**Yugandhar Open Master Data Management (MDM) Hub**

**Development and Customization Guide**

Yugandhar Open MDM Hub Release – V2.0.0

Date – 11/06/2018

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# About Yugandhar Open MDM Hub Project

Master Data Management came a long way in last decade or so. There are currently more than 20 MDM solutions catering to various specializations of MDM like Customer Data Integration (CDI), Product Information Management (PIM), vendor and supplier management etc. However most of these solutions come with licensing costs amounting to thousands of dollar. To offer a completely free solution which would be made available through Apache 2.0 license, A Project is started in 2017 under the name ‘Yugandhar Open MDM Project’ to build Open Source MDM solutions catering to CDI, PIM and Data Governance Capabilities. Yugandhar in Sanskrit means Ever Lasting and the strongest of its time. Our vision is to build the strongest, Open Source, Multi Domain, Cross Industry and completely free MDM Solution.

We are happy to announce that the first release of the Yugandhar MDM Hub catering to CDI solution is built with Open source technologies like Spring and Hibernate etc, inbuilt data Model, 400+ ready to use services and having incredible Out of the Box capabilities is currently being distributed. We aim to make the current CDI offering the strongest and Planning to bring Data Stewardship and PIM solutions in upcoming years.

# About this document

This is the development and customization guide of the Yugandhar Open MDM Hub. This is intended for the use of developers.

# Before reading this document

Please refer the ‘Yugandhar Open Master Data Management (MDM) Hub Architectural Overview’ document.

# Understanding Java Projects and Workspace

The Yugandhar Open Master Data Management (MDM) Hub codebase is shared on github at below location

1. Github public repository - <https://github.com/yugandharproject/yugandhar-open-mdmhub>
2. Javadoc – <github repository>\resources\javadocs
3. Dbdocs – <github repository>\resources\dbdocs
4. Documentation -<github repository>\resources\documentation
5. Database setup scripts -<github repository>\resources\dbsetupscripts

You may choose to download the projects using ‘clone and download’ option available online or checkout using github client.

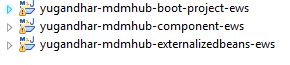
## Project structure

The Yugandhar Open MDM Hub currently has below three projects as shown in below screenshot. There is slight changes in the EWS and JEEC code base related to Springboot configuration, Spring Initializer, JMS and packaging etc. The

EWS:

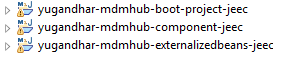
Github: <https://github.com/yugandharproject/yugandhar-open-mdmhub/>

Package: yugandhar-open-mdmhub-ews



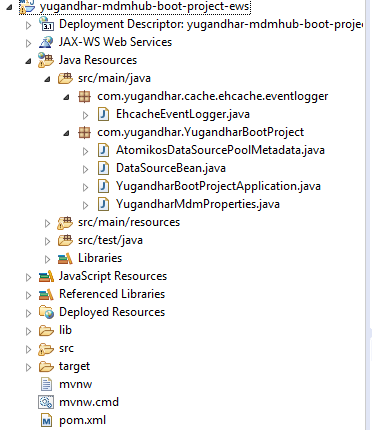
JEEC: <https://github.com/yugandharproject/yugandhar-open-mdmhub/>

Package: yugandhar-open-mdmhub-jeec



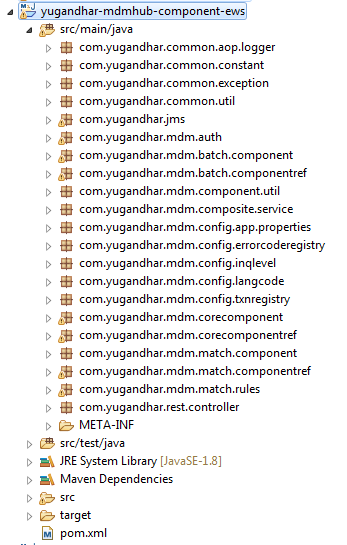
### yugandhar-mdmhub-boot-project-ews

This is spring boot project application project having the Springboot Initializer configuration of Yugandhar Open MDM Hub. The below screenshot shows the structure of the YugandharBootProject. The class com.yugandhar.YugandharBootProject.YugandharBootProjectApplication has the spring boot initialization configuration which is used in conjunction with application.properties file. ehcache.xml and yugandhar\_logback.xml files are used to configure ehcache and logback respectively.



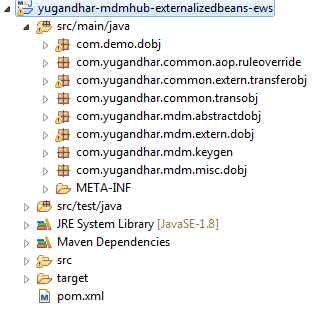
### yugandhar-mdmhub-component-ews

This project is the core of all the transactions. The Component, service, repository and rule classes of every entity are placed in this project.



### yugandhar-mdmhub-externalizedbeans-ews

This project is primarily used to externalize the DOs, rules and unique key generator and transfer objects.



## Externalization of java classes for customization

This project *yugandhar-mdmhub-externalizedbeans-ews* makes few classes available for customization to the users of the Yugandhar Open MDM Hub so that the behavior of the out of the box DOs, rules or services are modified. This is done so that the modifications of the core Yugandhar project team and the customizations does not cross with each other while upgrading to latest version of the Yugandhar Open MDM Hub. This would keep the code clean and any further enhancement by Yugandhar team in the templates in future releases can be seamlessly incorporated in your code.

Let’s understand it through a use case - The v1.0 of Yungandhar Open MDM Hub has table LE\_PERSON which provides multiple attributes. In your project there may be requirements wherein there is a need to store an attribute which is not currently present in LE\_PERSON table e.g. Ethnicity of the person. So you made the customization in the code by adding new attribute in LePerson entity DO. In the meantime, Yugandhar team also introduced additional feature which required to store height of the person in LE\_PERSON table so LePerson entity DO is modified and released in some next version of Yungandhar Open MDM Hub. Now if you upgrade your code to V2.0 then it might mess the code between both the teams. So there was a genuine need to separate the code for the Yugandhar team and customizations to work on. This is achieved by using abstract class and child classes.

There are two DOs provided for one entity, the abstractDO and the child DO e.g. LePersonDO AbstractLePersonDO. The thumb rule is that Yugandhar Development team will modify AbstractLePersonDO and customizations will be added to LePersonDO so to keep the change separate which will help to do code merging simple.

The below packages have the objects which can be used to extend or override the product behavior.

* + com.yugandhar.mdm.extern.dobj – All the entity data objects
  + com.yugandhar.common.extern.transferobj – The transfer object encapsulating the entity object
  + com.yugandhar.mdm.keygen.YugandharKeygenerator - to override default key generation
  + com.yugandhar.common.aop.ruleoverride – This is Aspect Oriented Programming (AOP) based rule to override the default behavior of transaction at pre and post level with before, after, around or proceedingJointPoint. You should copy and make as many aop rules as needed.

Its best practice to avoid making changes to any other class than that of mentioned above.

Also keep in mind that there is no restriction on introducing new service, entities and rules in your own project which will make use of Yugandhar projects mentioned above.

## Understanding Java classes

### <entity>Component.java

The Component beans handle the entity level data CRUD (Create, Update, Retrieve, Delete) operations. This bean refers and makes use of Entity Data Objects (DO), entity manager and JPA repository classes.

Component Bean primary have below methods

* Persist() –This method is used to create a new record in a database entity.
* merge() –This method is used to update existing record in a database entity based on primary key.
* findById() –This method is used to retrieve existing record in a database based on primary key.
* findByBusinessKey() – This method is used to search a database table based on business key e.g. firstname and lastName from Person table.

### <entity>ComponentRule.java

The component rule class used to write the business rules for a specific entity transaction based on the method from component bean is invoked. The entity transaction can have rules. The business rules are defined at below levels based on the transaction

* Rule cross points for Persist() method:
* prevalidatePersit
* preExecutePersist
* postExecutePersit

* Rule cross points for Merge() method
* PrevalidateMerge
* preExecuteMerge
* postExecuteMerge

* Rule cross points for FindById()
* postExecuteFindById
* prevalidateFindById
* Rule cross points for FindByBusinessKey() method
* postExecuteFindByBusinessKey
* prevalidateFindByBusinessKey

This rule class is carved out separately so that the users make the changes in the rule class instead of the Component class itself. This way any future changes in the component class made by Yugandhar Development Team will not mess up with the changes of users.

### <entity> JPA Repository.java

The JPA repository is implementation of org.springframework.data.jpa.repository.JpaRepository interface used primarily to search the data from the single database based business keys.

### <entity>Service.java

This is a Service type of Spring bean. The request from request Processor would always come to Service bean for further processing. The Service bean is a logical layer between RequestProcessor and Component bean introduced to create base or composite transaction and infuse any additional business logic so that Component beans are kept intact.

### Entity Data Object Classes

The entity data objects are used by hibernate to map the DO to database entities. We have bifurcated the DOs in AbstractDO and Child DO wherein the Yugandhar team will extend the Abstract DOs in upcoming releases. The users of the Product must always add additional attributes in Child DO objects so that the changes of Yugandhar Team and users are kept independent. Refer section ‘Externalizing the classes for customization’ for more details.

## Cache configuration

Yugandhar Open MDM Hub cache the Reference Data values (List of values stored as key-value pairs) so to improve transaction response time. It uses ehcahce as ehcache is an open source, standards-based cache that boosts performance, offloads your database, and simplifies scalability. It's the most widely-used Java-based cache because it's robust, proven, full-featured, and integrates with other popular libraries and frameworks. The ehcache configuration file is kept in /src/main/resources/ehcache.xml of the YugandharBootProject of the code base. The default ehcache expiry time is configured as 1296000 seconds (15 days) in the ehcache.xml configuration file. This may be revisited as per the requirements.

Ehcache is configured in Spring boot project application.properties file using below property

#ehcache

spring.cache.jcache.config=classpath:ehcache.xml

Visit [www.ehcache.org](http://www.ehcache.org) for understanding ehcache in further detail.

## Spring boot properties

* EWS:The Yugandhar Open MDM Hub for EWS uses application.properties and yugandhar-mdm.properties present at / yugandhar-mdmhub-boot-project-ews/src/main/resources folder. The Datasource, logging, ehcache, JTA transaction manager and Json configuration are currently configured in these property files. The properties are self-explanatory and should be enabled/disabled as needed. The data source userid and password can be plain text or encrypted, to encrypt a string use the command provided in the encryption utility and place the encrypted password at appropriate place. Refer Encryption utility section for more details.
* JEEC:The Yugandhar Open MDM Hub for JEEC uses application server data sources, ActiveMQ implementation and JTA transaction manager instance. It gets all the required details using application server JNDI, the configuration of required server configuration is provided in environment setup guide. There are very few configurations in properties file for JEEC in comparison to EWS.

# Understanding different Components

## Data Model

Yugandhar Open MDM has below types of entities in the database

### Data entities

### Reference data entities (Storing list of values as key – value pairs)

### Configuration tables

### Audit log tables

All the above entities are covered in comprehensive details in Data Model Guide.

## Understanding Application Configuration

### Application Properties

The application properties are stored in CONFIG\_APP\_PROPERTIES table.

### Error Codes registry

The error codes are stored in CONFIG\_ERRORCODE\_REGISTRY table. This table have CONFIG\_LANGUAGE\_CODE\_KEY attribute which is used to store multilingual support for the error code. By default Yugandhar Open MDM Hub take the language code from the header object (txnHeader.requesterLanguage attribute) of the request message and retrieve the error code on language code – error code combination.

### Transactions Registry

Every transaction is registered in CONFIG\_TXN\_REGISTRY table so to get picked by the request processor. The transaction name, class and method needs to be registered in the table.

### Multilingual support for reference tables

The list of languages considered for multilingual support is configured in CONFIG\_LANGUAGE\_CODE. This table should not be confused with REF\_LANGUAGE\_CODE which is used to store the LOV of worldwide languages available or served by enterprise.

The application configuration entities are covered in more detail in Data Model guide.

## Extending Data Model

### Extending existing Data Object

The existing data and reference data entities are extendable i.e. new persistent as well as non-persistent attributes can be added to existing Data Objects (DO). As mentioned in section ‘Externalization of java classes for customization’ there are two DOs provided for one entity, the abstractDO and the child DO e.g. LePersonDO AbstractLePersonDO. The thumb rule is that Yugandhar Development team will modify AbstractLePersonDO and user development team will modify LePersonDO so to keep the change separate which will help to do code merging simple.

Below is the process to add new attribute to existing entity

1. Add an attribute in the database in the base table which needs to be extended (e.g. LE\_PERSON).
2. Modify <entity>DO class of the entity (e.g. LePersonDO) and add the new attribute manually. Generate getters and setters for the same using eclipse IDE.
3. If you want to add any business validation or logic around this attribute then use Aspect oriented programming to add the business logic of pre / post / around the existing services as mentioned in section ‘Understanding Java classes’ in the class <entity>ComponentRule.java.
4. Do not modify the OOTB product classes to add any business logic as this will defeat the externalization purpose. Also it will create trouble while upgrading the product to next version of Yugandhar Open MDM Hub.

A sample aop rule ‘com.yugandhar.common.aop.ruleoverride.YugandharRuleOverrideAspect’ is provided in the

### Introducing new Data Object

Introduction of New data Object is done when a completely new database entity needs to be created in database. The details of this step are covered in Code Generation Guide.

## Optimistic Lock

To avoid concurrent update of the same record, MDM Hub use optimistic lock based on VERSION attribute of the database. MDM hub relies heavily on Hibernate Optimistic lock feature.

Optimistic locking assumes that multiple transactions can complete without affecting each other, and that therefore transactions can proceed without locking the data resources that they affect. Before committing, each transaction verifies that no other transaction has modified its data. If the check reveals conflicting modifications, the committing transaction rolls back. When your application uses long transactions or conversations that span several database transactions, you can store versioning data, so that if the same entity is updated by two conversations, the last to commit changes is informed of the conflict, and does not override the other conversation's work. This approach guarantees some isolation, but scales well and works particularly well in Read-Often Write-Sometimes situations. \* (The definition is as per Hibernate website)

So while updating a record in database through CDI services, the version attribute needs to be provided in the request having the value matching with the value in the database. e.g. For updating LE\_PERSON table having idpk x, provide the legalentityDO. lePersonDO.version attribute the same as that in the database for idpk x.

## Building Services

Service is a spring bean class which can be integrated with Yugandhar Open MDM Hub request response framework so that set of business logic is executed as one transaction.

Logically there are three types of entity services

1. Base entity services

Base entity services perform CRUD (create, retrieve, update and delete) operations on single database entity.

1. Composite Services

Composite entity services perform CRUD (create, retrieve, update and delete) operations on multiple database entities as single transaction. Also composite services can have composition of create/ retrieve/ update or delete in single services. e.g. updateLegalEntity service update the legal entity record along with person, corporation, address and identifiers etc. also you may associate new address or identifier through this service itself.

Also, search services can also considered as composite services.

1. Search Services: Search services may use JPA repository or JDBC native SQLs for searching the data entities.

Samples –

1. Base entity Service – Refer *com.yugandhar.mdm.corecomponent.PersonnamesComponent.findByLegalEntityIdPk()* method which is registered as transaction. You may skip writing the code to rule class (e.g. PersonnamesComponentRule.prevalidatexxx() ) and directly write the logic in your method.
2. Composite Service – Refer OOTB service class com.yugandhar.mdm.composite.service.CreateLegalEntityService
3. Search Service – Refer OOTB Service class com.yugandhar.mdm.composite.service.SearchLegalEntityByLEAttributesService

After writing the code you need to register this as a transaction in Configuration transaction registry CONFIG\_TXN\_REGISTRY table. You may use below sql to register the transaction

|  |
| --- |
| Insert into <SCHEMA\_NAME>.CONFIG\_TXN\_REGISTRY  (ID\_PK, VERSION, TXNSERVICE\_NAME, TXNSERVICE\_CLASS, TXNSERVICE\_CLASSMETHOD, DESCRIPTION,CREATED\_TS, UPDATED\_TS, UPDATED\_BY\_USER, UPDATED\_TXN\_REF\_ID)  Values  (YUG\_REGISTRY\_SEQ.nextval, 0, '*<name of transaction>*', '*<fully qualified name of the class which have the method>* , '*<method name>*',  '*<description of the service>*', CURRENT\_TIMESTAMP,CURRENT\_TIMESTAMP,'*<user name>', '<transaction id>*');  COMMIT; |

The MDM Hub request response framework invokes the given method using Spring ReflectionUtils framework.

The TxnTransferObj is the default transfer object of MDM request and response. The TxnTransferObj encapsulates TxnPayload object which is the wrapper for all the objects. So if you are introducing a whole new object as request or response then you need to define this in TxnPayload object. Please refer Code Generation guide to understand how to define an object in TxnPayload object.

## Modifying Business Rules using Aspect Oriented Programming

Validation and Business rules are defined in Component rule classes. Yugandhar Open MDM Hub provides several Out of the Box (OOTB) business validations for Create, update, retrieve, find and search transactions of every entity. These rules are extendable so a developer can use Aspect Oriented programming (AOP) feature of Spring to add completely new logic or change the logic already written in OOTB code base. The join points for the rule modification are mentioned in ‘<entity>ComponentRule.java’ section of ‘Understanding Java classes’ section.

A sample rule override aspect YugandharRuleOverrideAspect is provided in the package com.yugandhar.common.aop.ruleoverride along with code base which have ProceedingJoinPoint on the preExecuteLegalentityCompMerge method of com.yugandhar.mdm.corecomponent.LegalentityComponentRule class.

Refer Spring Documentation for detailed understanding of AOP

<https://docs.spring.io/spring/docs/4.3.x/spring-framework-reference/html/aop.html>

<https://docs.spring.io/spring/docs/current/spring-framework-reference/core.html>

## Authorization Framework (Access Control)

Authorization framework is used to provide access to the user or group to a particular transaction service. The authorization framework consists of below data entities

* + AUTH\_ROLES\_REGISTRY -This Table stores the Authorization roles
  + AUTH\_USER\_REGISTRY - This table stores the user names
  + AUTH\_USER\_ROLE\_ASSOC - This table stores the user to role association.
  + AUTH\_USERROLE\_ACCESSCONTROL - This table stores the user/role to txn mapping so that execution of the transaction is controlled based on the transaction being invoked from the request. PROFILE\_TYPE can be either USER or ROLE, mention the IDPK of the AUTH\_ROLES\_REGISTRY if PROFILE\_TYPE is role else mention the IDPK of AUTH\_USER\_REGISTRY if PROFILE\_TYPE is USER
  + CONFIG\_APP\_PROPERTIES – the property com\_yugandhar\_authorization\_framework\_enabled must be set to true in this table. The authorization framework can be disabled altogether if the value is set to false. There might be a need to disable the authorization framework in non-production environment or in production for some specific business scenario. If so, this property must be set to false so that the framework is disabled.

Before invoking the transaction, the request processor performs the authorization based on txnHeader.userName or txnHeader.userRole and txnHeader.transactionServiceName attributes.

The searchAuthAccessControl service is used to perform the authorization based on below rule

1. If username and userRole are present in the request then authorization if all of the below conditions are satisfied
   * The given user must be present in AUTH\_USER\_REGISTRY table.
   * The given role must be present in AUTH\_ROLES\_REGISTRY table.
   * The user must be associated with the given role in AUTH\_USER\_ROLE\_ASSOC table
   * The role has access to the transaction invoked i.e. AUTH\_USERROLE\_ACCESSCONTROL have entry for given role and transaction service name.
2. If userRole is present and username is null in the request then role is authorized to perform the given transaction if all the below conditions are satisfied
   * The given role must be present in AUTH\_ROLES\_REGISTRY table.
   * The role has access to the transaction invoked i.e. AUTH\_USERROLE\_ACCESSCONTROL have entry for given role and transaction service name.
3. If username is present and userRole is null in the request then user is authorized to perform the given transaction if all the below conditions are satisfied
   * The given user must be present in AUTH\_USER\_REGISTRY table.
   * The user has access to the transaction invoked i.e. AUTH\_USERROLE\_ACCESSCONTROL have entry for given user or role and transaction service name.

Sample header objects are as below

|  |  |
| --- | --- |
| Sample 1 -  username and roleName both are present in header | "txnHeader": {  "userName": "rakesh",  "userRole": "admin",  "transactionServiceName": "createLegalEntity"  } |
| Sample 2-  Only roleName present in header | "txnHeader": {  "userRole": "admin",  "transactionServiceName": "createLegalEntity"  } |
| Sample 3 -  Only username is present in header | "txnHeader": {  "userName": "rakesh",  "transactionServiceName": "createLegalEntity"  } |

Note – As Yugandhar Open MDM Hub is built on SOA framework, authentication (user credentials validation) framework is not provided. The application heavily depends on Application Server features (e.g. LDAP or webseal integration, SSL handshake etc) for user authentication. It is considered that the user or role name coming in the request is valid and authenticated.

The rules for authorization are defined in com.yugandhar.mdm.auth.searchAuthAccessControlService class. So if there is a need to change the above mentioned rules then write a new service for authorization and replace the TXNSERVICE\_CLASS and TXNSERVICE\_CLASSMETHOD with appropriate values as per new rule class.



## Inquiry Level Framework

Inquiry level framework provides capability to define different levels of output for the same transaction based on inquiry level. e.g. for OOTB transaction, retrieveLegalentity transaction provides different level of output based on inquiry level 101, 102 and so on.

**The Data Model:**

The Inquiry level framework consists of single data entity CONFIG\_INQUIRY\_LEVELS.

**OOTB Service**: findAllConfigInquiryLevelsByBusinessKeyBase – this service search the CONFIG\_INQUIRY\_LEVELS table based on INQUIRY\_LEVEL and APPLICABLE\_DOBJ attributes.

The model is very simple wherein you need to define the applicable Data object and child object which would be part of that object as a result. E.g. as mentioned in ‘currently configured Inquiry levels for Legal entity’ section, you can see that for inquiry level 102 the application Data object is LegalentityDO which would have LeSystemKeysRegistryDO, LePersonDO or LeCorporationDO if the data for these object is present. No other data will be pulled for this inquiry level.

|  |  |  |
| --- | --- | --- |
| 102 | LegalentityDO | LeSystemKeysRegistryDO |
| 102 | LegalentityDO | LePersonDO |
| 102 | LegalentityDO | LeCorporationDO |

Also it’s very much possible to define multilevel inquiry levels for the same transaction e.g. as shown in the below snippet, the retrieveLegalEntityByLegalEntityId have legal entity inquiry level as well as account inquiry level set. So LE inquiry level 106 includes AccountDO and while retrieving account for the LE the account inquiry level is used. Currently multilevel inquiry levels are NOT widely used in OOTB services so you may need to do customization for additional level of inquiry levels.

|  |
| --- |
| {"txnHeader": {  ………  "transactionServiceName": "retrieveLegalEntityByLegalEntityId"  },  "txnPayload": {  "legalentityDO": {  "idPk": "77776663666777799dg",  "inquiryLevel": "106",  "accountInquiryLevel":"103"  }}} |

### Introducing new inquiry level

For introducing new inquiry level you need to define new inquiry level and insert the rows in CONFIG\_INQUIRY\_LEVELS table with applicable\_DOBj and child DOBJ.

e.g. if you want to retrieve only the LePersonDO and address of the legal entity then you may create a new inquiry level (e.g. 200001) and create these rows.

|  |  |  |
| --- | --- | --- |
| 200001 | LegalentityDO | LePersonDO |
| 200001 | LegalentityDO | LeCorporationDO |
| 200001 | LegalentityDO | LeAddressAssocDO |

The above example will work for the OOTB transactions where inquiry level is used. (Please note that the data object names are case sensitive in OOTB services). However if you are creating a new composite service then you must write the logic to return the response based on inquiry level, you may refer the code of *com.yugandhar.mdm.composite.service.RetrieveLegalEntityByLegalEntityIdService* class and retrieveConfigInquiryLevelChildObjList() method in the same class.

### Configuring Default Inquiry levels for Legal Entity and Account

The properties of the CONFIG\_APP\_PROPERTIES have below properties for defining the default inquiry level value if inquiry level is not provided in the request. You may change the default inquiry level if needed.

|  |  |
| --- | --- |
| Property Name | Value |
| com\_yugandhar\_inqlevel\_defaultvalue\_retrieve\_AccountDO | 101 |
| com\_yugandhar\_inqlevel\_defaultvalue\_retrieve\_LegalentityDO | 102 |
| com\_yugandhar\_inqlevel\_defaultvalue\_search\_LegalentityDO | 101 |
| com\_yugandhar\_inqlevel\_defaultvalue\_search\_AccountDO | 101 |

### Currently configured Inquiry levels for Legal entity

|  |  |  |
| --- | --- | --- |
| INQUIRY\_LEVEL | APPLICABLE\_DOBJ | CHILD\_DOBJ |
| 101 | LegalentityDO | LeSystemKeysRegistryDO |
| 102 | LegalentityDO | LeSystemKeysRegistryDO |
| 102 | LegalentityDO | LePersonDO |
| 102 | LegalentityDO | LeCorporationDO |
| 103 | LegalentityDO | LeSystemKeysRegistryDO |
| 103 | LegalentityDO | LePersonDO |
| 103 | LegalentityDO | LeCorporationDO |
| 103 | LegalentityDO | LeAddressAssocDO |
| 103 | LegalentityDO | LePhoneAssocDO |
| 103 | LegalentityDO | LePreferencesDO |
| 104 | LegalentityDO | LeSystemKeysRegistryDO |
| 107 | LegalentityDO | LePersonDO |
| 107 | LegalentityDO | LeCorporationDO |
| 104 | LegalentityDO | LePersonDO |
| 107 | LegalentityDO | LeAccountAssocDO |
| 108 | LegalentityDO | LePersonDO |
| 108 | LegalentityDO | LeCorporationDO |
| 108 | LegalentityDO | LeAddressAssocDO |
| 104 | LegalentityDO | LeCorporationDO |
| 104 | LegalentityDO | LeAddressAssocDO |
| 104 | LegalentityDO | LePhoneAssocDO |
| 104 | LegalentityDO | LePreferencesDO |
| 104 | LegalentityDO | LeIdentifierKycRegistryDO |
| 104 | LegalentityDO | MiscellaneousInfoDO |
| 105 | LegalentityDO | LeSystemKeysRegistryDO |
| 105 | LegalentityDO | LePersonDO |
| 105 | LegalentityDO | LeCorporationDO |
| 105 | LegalentityDO | LeAddressAssocDO |
| 105 | LegalentityDO | LePhoneAssocDO |
| 105 | LegalentityDO | LePreferencesDO |
| 105 | LegalentityDO | LeIdentifierKycRegistryDO |
| 105 | LegalentityDO | MiscellaneousInfoDO |
| 105 | LegalentityDO | LeAccountAssocDO |
| 106 | LegalentityDO | LeSystemKeysRegistryDO |
| 106 | LegalentityDO | LePersonDO |
| 106 | LegalentityDO | LeCorporationDO |
| 106 | LegalentityDO | LeAddressAssocDO |
| 106 | LegalentityDO | LePhoneAssocDO |
| 106 | LegalentityDO | LePreferencesDO |
| 106 | LegalentityDO | LeIdentifierKycRegistryDO |
| 106 | LegalentityDO | MiscellaneousInfoDO |
| 106 | LegalentityDO | LeAccountAssocDO |
| 106 | LegalentityDO | LePropertyAssocDO |
| 106 | LegalentityDO | LeVehicleAssocDO |
| 106 | LegalentityDO | LeToLeRelationshipDO |
| 107 | LegalentityDO | LeSystemKeysRegistryDO |
| 108 | LegalentityDO | LePhoneAssocDO |
| 108 | LegalentityDO | LeIdentifierKycRegistryDO |

### Currently configured Inquiry levels for Account

|  |  |  |
| --- | --- | --- |
| INQUIRY\_LEVEL | APPLICABLE\_DOBJ | CHILD\_DOBJ |
| 101 | AccountDO | AccountDO |
| 102 | AccountDO | AccountAddressAssocDO |
| 102 | AccountDO | AccountPhoneAssocDO |
| 103 | AccountDO | AccountAddressAssocDO |
| 103 | AccountDO | AccountPhoneAssocDO |
| 103 | AccountDO | LeAccountAssocDO |

## Pagination Framework

The Pagination framework supports paged retrieval of the information. The txnPayload object have below attributes which needs to be provided while invoking the transaction.

### Request Parameters -

paginationIndexOfCurrentSlice – used to provide the requested page number

paginationPageSize - Input parameter to define the size of the page (e.g. 25 elements or 100 elements

### Response Parameters

The response returns additional information about the total number of pages, elements on current slice and total elements.

* **paginationIndexOfCurrentSlice**: Same as that of Input parameter
* **paginationPageSize**: Same as that of the request parameter
* **paginationInfoElementsOnCurrentSlice** - Output information on elements database rows on the current slice or page.
* **paginationInfoTotalElements**: Output information on total number of elements database rows) for given search/retrieve/find criteria. This attribute is returned only in case of retrieve transaction response and NOT in search response as search result may potentially be very large and it will degrade the transaction response time if total number of elements is to be calculated.
* **paginationInfoTotalPages**: Output information on total number of pages for given search/retrieve/find criteria. This attribute is returned only in case of retrieve transaction response and NOT in search response as search result may potentially be very large and it will degrade the transaction response time if total number of elements is to be calculated.

Sample request xml

|  |
| --- |
| {  "txnHeader": {  ……  "transactionServiceName": "searchLegalEntityByLEAttributes"  },  "txnPayload": {  "paginationIndexOfCurrentSlice":0,  "paginationPageSize": 100,  "searchLegalEntityRequestDO": {  "displayName": "%ABC",  "personNameOne": "%Name",  "personLastName": "Last",  "corporationName": null,  "addressLineOne": "Line1",  "addressLineTwo": "Line2",  "city": "Pune",  "stateProvinceRefkey": "1",  "countryRefkey": "1",  "postalCode": "1",  "identificationTypeRefkey": "1",  "identificationNumber":"%111%",  "phoneNumber": "1",  "systemKeysRegistryReferenceId": "1",  "inquiryFilter":"ACTIVE",  "inquiryLevel": null  }}} |

At the entity manager level, Yugandhar Open MDM Hub uses the jpa repository in retrieve transactions and entity manager query parameters for search transactions. Refer the code of below class to understand at the code level

**Configuring pagination for search transactions:** com.yugandhar.mdm.composite.service.SearchLegalEntityByLEAttributesService

**Configuring pagination for retrieve transactions**: LePreferencesComponent.findByLegalEntityIdPk()

## Reference data management

## Pluggable primary keys

Pluggable primary key feature enables creating the record in the database with given primary key in the request. Generation of the primary key in MDM Hub happens as per below logic

1. If primaryKeyDO is present for a given DO then verify that no record having given idpk is present in the database and then create a new record in database.
2. If primaryKeyDO then generate the primary key based on default primary key generator and create a record in database.

The primary key generator is externalized in YugandharKeygenerator class. You may override the default generateKey() method if unique key generation logic needs to be customized.

Snippet: Create legal entity transaction with user provided idpk

|  |
| --- |
| "transactionServiceName": "createLegalEntity"  },  "txnPayload": {  "legalentityDO": {  "primaryKeyDO": {  "idPk": "77776663666AAAA211"  },  "displayName": "JOHN MCLEAN", |

Snippet: Create legal entity transaction with auto generated idpk

|  |
| --- |
| "transactionServiceName": "createLegalEntity"  },  "txnPayload": {  "legalentityDO": {  "idPk": null  "displayName": "JOHN MCLEAN", |

By default, every persistent data Object (DO) a primaryKeyDO is provided in the MDM Hub. This is also applicable for DOs generated using Yugandhar free-marker Generators.

## Application Logging

The MDM Hub application logging is configured using logback logging framework using below spring boot properties (application.properties file)

# logging

logging.pattern.console=%d{yyyy-MM-dd HH:mm:ss} %-5level %logger**{36}** - %msg%n

logging.level.org.hibernate.SQL=info

logging.level.org.hibernate.type.descriptor.sql=trace

logging.level.com.yugandhar.\*=INFO

logging.config= classpath:yugandhar\_logback.xml

#logging.file= #

Currently below loggers are defined in yugandhar\_logback.xml

YugandharPerfSummaryLogger – This logger logs the performance summary of every transaction having success response.

YugandharPerfErrorSummaryLogger - This logger logs the performance summary of every transaction having failure response

YugandharCommonLogger – This is the common logger which logs the application processing.

YugandharCacheLogger - This logger logs the ehcache and caching framework related logs.

YugandharMQRequestResponseLogger – This logger logs the request and response messages received through MQ.

YugandharMatchEngineLogger – This logger is used to log the messages related to matching engine.

You may change the log levels, log file name pattern, appender type etc using logback xml.

## Audit Logs

The Audit log framework consists of database tables to store the insert, update and delete operations performed on every single record of the database. Refer ‘Understanding Audit Log table structure’ of the data model guide for complete coverage of the functionality.

## Match and Merge framework

The match and merge framework gets invoked at the end of create and update legal entity composite services. The matching can be performed in realtime, near-realtime and batch modes.

### Match engine rule types

Currently deterministic and fuzzy matching rules can be defined in the matching

**Deterministic –** find the search candidates with exact matching the search attributes. Objects will be considered match if all the attributes match exactly.

**Fuzzy -** find the search candidates with phonetic matching the search attributes which increases the search candidates which may probably get rejected in deterministic searches. In the current fuzzy match, the Objects are considered match if all the attributes match exactly.

### Modes of Match engine

**Realtime Mode**: in this mode the matching will be performed at the end of create/update transaction. As the matching gets performed as part of create/update transactions, the response time would be very high and it’s not recommended to go for realtime mode unless strongly needed.

**Near-Realtime mode**: In this mode the legalentity matching will be performed in decoupled mode by doing the matching through JMS framework. At the end of create/update transaction, a message will be send to CDI request queue to invoke performLeMatch transaction to do le matching. This way the matching will be decoupled with the create/update transaction improving the response time of the transactions.

**Batch mode:** In batch mode, an entry will be made in BATCH\_ENTITY\_TO\_PROCESS table with proposed action code as ‘2: SEARCH MATCH CANDIDATE’. Some batch processor job (e.g. ETL or custom job) to invoke the performLeMatch as per convenient time schedule.

The modes can be configured by setting the com\_yugandhar\_match\_le\_candidateSearch\_processing\_mode property in configuration properties

### Configuration properties

|  |  |  |
| --- | --- | --- |
| **Property Name** | **Value** | **description** |
| com\_yugandhar\_match\_le\_framework\_enabled | true | To enable or disable the match engine / framework. |
| com\_yugandhar\_match\_le\_engine\_type | deterministic | The match engine type. Valid values fuzzy or deterministic |
| com\_yugandhar\_match\_le\_Deterministic\_LePerson\_RuleClass | com.yugandhar.mdm.match.rules.LePersonDeterministicMatchRule | Person match deterministic rule class |
| com\_yugandhar\_match\_le\_Deterministic\_LePerson\_RuleClassMethod | process | Person match deterministic rule class method name |
| com\_yugandhar\_match\_le\_Fuzzy\_LePerson\_RuleClass | com.yugandhar.mdm.match.rules.LePersonFuzzyMatchRule | Person match fuzzy rule class |
| com\_yugandhar\_match\_le\_Fuzzy\_LePerson\_RuleClassMethod | process | Person match fuzzy rule class method name |
| com\_yugandhar\_match\_le\_Deterministic\_LeCorporation\_RuleClass | com.yugandhar.mdm.match.rules.LeCorporationDeterministicMatchRule | corporation match deterministic rule class |
| com\_yugandhar\_match\_le\_Deterministic\_LeCorporation\_RuleClassMethod | process | corporation match deterministic rule class method name |
| com\_yugandhar\_match\_le\_Fuzzy\_LeCorporation\_RuleClass | com.yugandhar.mdm.match.rules.LeCorporationFuzzyMatchRule | corporation match fuzzy rule class |
| com\_yugandhar\_match\_le\_Fuzzy\_LeCorporation\_RuleClassMethod | process | corporation match fuzzy rule class method name |
| com\_yugandhar\_match\_le\_Deterministic\_LePerson\_inquiryLevel\_default | 108 | Default Legal entity inquiry level for person match candidates in deterministic rule |
| com\_yugandhar\_match\_le\_Fuzzy\_LePerson\_inquiryLevel\_default | 108 | Default Legal entity inquiry level for person match candidates in fuzzy rule |
| com\_yugandhar\_match\_le\_Deterministic\_LeCorporation\_inquiryLevel\_default | 108 | Default Legal entity inquiry level for corporation match candidates in deterministic rule |
| com\_yugandhar\_match\_le\_Fuzzy\_LeCorporation\_inquiryLevel\_default | 108 | Default Legal entity inquiry level for corporation match candidates in fuzzy rule |
| com\_yugandhar\_match\_le\_candidateSearch\_processing\_mode | near-realtime | define how the candidate search process runs, valid values are realtime,near-realtime or batch |

### Data Model

**MATCH\_CANDIDATE\_LE\_REGISTRY:**

This table stores the match results after performing matching on particular legal entity. e.g. if legal entity A1 is being matched and identified to have A2 and A3 as candidate legal entities having match pattern with A2 as YYYNYY and with A3 as NYYYYN, identified to be manual reviewed before merging then two records would be created in this table with ID\_PK of A1 legal entity to be mapped to LEGALENTITY\_IDPK attribute and ID\_PK of A2 being mapped to CANDIDATE\_LEGALENTITYIDPK attribute. YYYNYY being mapped to MATCH\_PATTERN, MATCH\_PROPOSED\_ACTION\_REFKEY as defined in REF\_MATCH\_PROPOSED\_ACTION, MATCH\_ACTIONSTATUS\_REFKEY mapped as defined in REF\_MATCH\_ACTIONSTATUS tables. The percentage match after performing the matching is stored inMATCH\_PERCENTAGE\_DESCRIPTION attribute.

**MATCH\_MERGED\_LE\_ASSOC:**

This table stores the legal entity relation after performing the matching. e.g. if Legalentity A1 is merged with A2 where A1 is survivor then the ID\_PK of A1 legal entity should be stored in SURVIVOR\_LEGALENTITY\_IDPK and ID\_PK of A2 legal entity should be stored in MERGED\_LEGALENTITY\_IDPK attribute. The reason for the merge should be stored in MERGE\_REASON\_REFKEY attribute along with any comments in the COMMENTS column

**REF\_MATCH\_ACTIONSTATUS:** The match action status LOV

**REF\_MATCH\_PROPOSED\_ACTION:** The match Proposed action LOV

**REF\_MATCH\_RESULT:** The match result LOV used to store if the match is exact match, close match etc

**REF\_MATCH\_SCORE:** The match score LOV used to store the match attribute pattern

**REF\_MATCH\_THRESHOLD :** This LOV stores the threshold of the match e.g. if an attribute match 80% then only it should be considered a close match etc.

### Candidate search transaction Service

Service Name - searchMatchCandidateLE

Java Class - com.yugandhar.mdm.composite.service.SearchMatchCandidateLEService class

### Match rules

The below rules are defined in com.yugandhar.mdm.match.rules package

**Corporation Match Rules**

* LeCorporationDeterministicMatchRule
* LeCorporationFuzzyMatchRule

**Person Match Rules**

* LePersonDeterministicMatchRule
* LePersonFuzzyMatchRule

**Common Match rule**

* LeAddressAndPhoneMatchRule

### Services of match and merge framework

**List of Base Services**

|  |  |
| --- | --- |
| **Service Name** | **Description** |
| findAllRefMatchScoreByMatchEntityObjectName | find All records by language code |
| createRefMatchThresholdBase | create record in the database |
| updateRefMatchThresholdBase | update the database record based on primary key i.e. idpk |
| retrieveRefMatchThresholdBase | retrieve the record from database based on primary key i.e. idpk |
| findRefMatchThresholdByBusinessKeyBase | find the unique record from dababase based on by business key |
| findAllRefMatchThresholdBase | find All records by language code |
| createRefMatchActionstatusBase | create record in the database |
| updateRefMatchActionstatusBase | update the database record based on primary key i.e. idpk |
| retrieveRefMatchActionstatusBase | retrieve the record from database based on primary key i.e. idpk |
| findRefMatchActionstatusByBusinessKeyBase | find the unique record from dababase based on by business key |
| findAllRefMatchActionstatusByLanguageCodeBase | find All records by language code |
| createRefMatchProposedActionBase | create record in the database |
| updateRefMatchProposedActionBase | update the database record based on primary key i.e. idpk |
| retrieveRefMatchProposedActionBase | retrieve the record from database based on primary key i.e. idpk |
| findRefMatchProposedActionByBusinessKeyBase | find the unique record from dababase based on by business key |
| findAllRefMatchProposedActionByLanguageCodeBase | find All records by language code |
| createRefMatchResultBase | create record in the database |
| updateRefMatchResultBase | update the database record based on primary key i.e. idpk |
| retrieveRefMatchResultBase | retrieve the record from database based on primary key i.e. idpk |
| findRefMatchResultByBusinessKeyBase | find the unique record from dababase based on by business key |
| findAllRefMatchResultByLanguageCodeBase | find All records by language code |
| createRefMatchScoreBase | create record in the database |
| updateRefMatchScoreBase | update the database record based on primary key i.e. idpk |
| retrieveRefMatchScoreBase | retrieve the record from database based on primary key i.e. idpk |
| findRefMatchScoreByBusinessKeyBase | find the unique record from dababase based on by business key |
| createMatchCandidateLeRegistryBase | create record in the database |
| updateMatchCandidateLeRegistryBase | update the database record based on primary key i.e. idpk |
| retrieveMatchCandidateLeRegistryBase | retrieve the record from database based on primary key i.e. idpk |
| createMatchMergedLeAssocBase | create record in the database |
| updateMatchMergedLeAssocBase | update the database record based on primary key i.e. idpk |
| retrieveMatchMergedLeAssocBase | retrieve the record from database based on primary key i.e. idpk |
| searchMatchCandidateLeRegistryBase | search all records of MATCH\_CANDIDATE\_LE\_REGISTRY table based on legalentityidpk candidateLegalentityidpk or matchPattern or matchProposedActionRefkey or matchActionstatusRefkey or all attributes |
| searchMatchMergedLeAssocBase | search all records of MATCH\_MERGED\_LE\_ASSOC table based on survivorLegalentityIdpk or mergedLegalentityIdpk or mergeReasonRefkey or all |

**Composite services**

|  |  |
| --- | --- |
| **Service Name** | **Description** |
| searchMatchCandidateLE | searchMatchCandidateLEService |
| performLeMatch | Performs the Legal Entity matching and create candidates |

Note – the match and merge framework is currently in BETA mode. The merge and survivorship rules are yet to be introduced.

## JMS Integration

Yugandhar Open MDM Hub by default uses Active MQ as messaging provider. The MDM Hub EWS is packaged with its own ActiveMQ setup, on the other hand JEEC depends heavily on Jboss server resources to integrate with MQ Server and uses JNDI to connect to MQ server.

The package ‘com.yugandhar.jms’ have the below listener and sender along with some sample and test classes.

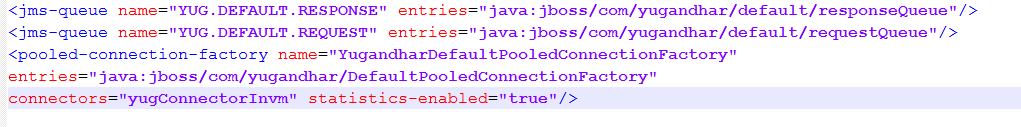
### Default Listener

MDM Hub has default MQ Listener defined in YugDefaultRequestQueueListener class which listens to queue YUG.DEFAULT.REQUEST using JMS configuration. For the JEEC version, a jms destination ‘java:jboss/com/yugandhar/default/requestQueue’ is defined in jboss server configuration which creates connectivity with queue and listener. The connection factory ‘yugJNDIDestJmsListenerContainerFactory’ is also defined in jboss configuration

### Default Sender

Default message sender for outbound messages is defined in YugJMSMessageSender class. The default response queue of MDM Hub is YUG.DEFAULT.RESPONSE. For the JEEC version, this queue is mapped to jms destination ‘java:jboss/com/yugandhar/default/responseQueue"’ defined on jboss application server.

The below entries in the jboss server defines the default request and response queues



Refer section ‘Configure RedHat JBOSS EAP’ of Development Environment Setup document to understand more about the jboss configuration.

## Phonetic searches

MDM Hub provides support for Phonetic searches on Person and corporation names as well as address attributes. In order to support the phonetic searches MDM Hub stores the phonetic attributes of the actual attribute. E.g. for LAST\_NAME of person, there is another attribute PHONETIC\_LAST\_NAME which stores the phonetic value of LAST\_NAME

### Phonetic attributes in PERSONNAMES tables

PHONETIC\_LAST\_NAME

PHONETIC\_NAME\_ONE

PHONETIC\_NAME\_THREE

PHONETIC\_NAME\_TWO

### Phonetic attribute in CORPORATIONNAMES table

PHONETIC\_CORPORATION\_NAME

### Phonetic attributes in ADDRESS table

PHONETIC\_ADDRESS\_LINE\_FOUR

PHONETIC\_ADDRESS\_LINE\_ONE

PHONETIC\_ADDRESS\_LINE\_THREE

PHONETIC\_ADDRESS\_LINE\_TWO

PHONETIC\_CITY, PHONETIC\_COUNTY

PHONETIC\_DISTRICT\_ZONE

PHONETIC\_STREET\_NAME

The configuration properties can be used to turn off the phonetic framework altogether. Also the default class to generate the phonetic value can also be changed if needed. Currently apache commons Nysiis class is used to generate phonetic values.

|  |  |
| --- | --- |
| Property Name | Value |
| com\_yugandhar\_phonetic\_framework\_enabled | true |
| com\_yugandhar\_phonetic\_algorithm\_class | org.apache.commons.codec.language.Nysiis |
| com\_yugandhar\_phonetic\_algorithm\_class\_method | encode |

Note – Currently phonetic searches are used only for searching match candidates. We plan to have extend the existing search transactions for phonetic searches in upcoming releases. However you can build your own services to search entities based on phonetic values. You may refer SearchMatchCandidateLEService code to understand the writing phonetic queries.

# Encryption Utility

The yugandhar-mdmhub-app.properties of EWS provides a functionality to have encrypted username and password for datasource. On the other hand, JEEC relies on the application server to encrypt the credentials.

A utility to encrypt a string is provided in the MDM. You may use this utility to encrypt and decrypt any other properties as required.

YugandharEncoderDecoder Arguments:

* Required: operation name valid values 'encode/decode'
* Required: input String valid values: any UTF-8 complaint String

**Encoder example:** YugandharEncoderDecoder encode mypassword

**Decoder example:** YugandharEncoderDecoder decode bXlwYXNzd29yZA==

Follow below steps to encrypt a password

* **Create a Jar file:** Package the ews as yugandhar-open-mdmhub-ews.jar using maven or eclipse export as jar functionality.
* **To Encode:** Open the command line, change the current directory where above jar is present. Execute below command to encrypt the password

*java -cp yugandhar-microservice-platform-ews.jar com.yugandhar.common.util.YugandharEncoderDecoder encode mypassword*

Result will be displayed as below:

*Encoded String:bXlwYXNzd29yZA==*

* **To decode:** Open the command line and provide below command

*java -cp yugandhar-microservice-platform-ews.jar com.yugandhar.common.util.YugandharEncoderDecoder decode bXlwYXNzd29yZA==*

Decoded string will be displayed as below

*Decoded String:mypassword*

# Setting up the Development Environment (Workspace)

Please refer ‘Development Environment Setup Guide’ document.

# Code Generation using Freemarker templates and Hibernate tools

Please refer ‘Code Generation Guide’ document.

# Invoking the transactions

Please refer ‘API and Transaction Reference Guide’ Document.

# Understanding Data Model

Please refer Data Model Guide and DB Doc.