external system sends the DeletedCrewAssignments message where several crew mRIDs are invalid. The crews with valid mRIDs are de-assigned from the appropriate entities (incidents, switching plans, safety documents), while for the crews with invalid mRIDs, the appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	EntityNotFound	
	Error.details	String	Invalid crew mRID(s): {0}	
Deleted CrewAssignments – Duplicate Crew mRIDs	Result	String	PARTIAL/FAILED	The external system sends the DeletedCrewAssignments message where there are duplicate crew mRIDs. The crews with valid mRIDs are assigned to the appropriate
	Error.code	String	2.7	

Use Case	Message Mapping			Action
	Property	Type	Value	
	Error.level	String	FATAL	incidents, while for crews with duplicate mRIDs, the appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.reason	String	DuplicateCrewMrIds	
	Error.details	String	Duplicate crew mRID(s) {0}.	
Deleted CrewAssignments – Crew is not assigned to entity mRIDs	Result	String	PARTIAL/FAILED	The external system sends the DeletedCrewAssignments message where several crews are not assigned to entities (incidents, switching plans, safety documents) provided in message. Crews are de-assigned from the entities that are valid. Otherwise, the appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	AssignmentDoesNotExist	
	Error.details	String	Assignment(s) {0} does not exist in ADMS.	
Deleted CrewAssignments – Duplicate entity mRIDs	Result	String	PARTIAL/FAILED	The external system sends the DeletedCrewAssignments message where there are duplicate entity mRIDs for one crew. Crews are assigned to entities that do not have invalid mRID(s). Otherwise, the appropriate error is returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	DuplicateCrewAssignmentMrIds	
	Error.details	String	Duplicate assignment mRID(s) {0}.	

7. RECEIVECREWS SERVICE

7.1. Changed Crews Operation

7.1.1. Overview

Due to various needs and communication problems, crews have a need to update its availability and connection status information in EcoStruxure GridOps. Such functionality is exposed through *ReceiveCrews* service which is exposed within WFM Adapter.

Update of crew availability and connection status information is performed through *ChangedCrews* operation and *ChangedCrewsEvent* object. After the request data is received, the WFM Adapter performs initial validation, transforms it into the internal format and applies it to the DMZ system. The second level of validation is performed on the CRS during the data update process. All changes introduced to the CRS in DMZ are asynchronously replicated to the IMS in the CORE system. After the replication process is finished, crew model changes are published and visible in the DMD application in the CORE system.

Figure 7.1 provides the visual representation of the described process.

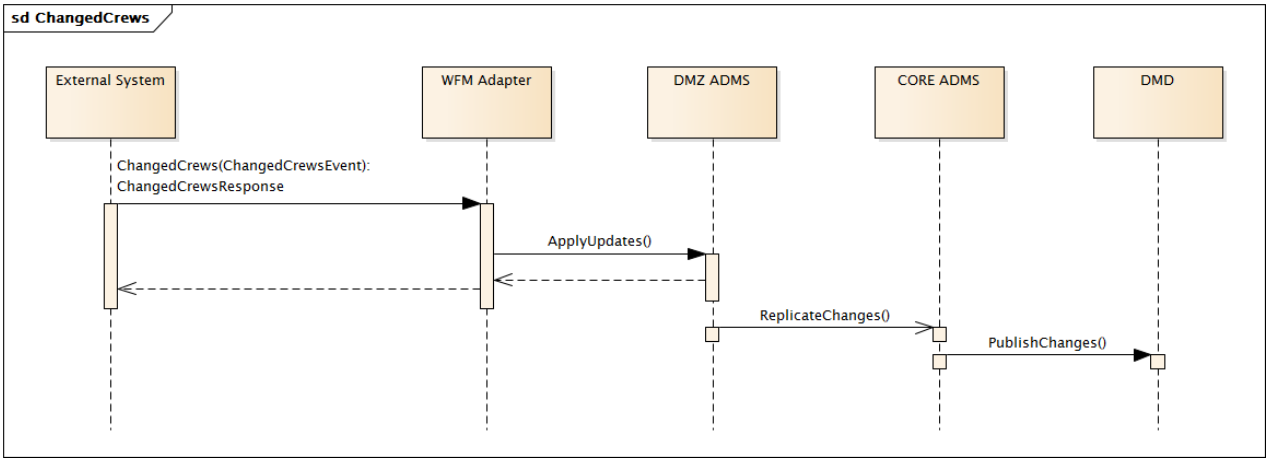

Figure 7.1 – The ChangedCrews operation execution

Depending on the both stages of validation, the WFM Adapter returns the appropriate *ChangedCrewsResponse* or *ChangedCrewsFault* with the detailed explanation of the occurred error.

7.1.2. Use Cases

Table 7.1 – The ChangedCrews operation use case

Use Case	Message Mapping			Action
	Property	Type	Value	
ChangedCrews – Message contains valid crew mRIDs	Result	String	OK	External system sends ChangedCrews message where all have valid mRIDs. Crew data (availability and field client connection status) are updated successfully. Response message is sent by WFM Adapter with OK result.
	Error.code	String	N/A	
	Error.level	String	N/A	
	Error.reason	String	N/A	
	Error.details	String	N/A	
ChangedCrews – Message contains invalid crew mRIDs	Result	String	PARTIAL/FAILED	The external system sends the ChangedCrews message where some crews have invalid mRIDs. For valid crews data are updated, while for the invalid ones the appropriate errors are returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	EntityNotFound	
	Error.details	String	Invalid crew mRID(s): {0}	
ChangedCrews – Message contains duplicate crew mRIDs	Result	String	PARTIAL/FAILED	The external system sends the ChangedCrews message that contains several duplicate crew mRIDs. For valid crews data are updated, while for the invalid (duplicate) ones, the appropriate errors are returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	DuplicateMRIDs	
	Error.details	String	Duplicate crew mRID(s) {0}.	
Unable to process request	Result	String	PARTIAL/FAILED	External system sends ChangedCrews message where all have valid mRIDs. At the time the request arrives to the adapter component, dependent services are unavailable. Error message is logged and system event is created. The response message is sent by the WFM Adapter with the FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	InternalServerError	
	Error.details	String	InternalServerError {0}.	

8. RECEIVE VEHICLE SERVICE

8.1. ChangedVehicles Operation

8.1.1. Overview

In order to maintain the correlation between vehicles and radio ID, *ReceiveVehicles* service is exposed within the WFM Adapter. Such correlation is updated through *ChangedVehicles* web service operation.

When vehicle-radio associations need to be updated, an external system creates the *ChangedVehiclesEvent* object and invokes the appropriate operation. The WFM Adapter performs initial validation of the received data, transforms it into the internal format and applies it to the DMZ system. The second level of validation is performed on the CRS during the data update process. All changes introduced to the CRS in DMZ are asynchronously replicated to the CRS in the CORE system.

Figure 8.1 provides the visual representation of the described process.

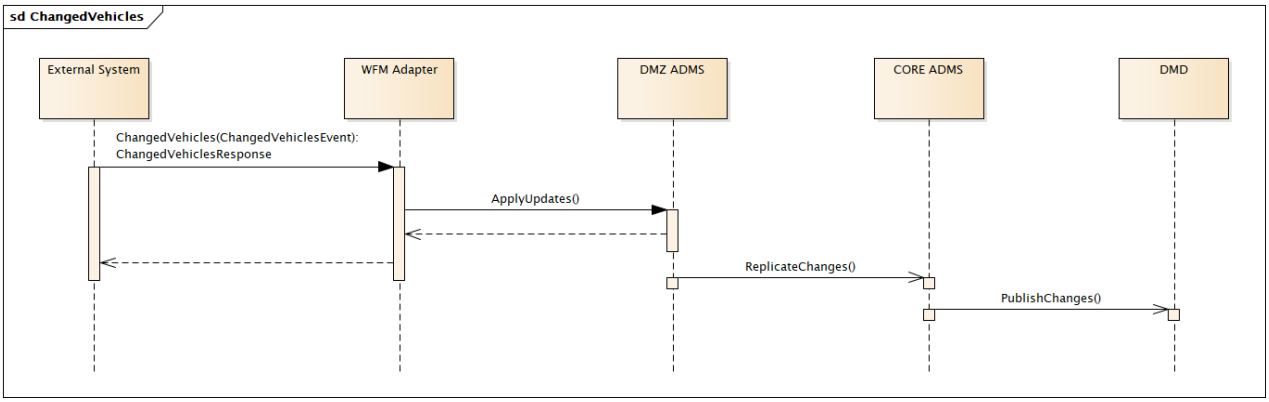

Figure 8.1 – The ChangedVehicles operation execution

Depending on the both stages of validation, the WFM Adapter returns the appropriate *ChangedVehiclesResponse* or *ChangedVehiclesFault* with the detailed explanation of the occurred error.

8.1.2. Use Cases

The list of use cases and corresponding faults is given in Table 8.1.

Table 8.1 – The ChangedVehicles operation use cases

Use Case	Message Mapping			Action
	Property	Type	Value	
ChangedVehicles – Message contains valid vehicle mRIDs and valid crew identifiers and radio identifiers	Result	String	OK	External system sends ChangedVehicles message where all vehicles have valid mRIDs and valid crew identifiers. Vehicle radioID and crew references are updated. Response message is sent by WFM Adapter with OK result.
	Error.code	String	N/A	
	Error.level	String	N/A	
	Error.reason	String	N/A	
	Error.details	String	N/A	
ChangedVehicles – Message contains invalid vehicle mRIDs	Result	String	PARTIAL/FAILED	The external system sends the ChangedVehicles message where some vehicles have invalid mRIDs. The radio IDs are updated for vehicles with valid mRIDs, while for the invalid ones the appropriate errors are returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	EntityNotFound	
	Error.details	String	Invalid vehicle mRID(s): {0}	
ChangedVehicles – Vehicle mRID(s) Missing	Result	String	PARTIAL/FAILED	The external system sends the ChangedVehicles message where some vehicles do not have mRID specified. The radio IDs are updated for vehicles with valid mRIDs, while for the invalid ones the appropriate errors are returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	MrIdNotProvided	
	Error.details	String	Vehicle MrID is not specified.	
ChangedVehicles – Message contains duplicate vehicle mRIDs	Result	String	PARTIAL/FAILED	The external system sends the ChangedVehicles message that contains several duplicate vehicles mRIDs. The radio IDs are updated for vehicles with valid mRIDs, while for the
	Error.code	String	2.7	
	Error.level	String	FATAL	

Use Case	Message Mapping			Action
	Property	Type	Value	
	Error.reason	String	DuplicateMRIDs	invalid (duplicate) ones, the appropriate errors are returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result.
	Error.details	String	Duplicate vehicle mRID(s) {0}.	
ChangedVehicles – Both RadioId and crew identifier are not provided	Result	String	PARTIAL/FAILED	The external system sends the ChangedVehicles message where RadioId and crew identifier are not provided for several vehicles. The radio IDs and crew references are updated for vehicles with valid data, while for the invalid (missing) ones, the appropriate errors are returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result
	Error.code	String	2.7	
	Error.level	String	FATAL	
	Error.reason	String	NoAttributeProvided	
	Error.details	String	No attribute for update provided for vehicles mRID(s): {0}	
ChangedVehicles – Request Message Contains Valid Vehicle mRIDs, radioIds and Empty String for crew identifier	Result	String	OK	External system sends ChangedVehicles message where all vehicles have valid mRIDs and empty string for crew identifiers. The radioIds are updated. Crew references are removed. Response message is sent by WFM Adapter with OK result.
	Error.code	String	N/A	
	Error.level	String	N/A	
	Error.reason	String	N/A	
	Error.details	String	N/A	
ChangedVehicles – Request Message Contains Valid Vehicle mRIDs radioIDs and does not have crew reference tag	Result	String	OK	External system sends ChangedVehicles message where all vehicles have valid mRIDs and do not have crew reference tag. The radioIds are updated. Crew references are not changed. Response message is sent by WFM Adapter with OK result.
	Error.code	String	N/A	
	Error.level	String	N/A	
	Error.reason	String	N/A	
	Error.details	String	N/A	
ChangedVehicles – Message contains valid vehicle mRIDs and valid crew identifiers and does not contain radio identifiers	Result	String	OK	External system sends ChangedVehicles message where all vehicles have valid mRIDs and do not have crew reference tag. Vehicle radioIds are not updated and crew references are updated. Response message is sent by WFM Adapter with OK result.
	Error.code	String	N/A	
	Error.level	String	N/A	
	Error.reason	String	N/A	
	Error.details	String	N/A	

Use Case	Message Mapping			Action
	Property	Type	Value	
ChangedVehicles – Crew and vehicle do not belong to the same company	Result	String	PARTIAL/FAILED	The external system sends the ChangedVehicles message where crew and vehicle do not belong to the same company for several vehicles. The radio IDs and crew references are updated for vehicles with valid data, while for the invalid ones, the appropriate errors are returned. The response message is sent by the WFM Adapter with the PARTIAL/FAILED result
	Error.code	String	2.7	
	Error.level	String	WARNNING	
	Error.reason	String	CompanyMismatch	
	Error.details	String	Crew {0} and vehicle {1} do not belong to the same company.	

9. MESSAGES

All messages that are exchanged in aforementioned service operations are defined according to the latest IEC standards – series of 61970 and 61968.

Note* Following chapters contain tables describing the message attributes. It is important to state that bolded attributes are considered mandatory for that specific service operation. Messages that do not comply with that rule will not be processed.

9.1. Common

9.1.1. Header

The header section is defined according to the IEC 61968-100. Currently, there are two required fields that must be populated:

- ***Verb*** – to identify a specific action to be taken. There is an enumerated set of valid verbs, where commonly used values include “get”, “create”, “change”, “cancel”, “close”, “execute” and “reply”. Within the event notification messages “past tense” verbs are used, which can include “created”, “changed”, “canceled”, “closed” and “executed”. Implementations should treat deprecated verbs “update” and “updated” as synonyms to “change” and “changed”. Each service operation has a dedicated verb for incoming and outgoing messages. The concrete verb value is defined in following chapters that describe message attributes.
- ***Noun*** – to identify the subject of the action and/or the type of the payload, such as the CrewAssignments, Vehicles, etc. Each service operation is defined by a concrete *Noun* value. It is defined in the following chapters which describe message attributes.

The field that can be optionally supplied includes the following:

- Revision – to indicate the revision of the message definition. By default, this should be “1”.
- ReplayDetection – this is a complex element with a timestamp and a nonce used to guard against replay attacks. The timestamp is generated by the source system to indicate when the message was created. The nonce is a sequence number or randomly generated string (e.g. UUID) that would not be repeated by the source system for at least a day. This serves to improve encryption.
- ***Context*** – a string that can be used to identify the context of the message. This can help provide an application level guard against incorrect message consumption in configurations where there may be multiple system environments running over the same messaging infrastructure. Some example values are PRODUCTION, TESTING, STUDY and TRAINING. In WFM adapter scope, context plays a big role in ChangedCrewAssignments operation, since its value distinguishes integrity update from incremental operations. Supported context values for specific service operations are located in the following chapters.

- Timestamp – an ISO 8601 compliant string that identifies the time the message was sent. This is analogous to the JMSTimestamp provided by JMS. Either Zulu ('Z') time or time with a time zone offset may be used.
- Source – identifying the source of the message, which should be the name of the system or organization.
- AsyncReplyFlag – the Boolean data type ("true" or "false" values) that indicates whether a reply message will be sent asynchronously. By default, replies are assumed to be sent synchronously.
- ReplyAddress – the address to which replies should be sent. This is typically used for asynchronous replies. This should take the form of a URL, topic name or queue name. This is analogous to the JMSReplyTo field provided by JMS. This is ignored when using unidirectional integration patterns (e.g., AckRequired=false). If the reply address is a topic, the topic name should be prefixed by "topic". If the reply address is a queue, the queue name should be prefixed by "queue". If the reply address is a web service, the reply address should be a URL beginning with "http://" or "https:/".
- AckRequired – the Boolean data type ("true" or "false" values) that indicates whether an acknowledgement is required. If false, this would indicate that a unidirectional integration pattern is being used for communicating transactional messages.
- User – a complex structure that identifies the user and associated organization. Should be supplied as it may be required for some interfaces, depending upon underlying implementations. This allows the UsersID string and optional the Organization string as sub-elements.
- MessageID – a string that uniquely identifies a message. Use of the UUID or sequence number is recommended. This is analogous to the JMSMessageID provided by JMS. A process should not issue two messages using the same MessageID value.
- CorrelationID – this is used to "link" messages together. This can be supplied on a request, so that the client can correlate a corresponding reply message. The server will place the incoming CorrelationID value as the CorrelationID on the outgoing reply. If not supplied on the request, the CorrelationID of the reply should be set to the value of the MessageID that was used on the request, if present. This is analogous to the use of the JMSCorrelationID provided by JMS. Given that the CorrelationID is used to 'link' messages together, it may be reused on more than one message. Use of a UUID or sequence number is recommended.
- Comment – any descriptive text, but shall never be used for any processing logic.
- Property – a complex type that allows the custom name/value pairs to be conveyed. The source and targets would need to agree upon usage. These are analogous to a Property as defined by JMS.
- Any – it can be used for custom extensions.

Figure 9.1 shows the graphical representation of the header field.

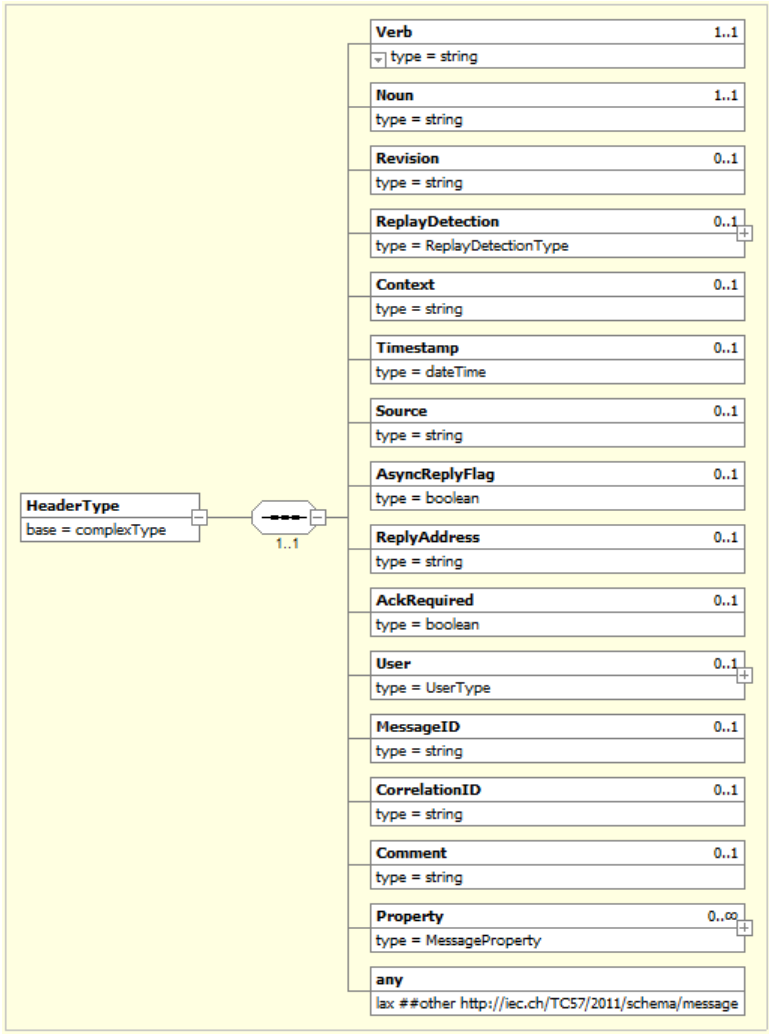

Figure 9.1 – The header field

9.1.2. Reply and Fault

The Reply.result value is an enumeration and would be populated in the following manner:

- "OK" – if there are no errors and all results have been returned. There is no requirement that a Reply.Error element be present.
- "PARTIAL" – if only a partial set of results has been returned, with or without errors. Existence of errors is indicated with one or more Reply.Error.code elements.
- “FAILED" – if no result can be returned due to one or more errors, indicated with one or more Reply.Error elements, each with a mandatory application level ‘code’.

If the result type is “PARTIAL” or “FAILED”, the **Error** field will be populated with the appropriate error description. The contents the **Reply** and **Error** fields are presented in Figure 9.2.

Following fields are mandatory on the application level for the **Error** field:

- **Code** – Carries the information about the error code, usually a numeric value. Client application can define error handlers based on error code.
- **Level** – The severity of the error. Possible values are: “INFORM“, “WARNING“, “FATAL“, “CATASTROPHIC“.
- **Reason** – Error reason, can be combined with error code for a mora specific error handling.
- **Description** – A detailed error description.

NOTE: Values of abovementioned error fields are configurable for each supported WFM use case and located in a corresponding configuration file.

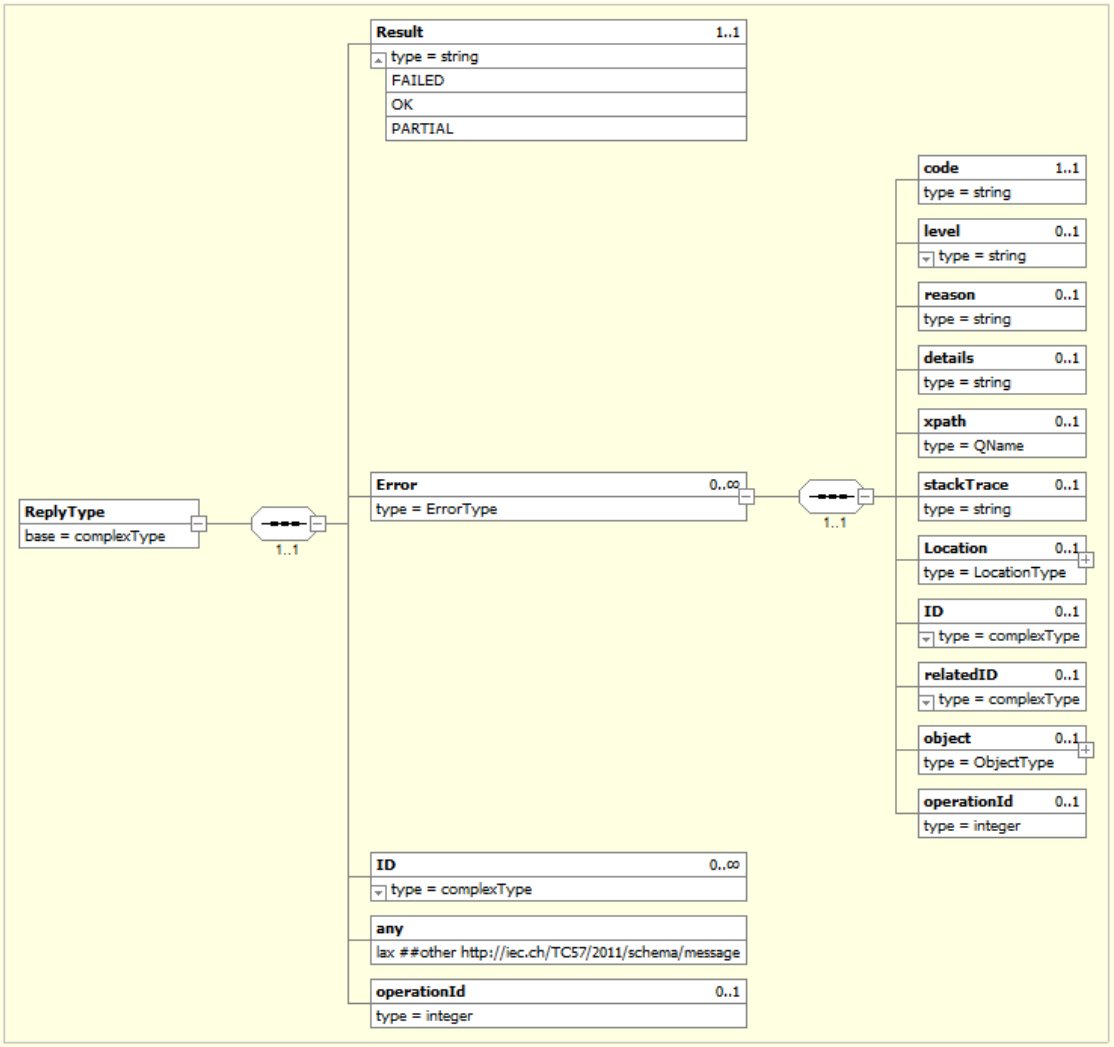

*Figure 9.2 – The **Reply** and **Error** field contents*

9.2. CreatedCrewModel Operation Messages

The operation definition:

CreatedCrewModelResponse CreatedCrewModel(CreatedCrewModelEvent)

9.2.1. Request

The *CreatedCrewModel* event message is defined according to the IEC 61968-100 and contains the following two sections:

- Header
- Payload

The Payload section carries the CIM defined profile (*CrewModel.xsd*) for the update of entire crew model. *CrewModel.xsd* schema and appropriate embedded schemas are provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4].

Following table defines the mapping between the *CrewModel.xsd* and appropriate crew model entities.

Table 9.1 – The CreatedCrewModel message header → the Crew model mapping

CreatedCrewModel message			Description	Crew model		
Section	Property	Type		Property	Type	Model Code
Header	**Verb**	String	The identifier for a specific action to be taken. For this message, the Verb is created.	Populated by external system	N/A	N/A
Header	**Noun**	String	The identifier for the subject of the action and/or the type of the payload. Noun is CrewModel.	Populated by external system	N/A	N/A
Header	**Timestamp**	DateTime	The timestamp when the message was produced. Example: 2015-12-31T12:34:56+02:00	Populated by external system	N/A	N/A
Header	Source	String	The source system or application that sends the message. For this message, the Source can be: WFM, FieldClient, EDS, etc.	Populated by external system	N/A	N/A

CreatedCrewModel message			Description	Crew model		
Section	Property	Type		Property	Type	Model Code
Header	**MessageID**	String	The unique message ID to be used for tracking messages.	Populated by external system	N/A	N/A
Header	**CorrelationID**	String	Correlation ID.	Populated by external system	N/A	N/A

Table 9.2 – Crew data → the Crew model mapping

CreatedCrewModel message			Description	Crew model		
Section	Property	Type		Property	Type	Model Code
Crew	mRID	String	CustomID of crew. It is mandatory field and it must be unique.			
Crew	availability	String	Availability of the crew.			
Crew	comment	String	Crew comment			
Crew	commentTime	DateTime	DateTime of the comment.			
Crew	commentUser	String	User that entered the comment.			
Crew	equipedWithFieldClient	Boolean	Indicates if crew has an onboard field client device.			
Crew	name	String	Name of crew. if exists must be unique.			
Crew	CrewType.mRID	String	Type of crew based on tasks it is capable to perform.			
Crew	Organisation.mRID	String	Name of the company that member belongs to. If set, all crew's members and vehicles must have, and will have, the same company reference.			
Crew	Organisation.name	String	Distinguished Name of the company that member belongs to.			

CreatedCrewModel message			Description	Crew model		
Section	Property	Type		Property	Type	Model Code
Crew	Regions.mRID	String	mRID of the region where crew operates in, that represent crew's area of operations and responsibility. Region can include multiple AOR areas.			
Crew	Regions.name	String	Not Applicable			

Table 9.3 – Crew Member data → the Crew model mapping

CreatedCrewModel message			Description	Crew model		
Section	Property	Type		Property	Type	Model Code
CrewMember	mRID	String	Crew member custom ID. Must be unique.			
CrewMember	isAvailable	Boolean	Availability of the member.			
CrewMember	name	String	Member name. If exist must be unique.			
CrewMember	isLead	bool	Indicates if member is a crew leader.			
CrewMember	type	String	Type of the crew member.			
CrewMember	userName	string	Member's username which is used for member login from the field client device This username corresponds to username from active directory and must be unique.			
CrewMember	Crew.mRID	String	Name of crew this member belongs to.			
CrewMember	Crew.name	String	CustomID of crew this member belongs to.			
CrewMember	License.mRID	String	Name of the License this member possesses. This is a list of values. License must be referenced by only one crew member.			
CrewMember	License.name	String	Not Applicable			
CrewMember	Organisation.mRID	String	Name of the company that member belongs to.			

CreatedCrewModel message			Description	Crew model		
Section	Property	Type		Property	Type	Model Code
CrewMember	Organisation.name	String	Distinguished Name of the company that member belongs to.			
CrewMember	Phone.localPhone	String	Not Applicable			

Table 9.4 – Vehicle data → the Crew model mapping

CreatedCrewModel message			Description	Crew model		
Section	Property	Type		Property	Type	Model Code
Vehicle	mRID	String	Custom ID of the vehicle. Must be unique.			
Vehicle	name	String	Vehicle name. If exist must be unique.			
Vehicle	alternateRadioID	String	Vehicle's backup radio identifier.			
Vehicle	Status.vale	String	Vehicle status indication.			
Vehicle	type	String	Type of the crew vehicle.			
Vehicle	Crew.mRID	String	Custom ID of the Crew related to this vehicle.			
Vehicle	Crew.name	String	Name of the Crew related to this vehicle.			
Vehicle	electronicAddress.radio	String	Vehicle's radio identifier.			
Vehicle	Organisation.mRID	String	Custom ID of the company member belongs.			
Vehicle	Organisation.name	String	Distinguished Name of the company that member belongs to.			

Table 9.5 – Skill data → the Crew model mapping

CreatedCrewModel message			Description	Crew model		
Section	Property	Type		Property	Type	Model Code
Skill	mRID	String	Custom ID of skill. Must be unique.			
Skill	name	String	Not Applicable			
Skill	minVoltageLevel	Float	Minimum voltage level (in kV) that crew member should work on.			
Skill	maxVoltegeLevel	Float	Maximum voltage level (in kV) that crew member should work on.			
Skill	operateInSubstation	Bool	If true, crew member can operate inside substation.			
Skill	operateOutOfSubstation	Bool	If true, crew member can operate outside substation.			
Skill	performePlannedWork	Bool	If true, crew member can perform planned work.			
Skill	performeSwitching	Bool	If true, crew member can perform switching.			
Skill	performUnplannedWork	Bool	If true, crew member can perform unplanned work.			
Skil	safetyDocumentType	String	Safety document type			
Skill	Hazards.type	String	Corresponds to hazard type that member can handle in case this skill is applicable to him.			

Table 9.6 – License data → the Crew model mapping

CreatedCrewModel message			Description	Crew model		
Section	Property	Type		Property	Type	Model Code
License	mRID	String	Custom ID of the license. Must be unique.			
License	name	String	Not Applicable			
License	exparationDate	DateTime	Time when this license expires			
License	Skill.mRID	String	Custom ID of skill this license applies to			

CreatedCrewModel message			Description	Crew model		
Section	Property	Type		Property	Type	Model Code
License	Skill.name	String	Not Applicable			

Table 9.7 – Organization data → the Crew model mapping

CreatedCrewModel message			Description	Crew model		
Section	Property	Type		Property	Type	Model Code
Organisation	mRID	String	Name of the company. Must be unique.			
Organisation	name	String	Distinguished name of the company. Must be unique.			
Organisation	owned	Bool	Is company owned by the utility.			

9.2.2. Response

After the *CreatedCrewModel* operation is executed, the response is returned in form of the *CreatedCrewModelResponse* message. The content of the response message is given in *CrewModelMessage.xsd* provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4]. Following table defines the mapping between the *CrewModelResponse* message and the appropriate entities in the crew model.

Table 9.8 – The CrewModelResponse message → the Crew model mapping

CreatedCrewModel message			Description	Crew model		
Section	Property	Type		Property	Type	Model Code
Header	**Verb**	String	The identifier for a specific action to be taken. For this message, the Verb is reply.	Populated by WFM Adapter	N/A	N/A
Header	**Noun**	String	The identifier for the subject of the action and/or the type of the payload. For this message, the Noun is CrewAssignments.	Populated by WFM Adapter	N/A	N/A

CreatedCrewModel message			Description	Crew model		
Section	Property	Type		Property	Type	Model Code
Header	**Timestamp**	DateTime	The timestamp when the message was produced. Example: 2015-12-31T12:34:56+02:00	Populated by WFM Adapter	N/A	N/A
Header	Source	String	The source system or application that sends the message. For this message, the source is the EcoStruxure GridOps.	Populated by WFM Adapter	N/A	N/A
Header	**MessageID**	String	The unique message ID to be used for tracking messages.	Populated by WFM Adapter	N/A	N/A
Header	**CorrelationID**	String	Correlation ID.	Populated by WFM Adapter	N/A	N/A
Reply	**Result**	String	Returned as part of synchronous response. The valid values are: OK, PARTIAL or FAILED.	N/A	N/A	N/A

9.2.3. Fault

The content of the fault message is given in *CrewModelMessage.xsd* provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4].

9.3. CreatedCrewAssignments Operation Messages

The operation definition:

CreatedCrewAssignmentsResponse

CreatedCrewAssignments(CreatedCrewAssignmentsEvent)

9.3.1. Request

The *CreatedCrewAssignments* event message is defined according to the IEC 61968-100 and contains the following two sections:

- Header
- Payload

The Payload section carries the CIM defined profile (*CrewAssignments.xsd*) for the association of one or multiple crews to one or more incidents. The visual representation of the *CrewAssignments.xsd* schema is provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4].

Following table defines the mapping between the *CrewAssignments.xsd* and the appropriate entities in the crew model.

Table 9.9 – The CreatedCrewAssignmentsEvent message → the Crew model mapping

CreatedCrewAssignments message			Description	Crew model		
Section	**Property**	**Type**		**Property**	**Type**	**Model Code**
Header	**Verb**	String	The identifier for a specific action to be taken. For this message, the Verb is created.	Populated by external system	N/A	N/A
Header	**Noun**	String	The identifier for the subject of the action and/or the type of the payload. Noun is CrewAssignments.	Populated by external system	N/A	N/A
Header	**Timestamp**	DateTime	The timestamp when the message was produced. Example: 2015-12-31T12:34:56+02:00	Populated by external system	N/A	N/A
Header	Source	String	The source system or application that sends the message. For Source can be: WFM, FieldClient, EDS, etc.	Populated by external system	N/A	N/A
Header	**MessageID**	String	The unique message ID to be used for tracking messages.	Populated by external system	N/A	N/A
Header	**CorrelationID**	String	Correlation ID.	Populated by external system	N/A	N/A
Payload	mRID	String	The unique identifier of the crew.	CustomID	String	OMS_CREW_CUSTOMID
Payload	Assignments.mRID	String	The IDs of assignments (incidents, switching plans, safety documents).	Assignment.GID	List<Long>	OMS_CREW_ASSIGNMENT_ASSGNMNT_ID
Payload	Assignments.name	String	External system ID (unique identifier) of assignment.	Assignment.GID	List<Long>	OMS_CREW_ASSIGNMENT_ASSGNMNT_ID
Payload	Assignments. createdDateTime	String	The time when the assignment was created.	AssignedTime	List<Long>	OMS_CREW_ASSIGNMENT_ASSIGNED_TIME
Payload	Assignments. isLeadingCrew	Boolean	Indication is the assigned crew the leading crew.	IsLeadingCrew	Boolean	OMS_CREW_ASSIGNMENT_IS_LEADING_CREW
Payload	Assignments. Status.value	String	The status of the assignment. Examples: Assigned, En Route, Arrived, Working, Completed, Secured, etc.	AssignmentStatus	Status	OMS_CREW_ASSIGNMENT_ASSIGN_STATUS

9.3.2. Response

After the *CreatedCrewAssignments* operation is executed, the response is returned in form of the *CreatedCrewAssignmentsResponse* message. The content of the response message is given in *CrewAssignmentsMessage.xsd* provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4]. Following table defines the mapping between the *CrewAssignmentsResponse* message and the appropriate entities in the crew model.

Table 9.10 – The CrewAssignmentsResponse message → the Crew model mapping

CrewAssignmentsResponse message			Description	Crew model		
Section	**Property**	**Type**		**Property**	**Type**	**Model Code**
Header	**Verb**	String	The identifier for a specific action to be taken. For this message, the Verb is reply.	Populated by WFM Adapter	N/A	N/A
Header	**Noun**	String	The identifier for the subject of the action and/or the type of the payload. For this message, the Noun is CrewAssignments.	Populated by WFM Adapter	N/A	N/A
Header	**Timestamp**	DateTime	The timestamp when the message was produced. Example: 2015-12-31T12:34:56+02:00	Populated by WFM Adapter	N/A	N/A
Header	Source	String	The source system or application that sends the message. For this message, the source is the EcoStruxure GridOps.	Populated by WFM Adapter	N/A	N/A
Header	**MessageID**	String	The unique message ID to be used for tracking messages.	Populated by WFM Adapter	N/A	N/A
Header	**CorrelationID**	String	Correlation ID.	Populated by WFM Adapter	N/A	N/A
Reply	**Result**	String	Returned as part of synchronous response. The valid values are: OK, PARTIAL or FAILED.	N/A	N/A	N/A
Payload	mRID	String	The unique identifier of the crew.	CustomID	String	
Payload	Assignments.mRID	String	The IDs of assignments.	Assignment.GID	List<Long>	

9.3.3. Fault

The content of the fault message is given in *CrewAssignmentsMessage.xsd* provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4].

9.4. ChangedCrewAssignments Operation Messages

The operation definition:

ChangedCrewAssignmentsResponse

ChangedCrewAssignments(ChangedCrewAssignmentsEvent)

9.4.1. Request

The *ChangedCrewAssignments* event message is defined according to the IEC 61968-100 and contains the following two sections:

- Header
- Payload

Content of the message is given in *CrewAssignmentsMessage.xsd* provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4].

The Payload section carries the CIM defined profile (CrewAssignments.xsd) for the association of one or multiple crews to one or more incidents. The content of the *CrewAssignments.xsd* schema is provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4].

Folowing table defines the mapping between the *CrewAssignments.xsd* and the appropriate entities in the crew model.

Table 9.11 – The ChangedCrewAssignmentsEvent message → the Crew model mapping

ChangedCrewAssignments message			Description	Crew model		
Section	**Property**	**Type**		**Property**	**Type**	**Model Code**
Header	**Verb**	String	The identifier for a specific action to be taken. For this message, the Verb is changed.	Populated by external system	N/A	N/A
Header	**Noun**	String	The identifier for the subject of the action and/or the type of the payload. Noun is CrewAssignments.	Populated by external system	N/A	N/A
Header	**Context**	String	Context defines mode of ChangedCrewAssignment operation, and its value can be Incremental or Bulk	Populated by external system	N/A	N/A
Header	**Timestamp**	DateTime	The timestamp when the message was produced. Example: 2015-12-31T12:34:56+02:00	Populated by external system	N/A	N/A
Header	Source	String	The source system or application that sends the message. Source can be: WFM, FieldClient, EDS.	Populated by external system	N/A	N/A
Header	**MessageID**	String	The unique message ID to be used for tracking messages.	Populated by external system	N/A	N/A
Header	**CorrelationID**	String	Correlation ID.	Populated by external system	N/A	N/A
Payload	mRID	String	The unique identifier of the crew.	CustomID	String	OMS_CREW_CUSTOMID
Payload	Assignments.mRID	String	The IDs of assignments (incidents, switching plans, safety documents).	Assignment.GID	List<Long>	OMS_CREW_ASSIGNMENT_ASSGNMNT_ID
Payload	Assignments.name	String	External system ID (unique identifier) of assignment.	Assignment.GID	List<Long>	OMS_CREW_ASSIGNMENT_ASSGNMNT_ID
Payload	Assignments. createdDateTime	String	The time when the assignment was created/changed.	AssignedTime	List<Long>	OMS_CREW_ASSIGNMENT_ASSIGNED_TIME
Payload	Assignments. Status.value	String	The status of the assignment. Examples: Assigned, En Route, Arrived, Working, Completed, Secured, etc.	AssignmentStatus	Status	OMS_CREW_ASSIGNMENT_ASSIGN_STATUS

ChangedCrewAssignments message			Description	Crew model		
Section	Property	Type		Property	Type	Model Code
Payload	Assignments. Status.reason	String	A free text field which can be used to specify some additional reason/comment when rejecting assignment.	AssignmentReason	Status	OMS_CREW_ASSIGNMENT_REJECT_REASON_ID

9.4.2. Response

After the *ChangedCrewAssignments* operation is executed, the response is returned in form of the *ChangedCrewAssignmentsResponse* message. The content of the response message is given in *CrewAssignmentsMessage.xsd* provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4]. Following table defines the mapping between the *CrewAssignmentsResponse* message and the appropriate entities in the crew model.

Table 9.12 – The CrewAssignmentsResponse message → the Crew model mapping

CrewAssignmentsResponse message			Description	Crew model		
Section	Property	Type		Property	Type	Model Code
Header	**Verb**	String	The identifier for a specific action to be taken. For this message, the Verb is reply.	Populated by WFM Adapter	N/A	N/A
Header	**Noun**	String	The identifier for the subject of the action and/or the type of the payload. For this message, the Noun is CrewAssignments.	Populated by WFM Adapter	N/A	N/A
Header	**Timestamp**	DateTime	The timestamp when the message was produced. Example: 2015-12-31T12:34:56+02:00	Populated by WFM Adapter	N/A	N/A
Header	Source	String	The source system or application that sends the message. For this message, the source is the EcoStruxure GridOps.	Populated by WFM Adapter	N/A	N/A
Header	**MessageID**	String	The unique message ID to be used for tracking messages.	Populated by WFM Adapter	N/A	N/A
Header	**CorrelationID**	String	Correlation ID.	Populated by WFM Adapter	N/A	N/A
Reply	**Result**	String	Returned as part of synchronous response. The valid values are: OK, PARTIAL or FAILED.	N/A	N/A	N/A

CrewAssignmentsResponse message			Description	Crew model		
Section	Property	Type		Property	Type	Model Code
Payload	mRID	String	The unique identifier of the crew.	CustomID	String	
Payload	Assignments.mRID	String	The IDs of assignments.	Assignment.GID	List<Long>	

9.4.3. Fault

The content of the fault message is given in *CrewAssignmentsMessage.xsd* provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4].

9.5. DeletedCrewAssignments Operation Messages

The operation definition:

DeletedCrewAssignmentsResponse DeletedCrewAssignments(DeletedCrewAssignmentsEvent)

9.5.1. Request

The *DeletedCrewAssignments* event message is defined according to the IEC 61968-100 and contains the following two sections:

- Header
- Payload

Content of the message is given in *CrewAssignmentsMessage.xsd* provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4].

The Payload section carries the CIM defined profile (CrewAssignments.xsd) for the association of one or multiple crews to one or more incidents. The content of the CrewAssignments.xsd schema is given in *CrewAssignments.xsd* provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4].

Following table defines the mapping between the *CrewAssignments.xsd* and the appropriate entities in the crew model.

Table 9.13 – The DeletedCrewAssignmentsEvent message → the Crew model mapping

DeletedCrewAssignments message			Description	Crew model		
Section	**Property**	**Type**		**Property**	**Type**	**Model Code**
Header	**Verb**	String	The identifier for a specific action to be taken. For this message, the Verb is deleted.	Populated by external system	N/A	N/A
Header	**Noun**	String	The identifier for the subject of the action and/or the type of the payload. For this message, the Noun is CrewAssignments.	Populated by external system	N/A	N/A
Header	**Timestamp**	DateTime	The timestamp when the message was produced. Example: 2015-12-31T12:34:56+02:00	Populated by external system	N/A	N/A
Header	Source	String	The source system or application that sends the message. For this message, the Source can be: FieldClient, EDS, etc.	Populated by external system	N/A	N/A
Header	**MessageID**	String	The unique message ID to be used for tracking messages.	Populated by external system	N/A	N/A
Header	**CorrelationID**	String	Correlation ID.	Populated by external system	N/A	N/A
Payload	mRID	String	The unique identifier of the crew.	CustomID	String	OMS_CREW_CUSTOMID
Payload	Assignments. mRID	String	The IDs of assignments (incidents, switching plans, safety documents).	Assignment.GID	List<Long>	OMS_CREW_ASSIGNMENT_ASSGNMNT_ID
Payload	Assignments. name	String	External system ID (unique identifier) of assignments.	Assignment.GID	List<Long>	OMS_CREW_ASSIGNMENT_ASSGNMNT_ID
Payload	Assignments. createdDateTime	String	The time when the assignment was created/changed.	AssignedTime	List<Long>	OMS_CREW_ASSIGNMENT_ASSIGNED_TIME

9.5.2. Response

After the *ChangedCrewAssignments* operation is executed, the response is returned in form of the *ChangedCrewAssignmentsResponse* message. The content of the response message is given in *CrewAssignmentsMessage.xsd* provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4]. Following table defines the mapping between the *CrewAssignmentsResponse* message and the appropriate entities in the crew model.

Table 9.14 – The CrewAssignmentsResponse message → the Crew model mapping

CrewAssignmentsResponse message			Description	Crew model		
Section	**Property**	**Type**		**Property**	**Type**	**Model Code**
Header	**Verb**	String	The identifier for a specific action to be taken. For this message, the Verb is reply.	Populated by WFM Adapter	N/A	N/A
Header	**Noun**	String	The identifier for the subject of the action and/or the type of the payload. For this message, the Noun is CrewAssignments.	Populated by WFM Adapter	N/A	N/A
Header	**Timestamp**	DateTime	The timestamp when the message was produced. Example: 2015-12-31T12:34:56+02:00	Populated by WFM Adapter	N/A	N/A
Header	Source	String	The source system or application that sends the message. For this message, the source is the EcoStruxure GridOps.	Populated by WFM Adapter	N/A	N/A
Header	**MessageID**	String	The unique message ID to be used for tracking messages.	Populated by WFM Adapter	N/A	N/A
Header	**CorrelationID**	String	Correlation ID.	Populated by WFM Adapter	N/A	N/A
Reply	**Result**	String	Returned as part of synchronous response. The valid values are: OK, PARTIAL or FAILED.	N/A	N/A	N/A
Payload	mRID	String	The unique identifier of the crew.	CustomID	String	
Payload	Assignments. mRID	String	The IDs of assignments (incidents or work orders).	Assignment.GID	List<Long>	

9.5.3. Fault

The content of the fault message is given in *CrewAssignmentsMessage.xsd* provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4].

9.6. ChangedCrews Operation Message

The operation definition:

ChangedCrewsResponse ChangedCrews (ChangedCrewsEvent)

9.6.1. Request

The *ChangedCrews* event message is defined according to the IEC 61969-100 and contains the following two sections:

- Header
- Payload

The Payload field carries the CIM defined profile (Crews.xsd) for updating crew's data (availability and field client connection status) in the crew model. Content of the Crews.xsd is provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4].

Following table defines the mapping between the *Crews* message payload and appropriate entities in the crew model.

Table 9.15 – The ChangedCrewsEvent message → the Crew model mapping

ChangedCrews message			Description	Crew model		
Section	**Property**	**Type**		**Property**	**Type**	**Model Code**
Header	**Verb**	String	The identifier for a specific action to be taken. Verb is changed.	Populated by external system	N/A	N/A
Header	**Noun**	String	The identifier for the subject of the action and/or the type of the payload. Noun is Crews.	Populated by external system	N/A	N/A
Header	**Timestamp**	DateTime	The timestamp when message was produced. Example: 2015-12-31T12:34:56+02:00	Populated by external system	N/A	N/A
Header	Source	String	The source system or application that sends the message. For this message, the Source examples are: WFM, GPS, etc.	Populated by external system	N/A	N/A
Header	**MessageID**	String	The unique message ID to be used for tracking messages.	Populated by external system	N/A	N/A
Header	**CorrelationID**	String	Since this is the request message, CorrelationID should be populated with the same value as MessageID	Populated by external system	N/A	N/A
Payload	mRID	String	The unique identifier of the crew. Value can represent crew name or customID. Default identifier type is defined in adapter registry configuration file.	CustomID or Name	String	OMS_CREW_ CUSTOMID OMS_CREWOBJ_NAME
Payload	Availability	String	Availability of the crew. Supported values are: Off work, Available. Out on mutual aid, On break, Standby.	CrewAvailability	String	OMS_CREW_AVAILABILITY
Payload	fcConnectionStatus	String	Field client connection status. Supported Values: Online, Offline.	FcConnectionStatus	String	OMS_CREW_FC_CONN_STATUS

9.6.2. Response

After the model is updated, the appropriate response is returned in the form of the *CrewsResponse* message. The content of the response message is given in *CrewsMessage.xsd* provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4]. Following table defines the mapping between the *CrewsResponse* message and the appropriate entities in the crew model.

Table 9.16 – The CrewsResponse message → the Crew model mapping

CrewsResponse message			Description	Crew model		
Section	Property	Type		Property	Type	Model Code
Header	**Verb**	String	The identifier for a specific action to be taken. Verb is reply.	Populated by WFM Adapter	N/A	N/A
Header	**Noun**	String	The identifier for the subject of the action and/or the type of the payload. For this message, the Noun is Crews.	Populated by WFM Adapter	N/A	N/A
Header	**Timestamp**	DateTime	The timestamp when the message was produced. Example: 2015-12-31T12:34:56+02:00	Populated by WFM Adapter	N/A	N/A
Header	Source	String	The source system or application that sends the message. For this message, the Source is EcoStruxure GridOps.	Populated by WFM Adapter	N/A	N/A
Header	**MessageID**	String	The unique message ID to be used for tracking messages.	Populated by WFM Adapter	N/A	N/A
Header	**CorrelationID**	String	Correlation ID.	Populated by WFM Adapter	N/A	N/A
Reply	**Result**	String	Returned as part of synchronous response. The valid values are: OK, PARTIAL or FAILED.	N/A	N/A	N/A
Payload	mRID	String	The unique identifier of the crew. Value can represent crew name or customID. Default identifier type is defined in adapter registry configuration file.	CustomID or Name	String	OMS_CREW_ CUSTOMID OMS_CREWOBJ_NAME

9.6.3. Fault

The content of the *CrewsFault* message is given in *CrewsMessage.xsd* provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4].

9.7. ChangedVehicles Operation Messages

The operation definition:

ChangedVehiclesResponse ChangedVehicles (ChangedVehiclesEvent)

9.7.1. Request

The *ChangedVehicles* event message is defined according to the IEC 61969-100 and contains the following two sections:

- Header
- Payload

The Payload field carries the CIM defined profile (*Vehicles.xsd*) for updating vehicle-radio and vehicle-crew associations in the crew model. The content of the CIM schema is given in *Vehicles.xsd* provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4].

Table 9.17 defines the mapping between the *Vehicle* message payload and appropriate entities in the crew model.

Table 9.17 – The ChangedVehiclesEvent message → the Crew model mapping

ChangedVehicles message			Description	Crew model		
Section	**Property**	**Type**		**Property**	**Type**	**Model Code**
Header	**Verb**	String	The identifier for a specific action to be taken. Verb is changed.	Populated by external system	N/A	N/A
Header	**Noun**	String	The identifier for the subject of the action and/or the type of the payload. Noun is Vehicles.	Populated by external system	N/A	N/A
Header	**Timestamp**	DateTime	The timestamp when message was produced. Example: 2015-12-31T12:34:56+02:00	Populated by external system	N/A	N/A
Header	Source	String	The source system or application that sends the message. For this message, the Source can be: WFM, GPS, etc.	Populated by external system	N/A	N/A
Header	**MessageID**	String	The unique message ID to be used for tracking messages.	Populated by external system	N/A	N/A
Header	**CorrelationID**	String	Correlation ID.	Populated by external system	N/A	N/A
Payload	mRID	String	The unique identifier of the vehicle	CustomID	String	OMS_CREW_VEHICLE_CUSTOMID
Payload	electronicAddress.radio	String	Radio ID of the vehicle.	RadioID	String	OMS_CREW_VEHICLE_RADIOID

9.7.2. Response

After the model is updated, the appropriate response is returned in the form of the *VehiclesResponse* message. The content of the response message is given in *VehiclesMessage.xsd* provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4]. Table 9.18 defines the mapping between the *VehiclesResponse* message and the appropriate entities in the crew model.

Table 9.18 – The VehiclesResponse message → the Crew model mapping

VehiclesResponse message			Description	Crew model		
Section	**Property**	**Type**		**Property**	**Type**	**Model Code**
Header	**Verb**	String	The identifier for a specific action to be taken. Verb is reply.	Populated by WFM Adapter	N/A	N/A
Header	**Noun**	String	The identifier for the subject of the action and/or the type of the payload. For this message, the Noun is Vehicles	Populated by WFM Adapter	N/A	N/A
Header	**Timestamp**	DateTime	The timestamp when the message was produced. Example: 2015-12-31T12:34:56+02:00	Populated by WFM Adapter	N/A	N/A
Header	Source	String	The source system or application that sends the message. For this message, the Source is EcoStruxure GridOps.	Populated by WFM Adapter	N/A	N/A
Header	**MessageID**	String	The unique message ID to be used for tracking messages.	Populated by WFM Adapter	N/A	N/A
Header	**CorrelationID**	String	Correlation ID.	Populated by WFM Adapter	N/A	N/A
Reply	**Result**	String	Returned as part of synchronous response. The valid values are: OK, PARTIAL or FAILED.	N/A	N/A	N/A
Payload	mRID	String	The unique identifier of the vehicle.	CustomID	String	OMS_CREW_VEHICLE_CUSTOMID

9.7.3. Fault

The content of the *VehiclesFault* message is given in *VehiclesMessage.xsd* provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4].

10. DEPLOYMENT

Described in the *EcoStruxure GridOps Management Suite 3.10 Enterprise Integration Platform - Functional Specification* [1].

The deployment specification is provided in the following table:

Table 10.1 – The deployment specification

Deployment Specification	
Application	AdapterWFM
Critical process	No
OASyS service	OASyS DNA DMS_INTEGRATION Service
Servers	pdmz-int-1, pdmz-int-2, bdmz-int-1, bdmz-int-2
Zone	pdmz, bdmz
Installation Type	Product
Installation add-on name	Integration Adapters

Figure 10.1 depicts standard deployment configuration for all Crew integration participants.

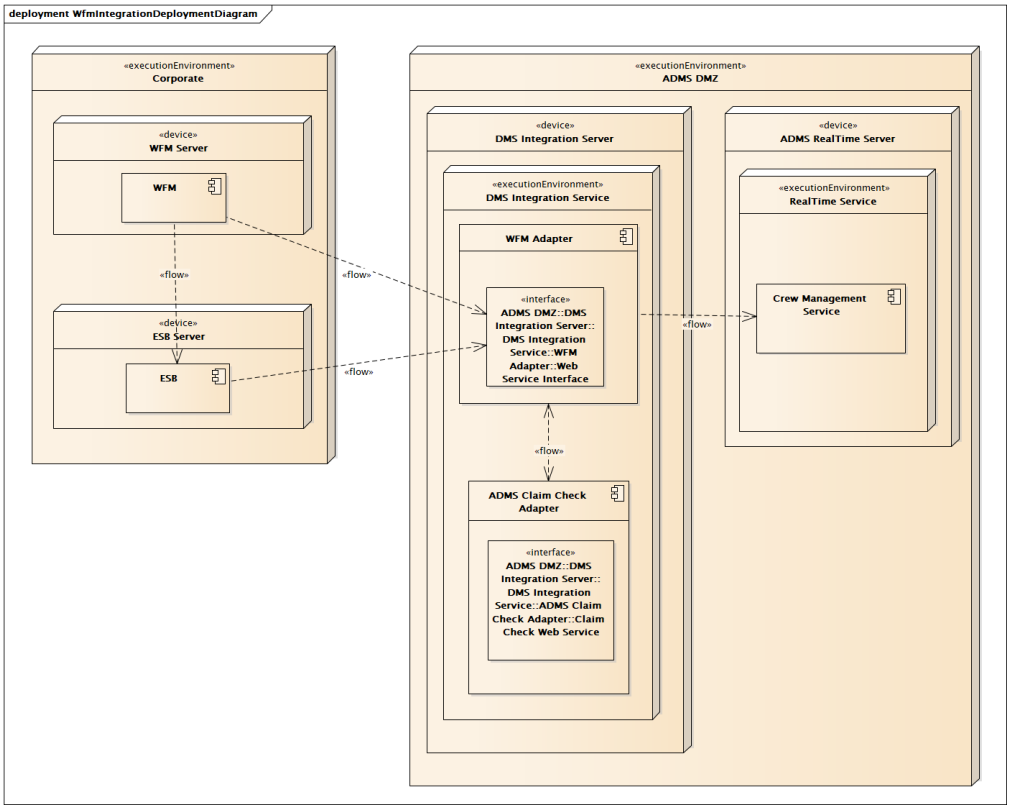

Figure 10.1 – The WFM Integration deployment diagram

Client's external systems can connect to the WFM Adapter web services either directly or through the ESB.

11. INTERFACE CONFIGURATION

WFM adapter provides certain amount of configurability so that smaller adjustments in the functionality can be easily applied to the system, without interface down time. Such feature is provided through dedicated configuration files of the WFM adapter.

Table 11.1 – The configuration files specification

Name of the config file	Configuration File Description
AdapterWfm	Registry configuration xml file
WfmAdapter_CreatedCrewAssignments_ErrorConfiguration	Error configuration xml file for ReceiveCrewAssignments process
WfmAdapter_ChangedCrewAssignments_ErrorConfiguration	Error configuration xml file for ReceiveCrewAssignments process
WfmAdapter_DeletedCrewAssignments_ErrorConfiguration	Error configuration xml file for ReceiveCrewAssignments process
WfmAdapter_ChangedVehicles_ErrorConfiguration	Error configuration xml file for ReceiveCrewVehicles process
WfmAdapter_ChangedCrews_ErrorConfiguration	Error configuration xml file for ReceiveCrews process
WfmAdapter_ReceiveCrewModel_ErrorConfiguration	Error configuration xml file for ReceiveCrewModel process
AdapterWfm_WebServiceConfiguration	Web service configuration xml file

Details about the structure and shared content of common interface configuration files are located in *EcoStruxure GridOps Management Suite 3.10 Enterprise Integration Platform - Functional Specification* [1].

Detailed content of above-mentioned configuration files is provided within the *Configuration* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4].

12. PERFOMANCE TESTING

12.1. System Setup

The system setup is provided within the *ADMS 3.8 SP1 Performances Testing – Enterprise.docx* document.

12.2. Performance Measurements

The results of the performance testing are provided within the *ADMS 3.8 SP1 Action measurements.xlsx* document.

12.3. Performance Best Practices

In order to achieve better performances when updating crew assignments through the WFM Interface, following guidelines should be followed:

- Group all assignments for one crew within the request message.
- Use multiple (concurrent) web service clients on the source system side.

13. APPENDIX

13.1. WSDL

The WSDL file, XSD schemas and sample messages defined according to the IEC 61968-100 standard for all WFM web services are provided within the *Web Service Definitions* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4].

13.2. Message Examples

Message examples for several use cases are provided within the *Message Examples* folder in the *EcoStruxure GridOps Management Suite 3.10 Workforce Management Interface.zip* file [4].

14. RELEASE NOTES

The following new features related to the Product WFM Interface were introduced in the software, starting from version 3.8 SP1.

14.1. Software Version 3.8 SP1

Feature	Description
Crew model import	Capability to import and maintain entire crew (WFM) model added through the *ReceiveCrewModelService*
Near real-time vehicle model update	Update of the vehicle model entities added trough following web service: • *ReceiveVehiclesService* – used for updating vehicle data (vehicle-crew association and radio ID)
Planned work assignments	Assignments to planed work and corresponding documents (switching plans, safety documents, etc.) is added to the *ReceiveCrewAssignmentsService*
Creation and deletion of assignments exposed	Additional operations for assignment creation and deletion added to *ReceiveCrewAssignmentsService*
Near real-time crew model update	Update of the crew model entities added trough following web service: • *ReceiveCrewsService* – used for updating crew data (availability and fcconnectionstatus)

14.2. Software Version 3.9

Feature	Description
Workforce Management Interface – Maintaining crews/vehicles correlation	ReceiveVehicleService within Workforce Management interface is enhanced to enable update of crew-vehicle association.

15. DEFINITIONS AND ABBREVIATIONS

Definition/Abbreviation	Description
CIM	Common Information Model
CRS	Crew Management Service
DMD	Dynamic Mimic Diagram
DMZ	Demilitarized Zone
ADMS	Advanced Distribution Management System
EDS	External Dispatching System
ESB	Enterprise Service Bus
OMS	Outage Management System
SOAP	Simple Object Access Protocol
WCF	Windows Communication Foundation
WFM	Workforce Management
WS	Web Service
XML	Extensible Markup Language
XSD	XML Schema Definition