Mobile Search Framework Architecture

Candidate Version 1.0 – 23 Feb 2010

Open Mobile Alliance

OMA-AD-MSrchFramework-V1_0-20100223-C

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1. Scope   (Informative)

The Architecture Document (AD) illustrates the Mobile Search Framework Enabler from an architectural perspective. This document contains the architecture diagram as well as functional components and interfaces definitions. To further demonstrate the architecture of the MSrchFramework Enabler, several flows are included in Appendix B.

This document does not contain any detailed definition of the components or the parameters of interfaces. These definitions are included in the TS document

2. References

2.1 Normative References

[OSE]	"OMA Service Environment", Open Mobile Alliance™, URL:http://www.openmobilealliance.org/
[RFC2119]	"Key words for use in RFCs to Indicate Requirement Levels", S. Bradner, March 1997, URL:http://www.ietf.org/rfc/rfc2119.txt
[OMA-MSrchFramework-RD]	"Mobile Search Framework Requirements", Open Mobile Alliance™, OMA-RD-MSrchFramework-V1_0, URL:http://www.openmobilealliance.org/

2.2 Informative References

[OMADICT]	"Dictionary for OMA Specifications", Version x.y, Open Mobile Alliance™, OMA-ORG-Dictionary-Vx_y, URL:http://www.openmobilealliance.org/
[OMA-PRS-IMPS-AD]	"Presence IMPS Architecture v1.3", OMA-AD-IMPS-V1_3, Open Mobile Alliance™, URL:http://www.openmobilealliance.org/
[OMA-PRS-SIMPLE]	"Presence SIMPLE Specification", Open Mobile Alliance™, OMA-TS-Presence_SIMPLE-V1_0, URL:http://www.openmobilealliance.org/
[OMA-MLS-AD]	"Mobile Location Service Architecture v1.0", OMA-AD-MLS-V1_0, Open Mobile Alliance™, URL:http://www.openmobilealliance.org/
[OMA-MOBAD]	"Mobile Advertising", Open Mobile Alliance™, OMA-ERP-MobAd-V1_0 URL: http://www.openmobilealliance.org/

3. Terminology and Conventions

3.1   Conventions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

All sections and appendixes, except "Scope" and "Introduction", are normative, unless they are explicitly indicated to be informative.

3.2   Definitions

User Interest Model	User Interest Model is created using User related information e.g Search History, user profile. This can facilitate to know what Search Domain user is more interested in. Further, it may also help to understand user preference inside that particular Search Domain.
Meta-Index	Meta-index is the information used to describe the content which a MSF-Source can provide. This information may be used for Search Engine selection.
Personalization Score	Personalization Score is the similarity between User related information and the result documents. It shows how well the result documents suits user's preference.
Search History	In the context of MSrchFramework Enabler, Search History is the collection of search request, Feedback and Interaction from the user.
Feedback	See definition in [OMA-MSrchFramework-RD]
Interaction	See definition in [OMA-MSrchFramework-RD]
Answer History	Answer History is collection for question asked and their respective answers provided. This collection can be queried if user wishes to get answers from already provided answers in the past.
Interface Template	The information needed (e.g. format, parameters) to map the search request and result response interface supported by the MSF with that of supported by External Source.

3.3   Abbreviations

OMA	Open Mobile Alliance
MSAS	Mobile Search Application Server
MSS	Mobile Search Server
SE	Search Engine
Q&A	Question and Answer
MSF	Mobile Search Framework

4. Introduction   (Informative)

To tackle the limitations of the current mobile search services, the Mobile Search Framework Enabler is expected to enable a kind of mobile search service which can (not limited to):

- Integrate various SE's capabilities to be comprehensive

- Personalize search result according to User related information.

- Provide targeted advertisements and recommended results.

- Accept multimedia as a search input

- Provide Subscribe-Push Management

- Provide Q&A functionality.

This document defines the architecture of Mobile Search Framework Enabler based on the requirement defined in [OMA-MSrchFramework-RD]. The main component identified for this enabler are Mobile Search Server (MSS), Mobile Search Application Server (MSAS), MSF-Client and MSF-Source.

The following figure shows various interacting entities involved in this enabler. The figure also depicts the possible deployment example for this enabler.
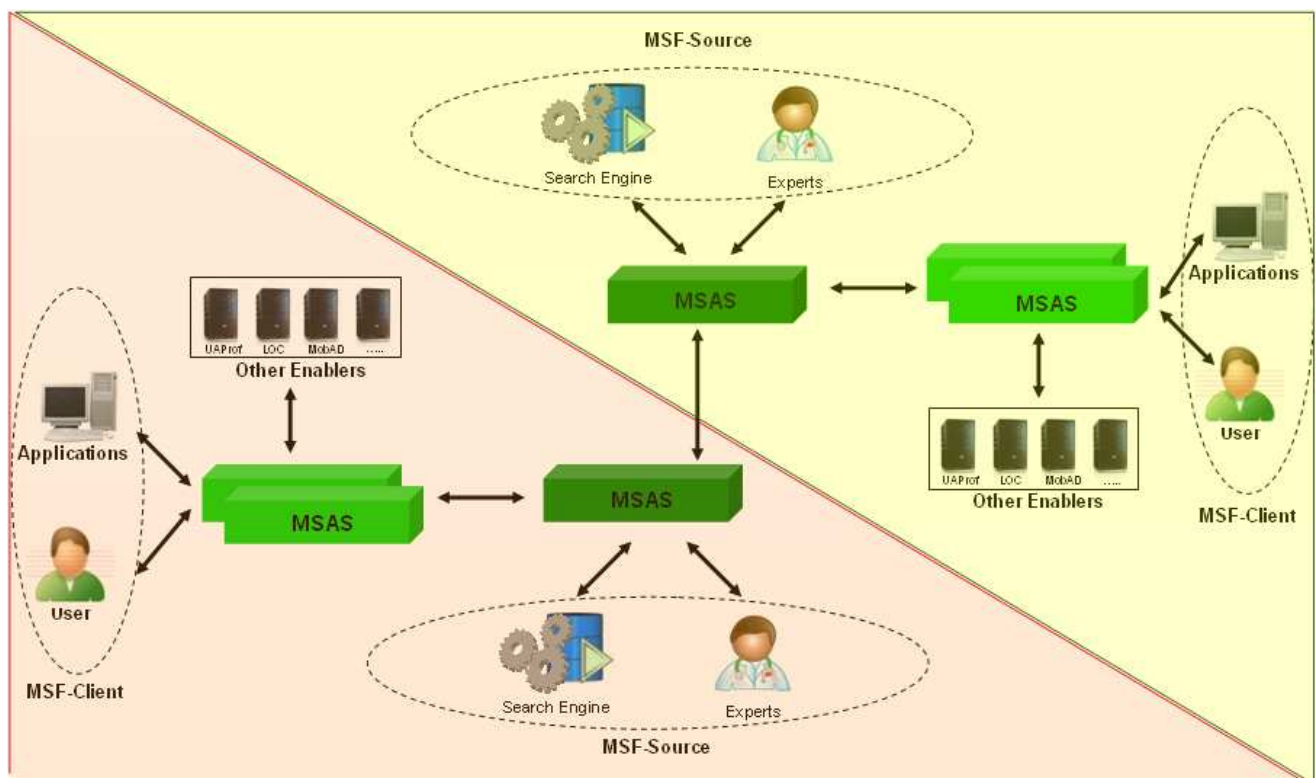
Figure 1: MSrchFramework Enabler deployment example

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 The diagram in Figure 2 shows the Mobile Search Enabler entities interacting with other external entities using the components and interfaces view
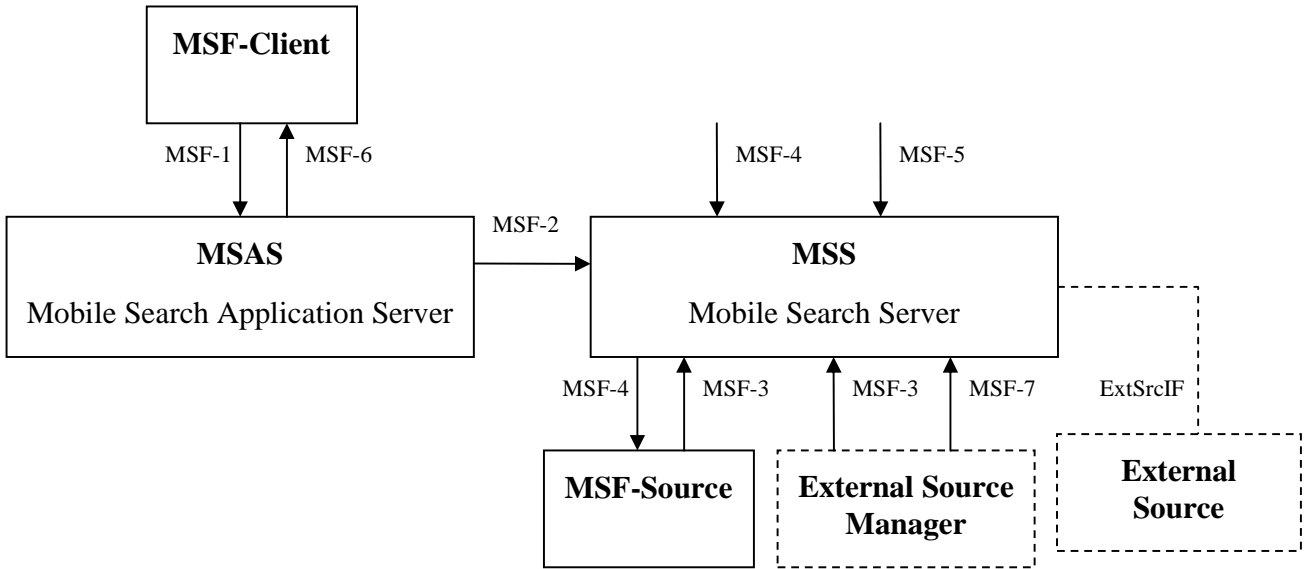
Figure 2: Architectural view of the MSrchFramework interacting with external entities

The shown entities and interfaces are described in the following sections.

4.1   Version 1.0

Version 1.0 of the MSrchFramework enabler architecture addresses all of the functional requirements included in [OMA-MSrchFramework-RD]

5. Architectural Model

5.1   Dependencies

. The MSF Enabler does not have any dependency to other OMA Enablers. However deployments of the MSrchFramework Enabler can use other OMA Enablers, such as:

- The Presence Enabler as described in [OMA-PRS-IMPS-AD] and [OMA-PRS-SIMPLE-AD].

- The Location Enabler as described in [OMA-MLS-AD].

- The Mobile Advertising Enabler as described in [OMA-MOBAD]

5.2   Architectural Diagram
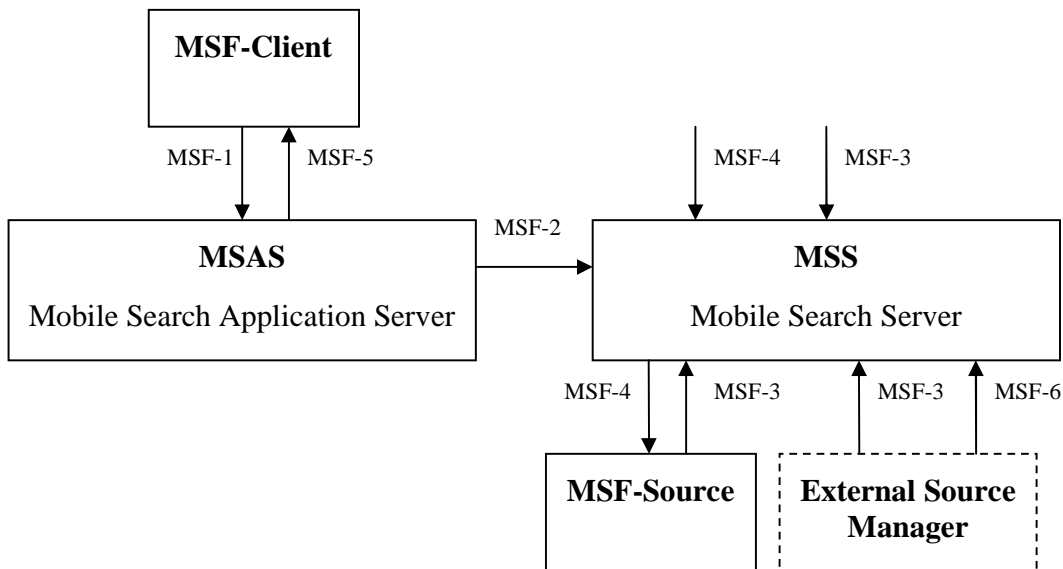
Figure 3: Architectural Diagram

5.2   Functional Components and Interfaces definition

5.2.1   Functional Components

5.2.1.1   MSAS (Mobile Search Application Server)

MSAS is the entry point to the enabler for all the user's requests. The main functionalities identified for MSAS are shown below

MSAS exposes MSF-1; uses MSF-6 exposed by MSF-Client and MSF-2 exposed by MSS.

5.2.1.1.1   User related information Collection

This function collects User related information including user profile, Search History, user context (e.g location) and user Interest Model, which may be obtained by interacting with other OMA enablers or internally from this enabler. Part of this User related information is sent to the MSS together with the search request, for example, to be used for personalized SE/Experts selection and Personalized Result Consolidation.

5.2.1.1.2   Query Domain Mapping

This function is responsible for identifying a Search Domain(s) for a request for which no Search Domain is specified by the user. This function will use User related information to select the appropriate domain for the request.

5.2.1.1.3   Target Advertising

This function is responsible for inserting advertisement into the search results. Advertisements are selected considering user's preference, location and other context information. This function may interact with OMA MobAd enabler, via MobAd-2 interface, to request for advertisements.

5.2.1.1.4   Search History & Recommendation Management

This function is responsible for store, maintain and manage the Search History.

The Search History consists of Feedback and Interaction of the user on the results received.

In particular it collects Feedback/Interaction from users on the search results provided and uses them in order to provide recommended result. Recommended results are provided by applying (one or more) recommendation algorithm(s) together with User related information on the results.

5.2.1.1.5   Subscribe-Push Management

This function is responsible for managing the Subscribe-Push functionality. It includes the management of:

- The request to subscribe/unsubscribe for specific information/content

- The filtration criteria and triggering conditions, provided or updated by the user. The filtration criteria are used to find the appropriate results/content, whereas the triggering conditions are used to initiate the request from the MSAS and then push the result/content.

The filtration criteria can be (non exhaustive): search keywords, Search Domains, , recommended results (in this case the user can choose to get only recommended results), context (e.g. location, …), receiver ID (will be used in case the intended receiver is not same as the one who is requesting or subscribing).

The triggering conditions can be (non exhaustive): push interval (e.g. daily, week days, …), context (location, presence, e.g. the push is triggered when the location is changed, …).

This function is also responsible for the management of policies related to push functionalities e.g considering MSF-Client's abilities to receive pushed content, managing receiver(s) authorizations e.g negotiating for receiving pushed content, for using context information.

5.2.1.2   MSS (Mobile Search Server)

MSS (Mobile Search Server) is mainly responsible for all the functions needed for Search Engine/Experts integration and result personalization. The main functionalities identified for MSS are below

MSS exposes MSF-2, MSF-3 and MSF-5; uses MSF-4 exposed by MSF-Source.

5.2.1.2.1 Personalized SE/Experts Selection

This function is responsible for selecting appropriate SE/Experts for a particular query. To do so, it considers several kind of information e.g SE expertise (Meta-Index - provided by the SE at the time of registration), User related information (e.g Interest Model, location, Search History provided by MSAS), search request (Search Domain, keywords - provided by MSAS).

5.2.1.2.2 Personalized Results Consolidation

This function is actually responsible for results (here results also includes answers) personalization. This function will achieve personalization in either of two ways:

- It uses User related information provided by MSAS, with the search request, to personalize search results and provide consolidated list of results. While consolidating it may do optimization on the results e.g remove redundancy, re-ranking/sorting based on e.g rank provided by the SE, SE importance level (may be calculated based on response time, quality of content, cost etc.)

- It can transfer the User related information, with the search request, to the Search Engine (user identity may be secured in this process). Search Engine will personalize search result based on User related information and return the personalized results to MSS. MSS consolidates the result list. While consolidating it may do some optimization on the results e.g remove redundancy, re-ranking/sorting based on Personalization Score provided by the SE, SE importance level (may be calculated based on response time, quality of content, cost etc.)

5.2.1.2.3 Query Building

This function is responsible for building and forwarding request to the selected External Source(s) (which doesn't expose/support the standard search interface MSF-4). This function optimizes user queries in the format which is understandable by the selected External Source(s). This function may also split the user's query for efficiency. This function may also pass User related information, with the search request, to the SE where the personalization is done.

This function may apply to MSF-Source in case Search-Domain specific parameters are provided, which makes related adaptation necessary.

5.2.1.2.4 MSF-Source Registration

This function is responsible for allowing MSF-Sources to register them with the framework providing some of the information (e.g expertise,) about them.

5.2.1.2.5 External Source Registration

This function is responsible for allowing External Sources to be registered, using the External Source Manager capabilities, with the framework providing some of the information (e.g. Interface Template, …) about them.

5.2.1.2.6 Q&A History

This function is responsible for maintaining a database of already asked question and their respective answers provided from different Experts. This database can be queried in case user wants questions from Answer History.

5.2.1.2.7 MSF-Client

MSF- Client is an entity which sends a search request to MSAS using MSF-1 interface and receives responded result from MSF-1 interface or pushed result from MSF-6 interface. MSF- Client can perform search request by keyword, free text or multimedia input. The MSF-Client can be deployed on a user's device or in an application server

MSF-Client exposes MSF-6 and uses MSF-1 exposed by MSAS.

5.2.1.2.8 Pushed Content Management

This function is responsible to manage (e.g store, render, queuing) pushed content and the related rules (e.g discar, accept, …).

5.2.1.3 MSF-Source

MSF-Source is the information/content source for MSS. It provides the actual information/content to MSS on request. The MSF-Source can be a Search Engine or an Expert.

MSF-Source exposes MSF-4 and uses MSF-3 exposed by MSS.

5.2.1.4 External Source Manager

This entity is responsible of the External Source registration management. It sends theInterface Templates to the MSS via MSF-7 in order to allow the MSS to perform the Query Building function.

5.2.2 Interfaces

5.2.2.1 MSF-1

This interface is exposed by MSAS and can be used to send/receive search request/response. The supported functions of this interface includes

- Accepting search request from MSF-Client and delivering search response. This request can be also a request for recommended results. In this case the request contains the indication of the algorithm(s) to be applied in order to provide recommendation on the results. The request can be a multimedia search as well where the MSF-Client uses multimedia files e.g. video, audio or image files as search request input, augmented with information that specify the search request purpose (e.g. find similar content, retrieve missing metadata related to the input , etc.). This function includes also the transfer of the response related to the search request from the MSAS to the MSF-Client (including the recommended results).

- Accepting Subscribe-Push search request. In this case, this interface allows the MSF-Client to subscribe/unsubscribe for specific information/content/results by providing/updating one or more filtration criteria (e.g. push interval, Search Domain(s), push context trigger(s), …).

- Providing the Feedback from the MSF-Client to the MSAS about results received and/or modifying an already existing Feedback. Different kind of Feedback can be supported by this interface: vote (a numerical value, e.g. from 0 to 100), comment (a free text where the user can express his evaluation), tag list (a list of keywords that describe the result).

- Providing the Interaction from the MSF-Client to the MSAS on results received. Different kind of Interaction can be supported by this interface: the action to click on particular result or type of result (e.g. results of a particular brand, results with multimedia contents …), the subsequent search done, etc….

- Querying of capabilities and functionalities supported by MSAS such as (not limited to): search functionalities supported (Q&A function, Subscribe-Push, …), recommendation algorithms supported, multimedia support (e.g.: the indication of the media type accepted as input search request), support for the free text search/by keyword, performance parameters (e.g. maximum number of requests accepted per time or in a period of time, minimum interval between two requests, average response time, …), Search Domains supported and geographical coverage, etc…

- Accepting Q&A request from MSF-Client and delivering Q&A responses (synchronous or asynchronous).

5.2.2.2 MSF-2

This interface is exposed by MSS. The supported functions of this interface include:

- Accepting search request from MSAS augmented with a part of user related information and delivering search response. In this response, if the MSF-Source provided its customer Feedback, then the MSS propagates this Feedback to the MSAS.

- Delivering of users Feedback from MSAS to MSS.

- Accepting Q&A related request from MSAS and transfer the response (which can be synchronous or asynchronous) back to it.

5.2.2.3   MSF-3

This interfaces is exposed by MSS and can be used to register/de-register and update configuration etc

- Sending asynchronous answer messages to MSS for previously submitted question.

- Accepting question retrieval request, made based on expertise, from Expert.

- Accepting registration, de-registration and update request and delivering response. The following is the list (not limited to) of information conveyed or updated to MSS in the registration process

    - Basic Information (access URL, contact)

    - Meta-Index.

This interface is also used for exchanging the Meta-Index between two MSSs.

5.2.2.4   MSF-4

This interface is exposed by MSF-Source and can be used to accept search request (including Q&A related request and response) from MSS and deliver response to MSS.

In the response, if there is an agreement between service provider and MSF-Source to exchange Feedback, then the MSF-Source provides its customer Feedback to the MSS together with the results.

This interface is also used for interaction (search request/response) between two MSS.

5.2.2.5   MSF-5

This interface is exposed by MSS and can be usedto exchange Meta-Index between different MSSs

5.2.2.6   MSF-6

This interface is exposed by MSF-Client and can be used to Push subsequent results/content for the subscription request in the context of Subscribe-Push functionality. One or more push notification of results/content can result from a single subscription request.

5.2.2.7   MSF-7

This interface is exposed by MSS and it is used to pass the Interface Templates which is used by the MSS to allow the integration of External Sources with the MSrchFramework.

5.3   Security Considerations

To address the requirements of Authentication and Authorization specified in the RD, the MSF Enabler should provide the following functions:

Authentication

The MSF Enabler supports mechanism to authenticate the SEs, Experts and other MSSs. The SEs and Experts will be authenticated, when they will be registering/de-registering or updating their information with the MSF Enabler. As MSSs are interworking, when an MSS receives an incoming request from another MSS, its identity is also to be checked.

Authorization

The MSF Enabler supports mechanisms to authorize the other MSSs, SE/Expert and MSF-Client when they request access to the MSS. For other MSS and applications, the requests are search requests. For SE and Expert, the requests are changing information requests

Appendix A.   Change History   (Informative)

A.1   Approved Version History

Reference	Date	Description
n/a	n/a	No prior version –or- No previous version within OMA

A.2   Draft/Candidate Version 1.0 History

Document Identifier	Date	Sections	Description
Draft Versions OMA-AD-MSrchFramework-V1_0	10 Apr 2009	All	Establish the initial empty Architecccture Document
	22 Apr 2009	1	Incorporate 0003R01
	11 Jun 2009	3.2, 3.3, 5.2, 5.3	Incorporate 0005R06, 0006R01
	2 Jul 2009	3.2, 4, 5.3, Appendix B	Incorporate 0015R01, 0016R02, 0017R01, 0018R01.
	10 Jul 2009	2.1, 3.2, 3.3, 5.1, 5.3, Appendix B	Incorporate 0020R02, 0021R01, 0022R02, 0025R01, 0027R02
	31 Jul 2009	3.2, 5.3, Appendix B	Incorporate 0028R05, 0034R01. Replace "User Information" with "user related information"
	13 Aug 2009	Appendix B	Incorporate 0033R03, 0036R01, 0039. Replace "User Information" with "user related information".
	1 Sep 2009	3.2, 5.3, Appendix B	Incorporate 0041R02, 0043, 0044R01, 0047R01, 0049R03, 0052R01, 0053R01, 0054R01, 0056R01, 0057R01, 0059R01, 0060. The Contents is updated.
	17 Sep 2009	5.3, Appendix B	Incorporate 0046R03, 0048R03, 0065R01. The Contents is updated.
	20 Oct 2009	1, 2.1, 3.2, 4.1, 5.2, 5.3, Appendix B	Incorporate 0068, 0072, 0075. Most COMMENT boxes are removed. And the Contents is updated.
	5 Nov 2009	5.2, 5.3	Change the MSF-Client box in AD from dotted line to bold line. Incorporate 0055R02.
	10 Nov 2009	5.2, 5.3	Incorporate 0092, 0093, 0096R01.
	14 Jan 2010	2.1, 2.2, 3.2, 4, 5.1, 5.2, 5.3.1.1.3, 5.3.1.1, 5.3.2.1, B.11	Incorporated 104R01, 105, 108, 109R01, 110, 114R01, 118, 119R01, 120.
	15 Jan 2010	5.3.1, 5.3.2	Incorporated 111R04, 112R02, 113R03. Chnages MSF-Clinet into bold lines.
	25 Jan 2010	All	Incorporated 0005R01, 0006, 0008R01, 0010, 0011R01. All ADRR editorial comment were incorporated
	3 Feb 2010	All	Incorportated 007R01, 0026R01
Candidate Versions OMA-AD-MSrchFramework-V1_0	23 Feb 2010	All	Status changed to Candidate by TP ref #OMA-TP-2010-0072-INP_MSrch_1_0_AD_for_Candidate_approval

Appendix B.   Flows (informative)

This section describes some high-level logical flows between the architectural entities of the Mobile Search Framework Enabler. These flows just serve for a better understanding of the architecture. For normative details see the Technical Specification

B.1   Personalized Search
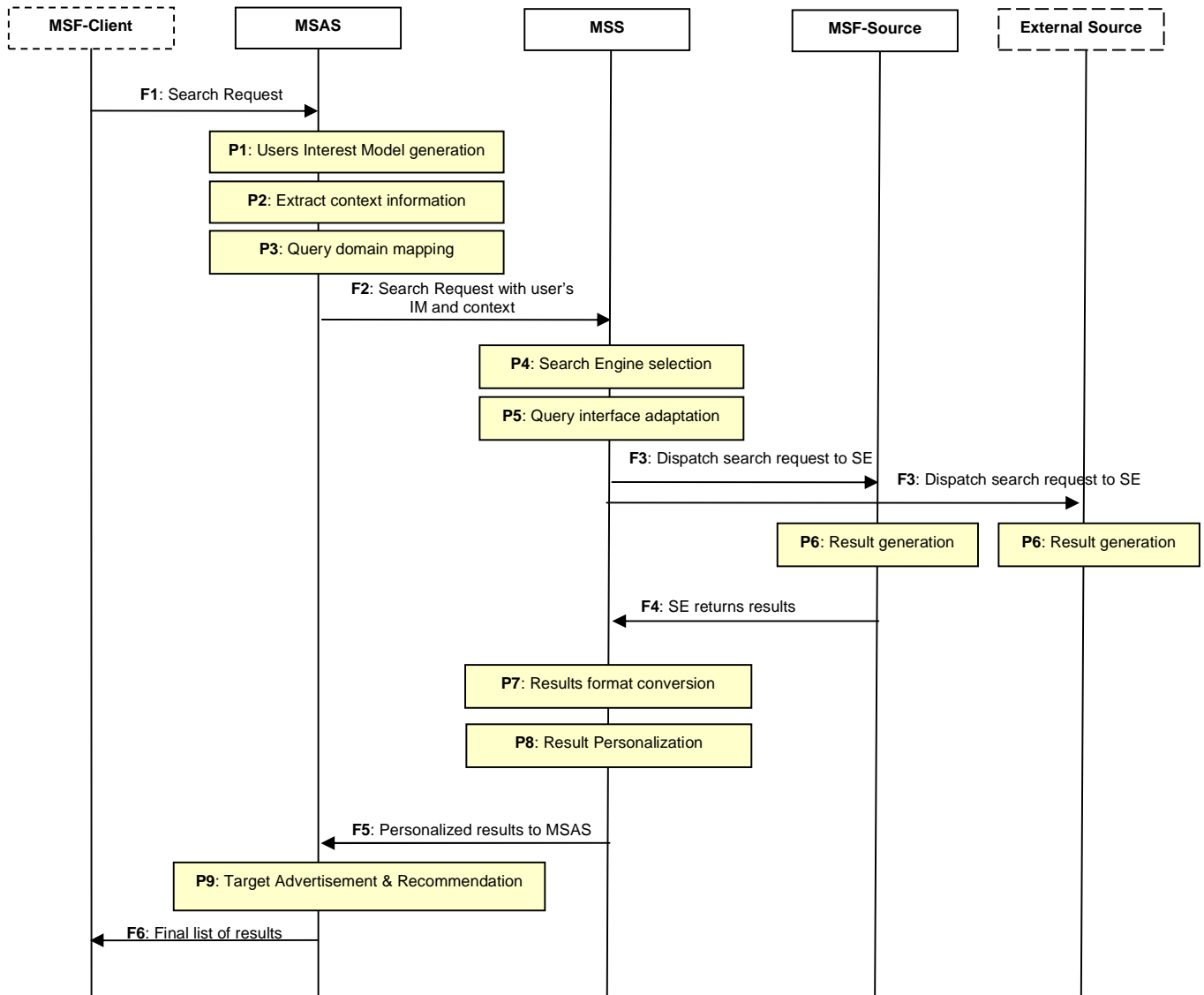
- **F1**: MSF-Client send a search request to MSAS

- **P1**: MSAS may generate users Interest Model (IM) considering user profile and Search History. User IM will be retrieved every time the request is received from MSF-Client.

- **P2**: MSAS interacts with other enablers to get the required user context information.

- **P3**: MSAS maps a Search Domain(s) for the request using users IM and other related context information, in case user doesn't specify any Search Domain.

- **F2**: MSAS sends search request with required user related including (not limited to) User Interest Model, location, profile to MSS.

- **P4**: MSS selects an appropriate search engine based on (not limited to) SE expertise, User related information (received in F2), search request (Search Domain, keywords) etc.

- **P5**: If among the selected SEs there are External Source(s), then MSS translate request format into the format supported by each External selected Source. This step is needed only for the External Source.

- **F3**: MSS dispatches the request to the selected SE. User related information including (not limited to) User Interest Model should also be sent with the search request to the SEs.

- **P6**: SE search for the results. SE may use User related information (received in F3) to personalize (mainly ranking and sorting) the result list produces.

- **F4**: SE returns the results. If personalization has been performed by SE in P6 then this request will also include Personalization Score (calculated in P6) associated with each result.

- **P7**: If some results come from External Source, then MSS converts the results format into a global uniform format. This is to help consolidating result (with different format) from different SE. MSS also removes redundancy among the results.

- **P8:** MSS aggregate the results provided by different search engine. In case personalization has been performed by SE, MSS re-rank and sort the results according to Personalization Score (returned by SE in F4) and SE importance level (e.g calculated based on response time, quality of content, selection ranking score, cost etc.) If Personalization Score from different SEs are incomparable then MSS may calculate Personalization Score itself (based on user related information received in F2) to use it for result consolidation and sorting. In case personalization has not been performed by SE, MSS will do personalization (in terms of personalized ranking and sorting) based on User related information (received in F2).

- **F5**: MSS send the personalized results to MSAS

- **P9**: MSAS complement search results with target advertisement and recommendations based on users Feedback.

- **F6**: Final search result are provided to the user

B.2   SE Registration
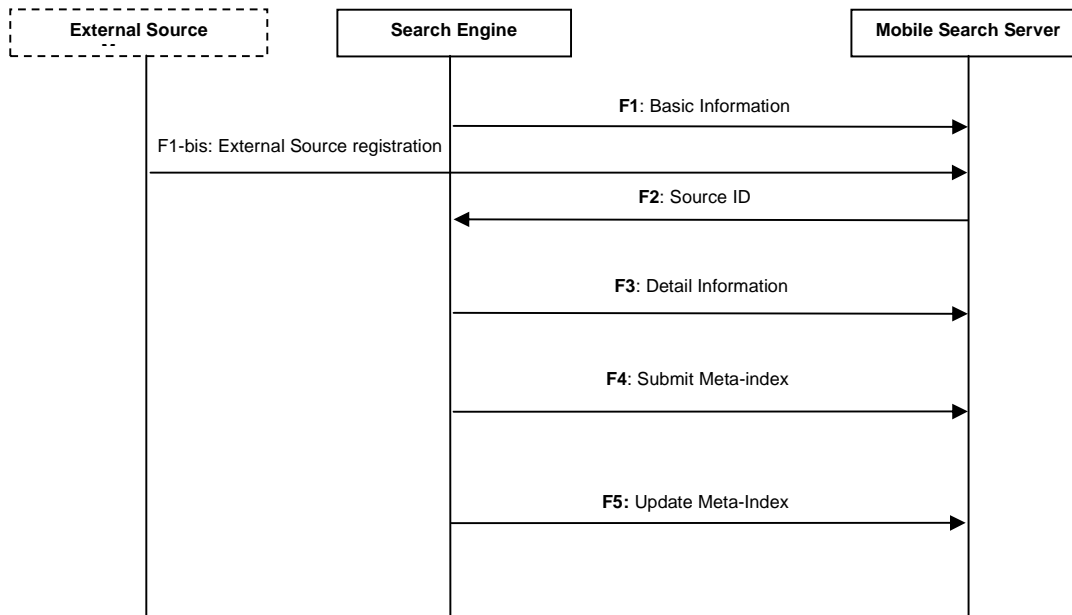
- **F1**: SE registers basic information like name, location, Search Domain, contact etc.

- F1-bis: The External Source Manager submits to the MSS the Interface Templates.

- **F2**: MSS acknowledge the request and assign a Source ID to the SE

- **F3**: SE further registers detailed information like supported request/response interface, required User related information, Target user group etc.

- F4: SE then submits Meta-Index (defined in section 3.2).

- F5: SE may further update their Meta-Index as required sometime in future.
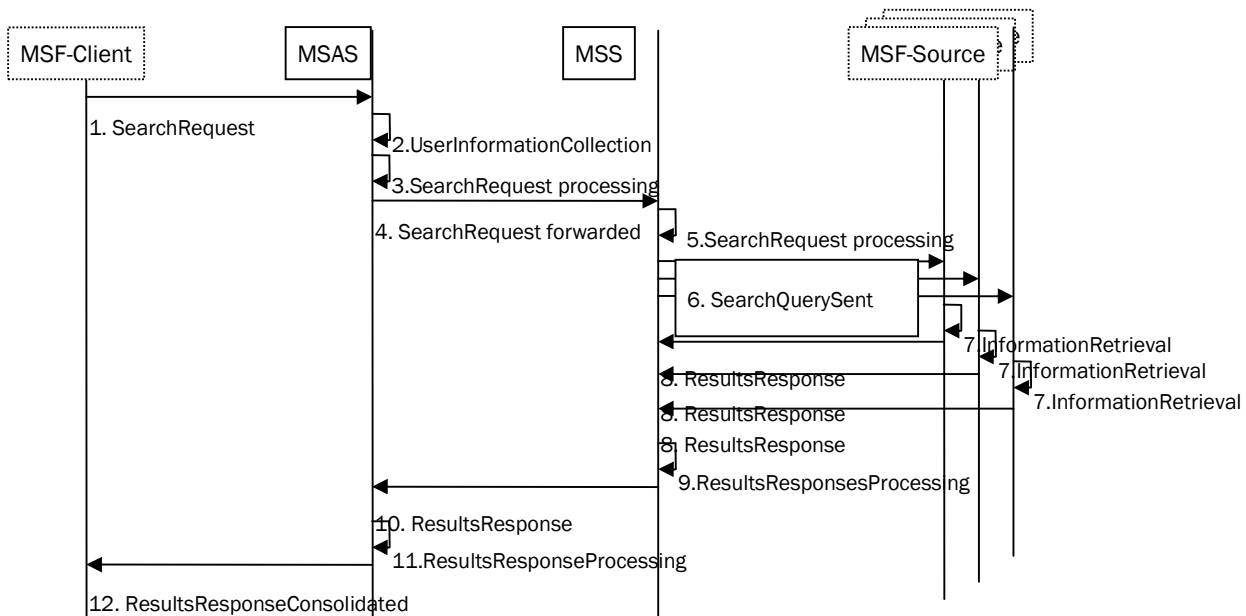
B.3 End-to-End Search Request Flow

**Figure 4: End-to-End Search Request flow**

1. SearchRequest: The MSF-Client sends a search request to the MSAS.

2. UserInformationCollection: The MSAS collects the user related information (e.g. profile, location, …) by interacting with other OMA enablers or internally from this enabler. As part of this step, the MSAS recovers internally the Search History information related to the search request (from all users).

3. SearchRequestProcessing: The MSAS processes the search request before forwarding it to the MSS. The type of processing which can be performed are, for example, Query Domain Mapping

4. SearchRequestForwarded: The MSAS forwards the search request enriched with some of the user related information collected and with the result of the processing applied to the MSS.

5. SearchRequestProcessing: The MSS processes the search request and other information received. The type of processing which can be performed are, for example, Query Building, MSF-Source(s) selection.

6. SearchQuerySent: The MSS sends the query for the search to the selected MSF-Source(s).

7. InformationRetrieval: The selected MSF-Source(s) retrieves the correct information that MSS has requested.

8. ResultsResponse: The selected MSF-Source(s) sends the response to the MSS containing the results.

9. ResultsResponsesProcessing: The MSS processes the results responses received before sending them to the MSAS. The type of processing which can be performed are, for example, results optimization by removing redundancy or by sorting the results.

10. ResultsResponse: The MSS sends the response to the MSAS containing the optimized results.

11. ResultsResponseProcessing: The MSAS processes the response before sending it to the user. The type of processing which can be performed are, for example, applying one or more recommendation algorithms to provide recommended results and re-rank the result according to that (i.e putting recommended result at the beginning of the list).

12. ResultsResponseConsolidated: The MSAS sends the consolidated results to the user.

B.4 Interworking
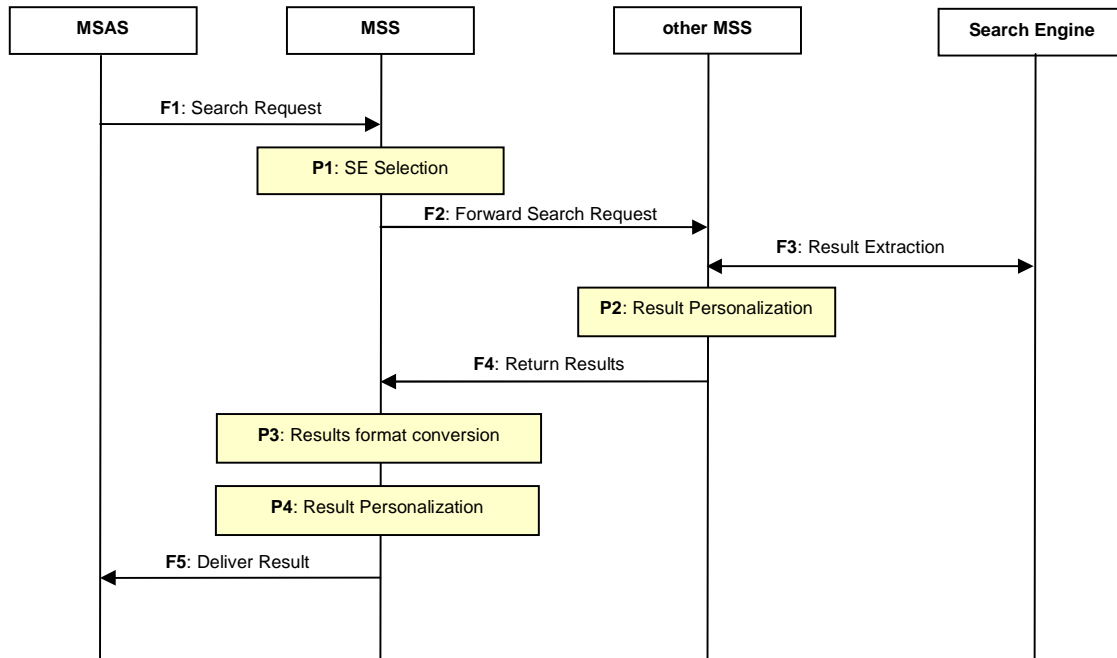
- **F1**: MSAS sends search request with required user related information (e.g User IM, location, profile) to MSS.

- **P1**: MSS selects an appropriate search engine based on (not limited to) SE expertise (Meta-Index), user related information (user Interest Model, location, profile), search request (Search Domain, keywords) etc.

- **F2**: MSS forwards request to other MSS. MSS will also send targeted SE's ID and user related information, including (not limited to) user Interest Model, to other MSS. Before sending the request to other MSS, if required, MSS converts the request into a format suitable for other MSS.

- **F3**: other MSS gets the result form the targeted SE(s) according to the specified SE's ID in F2

- **P2**: other MSS can personalize result based on information received in F2.

- **F4**: other MSS returned personalized search results to MSS.

- **P3:** MSS converts the results format into a global uniform format. This is to help consolidating result (with different format) from different SE. MSS also removes redundancy among the results.

- **P4**: MSS further do personalization on the result based on any other user related information which was not made available to other MSS.

- **F5**: Final results/contents are returned to MSAS.

B.5   Interworking 2
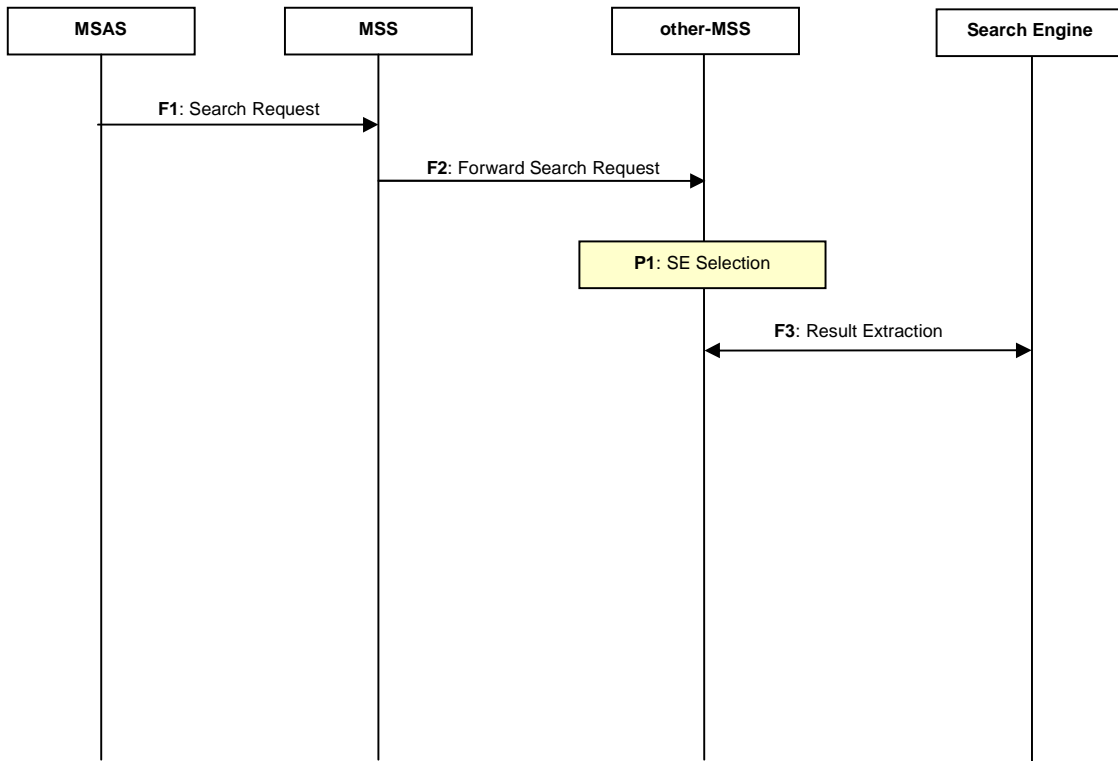
- **F1**: MSAS sends search request with required user information (e.g. User IM, location, profile) to MSS.

- **F2**: MSS selects other-MSS (e.g based on the capabilities of SEs registered to other-MSS) and forwards the request to it. MSS will also send user related information, including (not limited to) user Interest Model, to other MSS. Before sending the request to other MSS, if required, MSS converts the request into a format suitable for other MSS.

- **P1**: other MSS selects an appropriate search engine based on (not limited to) SE expertise (Meta-Index), user related information (user Interest Model, location, profile), search request (Search Domain, keywords) etc.

- **F3**: other MSS gets the result form the targeted SE(s).

For further steps refer to B.4 from P2 to F5.
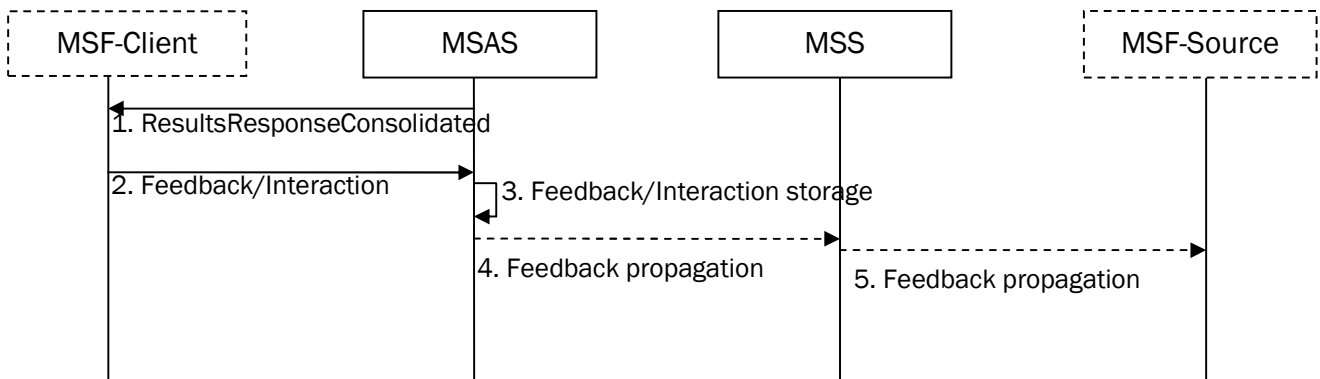
B.6   Search History Flow

Figure 5: Search History Flow

1. ResultsResponseConsolidated: the MSAS sends the consolidated results to the user.

2. Feedback/Interaction: The user expresses (explicitly or implicitly) his Feedback/Interaction about the results.

3. Feedback/Interaction storage: The MSAS stores the received Feedback/Interaction from the user.

4. Feedback propagation: Optionally (depending on the agreement between service provider and MSF-Source) the MSAS can report Feedback received from its users about the results to the MSS.

5. Feedback propagation: The MSS propagates the Feedback, if provided by the MSAS in step 4, to the MSF-Source (that provided the results).
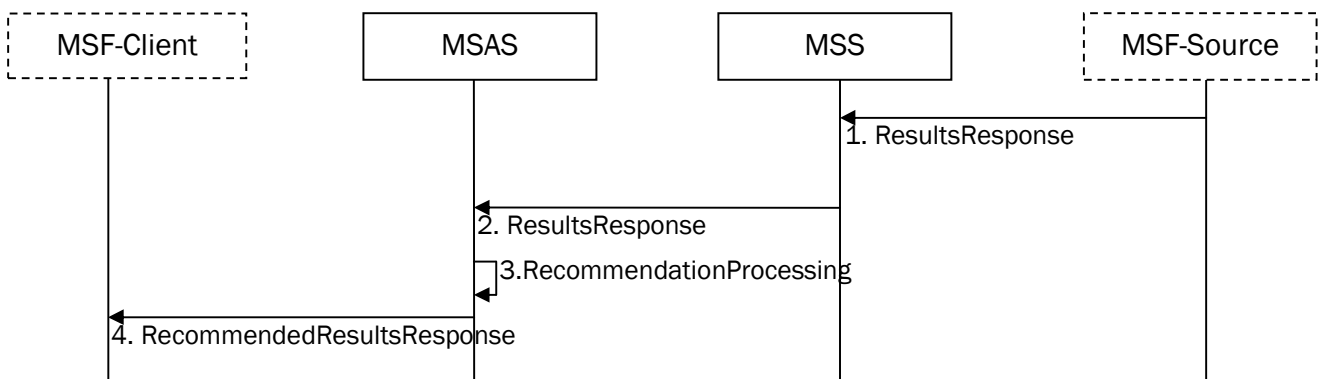
B.7 Recommendation Flow

Figure 6: Recommendation Flow

1. ResultsResponse: The selected MSF-Source(s) sends the response to the MSS containing the results. Optionally, depending on the agreement between service provider and the MSF-Source, the MSF-Source can send the Feedback (from its customers) about the results provided.

2. ResultsResponse: The MSS sends the response to the MSAS containing the optimized results. The MSS propagates the results with associated Feedback, if provided by the MSF-Source in step 1.

3. RecommendationsProcessing: The MSAS processes the response before sending it to the user by applying one or more recommendation algorithms in order to provide recommended results and re-rank the results according to that (i.e putting recommended result at the beginning of the list). The processing related to the recommendations uses the Search History information retrieved by the MSAS and, optionally the Feedback provided by the MSF-Source in step 1.

4. RecommendedResultsResponse: The MSAS sends the consolidated results, including the recommended results, to the user.

B.8   Q&A Flow
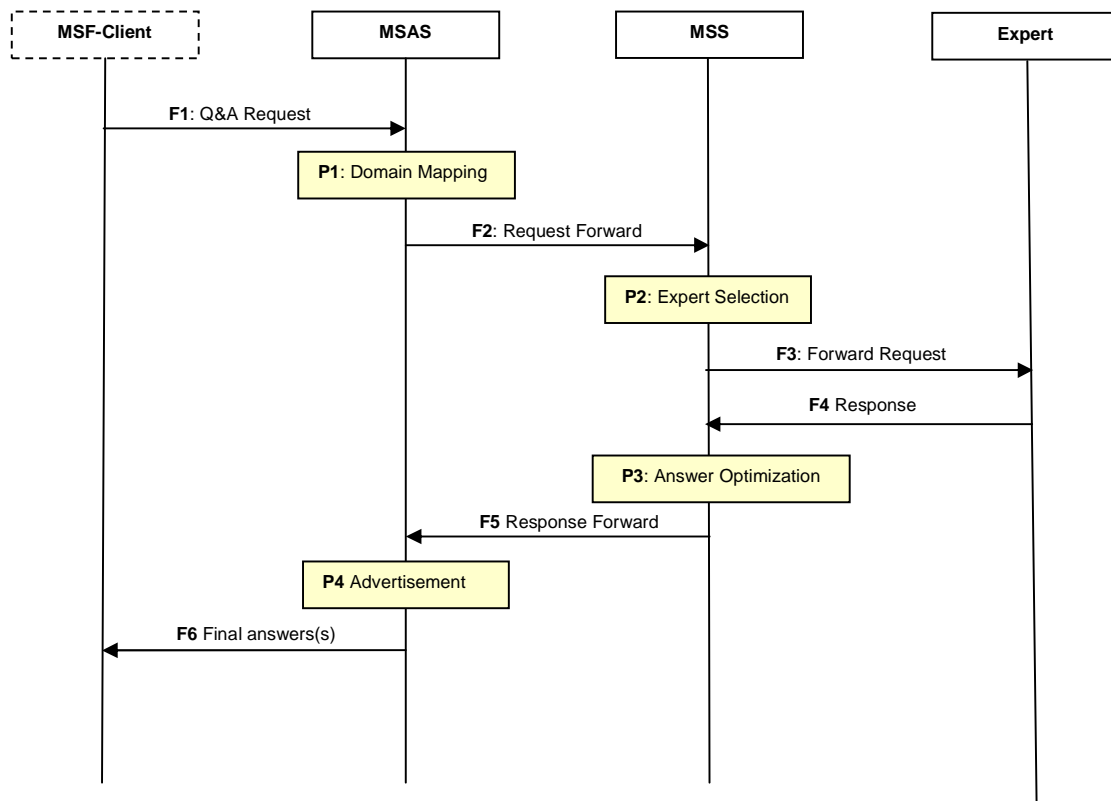
- **F1**: User sends a question to MSAS. User will specify whether the answer is required from Answer History or from Experts.

- **P1**: MSAS will perform domain mapping for the question.

- **F2**: MSAS will forward request to MSS.

- **P2**: MSS select appropriate experts. If the answer is required from Answer History, no Expert selection will be done. MSS will retrieve answer(s) from Answer History and then continue from P3 by passing F3 and F4.

- **F3**: MSS dispatch the request to selected Expert(s).

- **F4:** Experts answers the question and send as a response to MSS.

- **P3:** MSS will perform optimization on different answer received form different Experts (or form Answer History) e.g redundancy check, ranking based on expert level etc. MSS also save the question and their corresponding answers into Answer History in case answers are from experts.

- **F5:** MSS forwards the final answer list to the MSAS

- **P4**: MSAS insert advertisement with the response and performs recommendations.

- **F6**: Final answer(s) are provided to the user.

B.9   Meta-Index Exchange/Update Flow

This flow is divided into three parts; (1) MSSs share information about each other (2) MSSs exchange Meta-Index for the first time (3) MSSs, periodically, updates submitted Meta-Index.
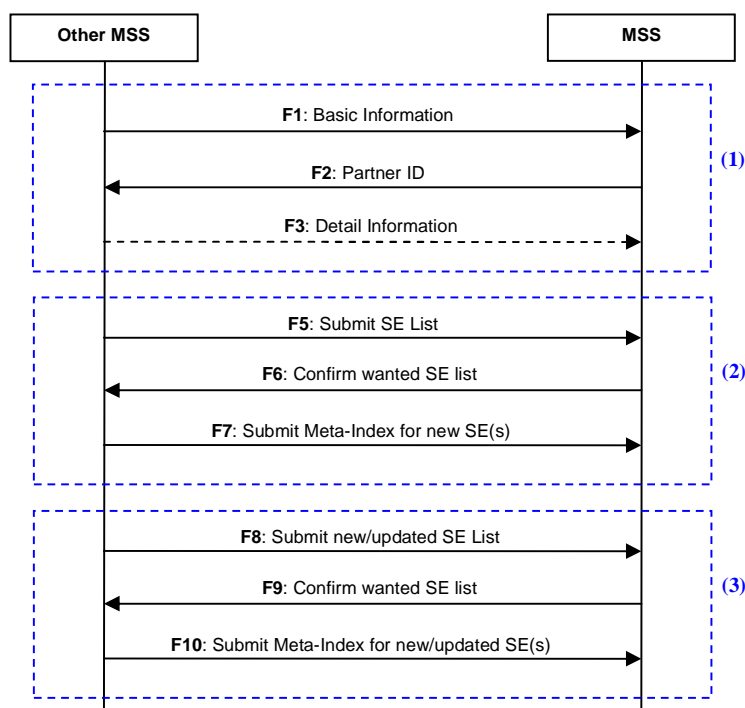

- **F1**: Other MSS registers basic information about itself like name, location, Search Domain, contact etc.

- **F2**: MSS acknowledge the request and assign a partner ID to the other MSS

- **F3**: Other MSS further registers detailed information about itself like supported request/response interface, required user related information, target user group etc.

- **F5**: Other MSS submits the list (with some text description) of some or all (depending on there polices) the SEs registered with it.

- **F6**: MSS confirms the list of those search engines for which it require Meta-Index (MSS may only require Meta-Index for those SE which are useful for it. The criterion of selection is implementation specific).

- **F7**: Other MSS sends the Meta-Index only for those SE returned (selected) by MSS.

- **F8:** Other MSS will trigger update of Meta-Index based on some trigger condition. The example of identified trigger condition for this enabler are periodically (e.g weekly), threshold of SE added/updated, manually at any time. Other

MSS will send the list (with some text information) of newly added SE and those which have updated their Meta-Index to MSS.

- **F9:** MSS will confirm the list of those SE for which it requires Meta-Index.

- **F10:** Other MSS sends the Meta-Index or updated Meta-Index only for those SE returned (selected) by MSS.

B.10 Application Initiated Search
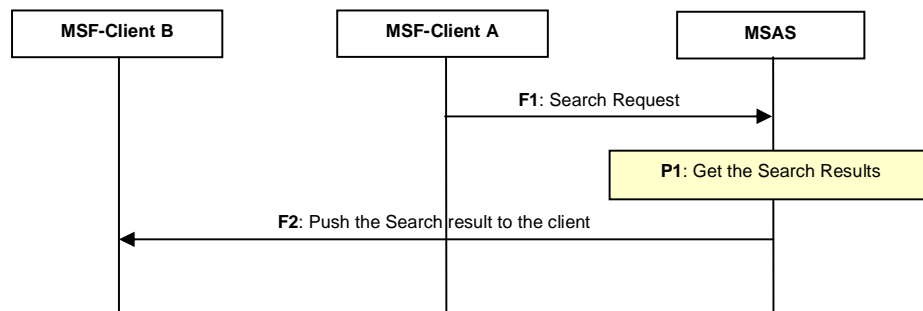
- **F1**: An application as MSF-Client-A sends a search request(s) to MSAS, the search request(s) carries one or more client IDs (different than MSF-Client-A) as MSF Requestor-B for the search result.

- **P1**: MSAS gets the final result

- **F2**: MSAS pushes the search results for each search request, to one or more target client (MSF-Client-B) according to the specified ID(s) in F1. Before this step there is a need of required management functionality related with push.

B.11 Subscribe-Push
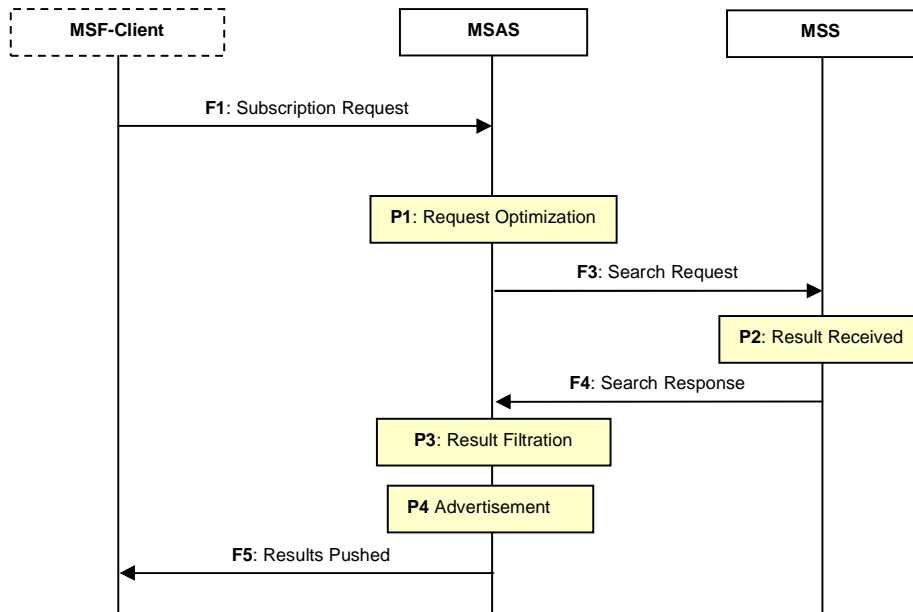
- **F1**: MSF-Client sends subscription request to MSAS with several filtration criteria and triggering condition. MSF-Client may specify a different receiver's ID for pushed content.

- **P1**: MSAS will consider context information while generating search request. E.g if user location is "Boston" and keywords provided are "Nike stores" then MSAS may generate final request with keywords "Nike stores Boston". MSAS will generate subsequent search request consider the time interval (if provided by the user as triggering condition).

- **F3**: MSAS will send search request to MSS periodically (according to the time interval provided by the user as triggering condition).

- **P2**: MSS receive the result.

- **F4**: MSS send the result to MSAS.

- **P3:** MSAS may further filter the results received based on (not limited to) presence, recommended results

- **P4**: MSAS insert advertisement to the search result.

- **F5**: Final results/contents are provided to the intended user. Before this step there is a need of required management functionality related with push.

Appendix C. External Components and Interfaces

In this section is provided an architectural view of the MSrchFramework Enabler components, including the interaction with some external entities and interfaces.

C.1 External Source

External Source is the information/content External Source for MSS. It doesn't provide the standard interface MSF-4 for the search request but use the own proprietary interface. It interacts with the External Source Manager in order to provide its search request/result response format templates (out-of-scope mechanism).

C.2 ExtSrcIF

This interface is exposed by the External Source and represents the proprietary interface that each External Source wants to be used in the search request/result response

Appendix D. <Additional Information>

D.1 App Headers

<More text>

D.1.1 More Headers

<More text>

D.1.1.1 More Headers

<More text>

	Column 1	Column 2
Row 1	Grid 1,1 data	Grid 1,2 data
Row 2	Grid 2,1 data	Grid 2,2 data

Table 1: Example Table