ISITEP
D5.5.1–SEMANTIC/SYNTACTIC TRANSLATOR DATABASE POPULATION

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REVISION TABLE

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V0.1	20/03/15	All	All	Initial version
V0.2	29/08/15	All	All	Slight adaptations
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Publishable extended abstract

The aim of this deliverable is to define and implement the architecture of a Semantic and Syntactic Translator. The Semantic and Syntactic Translator, as part of the ISITEP Enhanced Terminal's architecture is presented both from the architectural, as well as the functional point of view.

In this deliverable, initially the architectural aspect of the translator is provided, in the context of the ISITEP Enhanced Terminal (IET). All the interfaces between the IET and the rest components of the framework are illustrated. In addition, the translator tool is broken to its sub-components, and the functional description of each one is analysed. In order to provide further insights in relation to the functionality of the tool, diverse communication scenarios are given, in combination with detailed step per scenario and the respective message sequence charts.

Furthermore, the translator API, the database schema, as well as the deployment environment are included in the deliverable. Last but not least, The TETRA and TETRAPOL apps' requirements are also mapped with the functional requirements that apply to the translator tool in relation to the interfaces and functionality that has been presented earlier in the document.

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1 INTRODUCTION

A key issue in interoperability is cooperation. Human factor is a fundamental issue in this process: differences in languages and procedures could make devices interoperability completely unsuccessful. A minimal technology is necessary to translate semantically and syntactically the predefined human interface on new enhanced terminals. The interoperability shall be transparent to PPDR resources. In other words, a PPDR resource accustomed to operate with a TETRA national device shall be able to operate in the same way (same language, same procedures) with its personal device in a foreign TETRA/TETRAPOL networks regarding the predefined usual orders.

Towards this end, the purpose of this document is to provide the description of the translation tool along with all the technical details that accompany it, including the proposed functional architecture, all the possible use cases and the deployment environment. Before proceeding to the internal architectural analysis of the tool, an overall illustration of the ISITEP Enhanced Terminal is introduced. Afterwards, we have analysed in this document the functional decomposition of the translation tool to several components and we have presented their placement to the various nodes giving also detailed analysis of the various interactions required to realize the proper operation of the designed tool.

Furthermore, the use cases (given as communication scenarios) are also described in this document. We present all the possible scenarios enabling the communication of the involved actors (i.e. tetra end users, authorized users, administrators) when using the translation tool and describe thoroughly the communication steps in each scenario. In addition, the document provides all the technical specifications of the deployment system that has been used for the system validation including the DB specification, the PC capabilities and any other prerequisites needed for the system validation. The validation methodology and outcomes are beyond the scope of this document and are available in deliverable D5.5.2. Furthermore, the deliverable gives a brief analysis of the database (DB) design, as well as the produced API used to interact with the storage unit.

Semantic and Syntactic translator is distributed across two network architecture components, namely:

- TETRA/TETRAPOL communication server.
- TETRA/TETRAPOL terminals.

From another functionality point of view at the last section of the document, the translator tool is linked with the functionality of the TETRA and TETRAPOL apps via their requirements mapping.

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2 DOCUMENT SCOPE

This deliverable (D5.5.1) reports on the activities addressed under Task 5.5.1. The document is organised as follows:

- Section 3 provides the definitions and abbreviations, which are found inside the document.
- Section 4 illustrates the architectural perspective, linking the translator tool with the ISITEP Enhanced Terminal, the available interfaces and the main functionality of them.
- Section 5 describes the functional architecture of the translator tool. Furthermore, the overall tool is decomposed into the different sub-modules that comprise the overall functionality. The use cases, -denoted as communication scenarios-, provide further insights with regard to the functionality of the tool.
- Section 6 initially presents the requirements of the TETRA and TETRAPOL apps and links them with the translator tool by making a mapping between them the translator tool's requirements. The afore-presented architecture, interfaces and functionality are used as reference for the justification of this mapping.
- Section 7 concludes the document.
- Section 8 provides the document references
- An Appendix is also provided at the end of this document

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3 DEFINITIONS AND ABBREVIATIONS

3.1 Definitions

This section is intended to capture the definitions of some key terms used in the document for the purpose of increased consistency:

Authentication: the act of positively verifying that the true identity of an entity (network, user) is the same as the claimed identity.

Command: This is the text to be translated. It mainly refers to the predefined set of translated texts/commands.

Source Language: The language that the user wants to translate.

Target Language: The language, into which the user wants his request to be translated.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

Acronym	Definition
API	Application Programming Interface
APU	Administration Processing Unit
DBD	Database Driver
EER	Enhanced Entity Relationship
ERHU	Engine Request Handler Unit
GUI	Graphical User Interface
HMI	Human Machine Interface
HTTP	Hypertext Transfer Protocol
IET	ISITEP Enhanced Terminal
PPDR	Public Protection and Disaster Relief
RDBMS	Relational Database Management System
REST	Representational State Transfer
RHU	Request Handler Unit
RPC	Request Processing Component
RPU	Request Processing Unit
RS	Remote Service
SDS	Short Data Service
SPU	Score Processing Unit
SQL	Structured Query Language
SST	Semantic and Syntactic Translator
SW	Software
TCP	Transmission Control Protocol
TE	Translation Engine
TETRA	Trans-European Trunked Radio
TPU	Translation Processing Unit

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4 THE SEMANTIC AND SYNTACTIC TRANSLATOR IN THE CONTEXT OF THE ENHANCED TERMINAL OPEN ARCHITECTURE

4.1 General

Initially, we provide insights with regard to the integration of the Semantic and Syntactic Translator in the context of the open architecture of the ISITEP Enhanced Terminal (IET), as this was defined in previous ISITEP deliverable ([1]). The main target of the ISITEP enhanced terminal is to integrate the TETRA and TETRAPOL technology and to improve the Public Protection and Disaster Relief (PPDR) forces interoperability during joint international operations overcoming language barriers and supporting procedure execution.

As far as the hardware of the IET is concerned, IET is composed by a programmable device, by a TETRA modem and by a TETRAPOL modem. The programmable device is exploited to integrate TETRA and TETRAPOL technology and to improve PPDR forces interoperability during joint international operations. The ISITEP project address both the hand-held and the vehicular solution, the two solutions are physically different because of the different needs that an hand-portable radio shall satisfy with respect from those ones that shall be satisfied by a vehicular radio.

4.2 Software Architecture

In the current section we provide information on the software architectural choices with regard to the IET and integration of the Semantic and Syntactic Translator (SST), which is presented in this deliverable. The software architecture of the Android device that supports the described solution is the same both for the Hand-Held and for the Vehicular solution.

In order to implement the IET, two different architectural options were evaluated. The first option considered was the classical PC-oriented structure on the bottom of this software architecture there is the adaptation and communication manager that interfaces the TETRA and the TETRAPOL modems and on the top of this SW architecture there is the Human – Machine interface (HMI). This is a software architecture that requires a tight integration between the involved software components without the possibility of reusing what have been already experienced by Selex-ES and by Airbus in the past years. This option requires an ad hoc development of each PPDR feature exported by the enhanced ISITEP terminal exposing the enhanced ISITEP terminal to the risk of a reduced functional coverage for the final ISITEP demonstrations.

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The option that was finally selected was the second one, which is also illustrated in

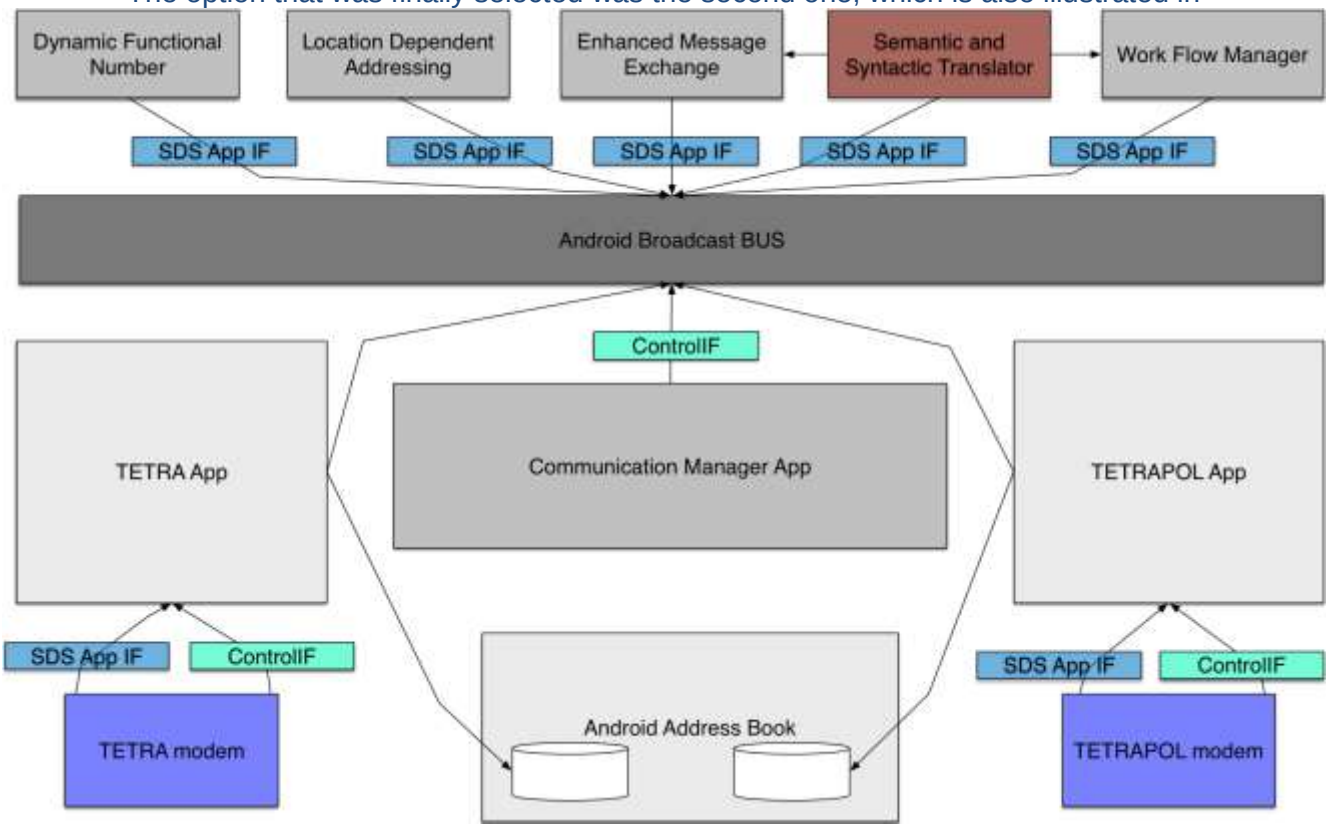

Figure 1.

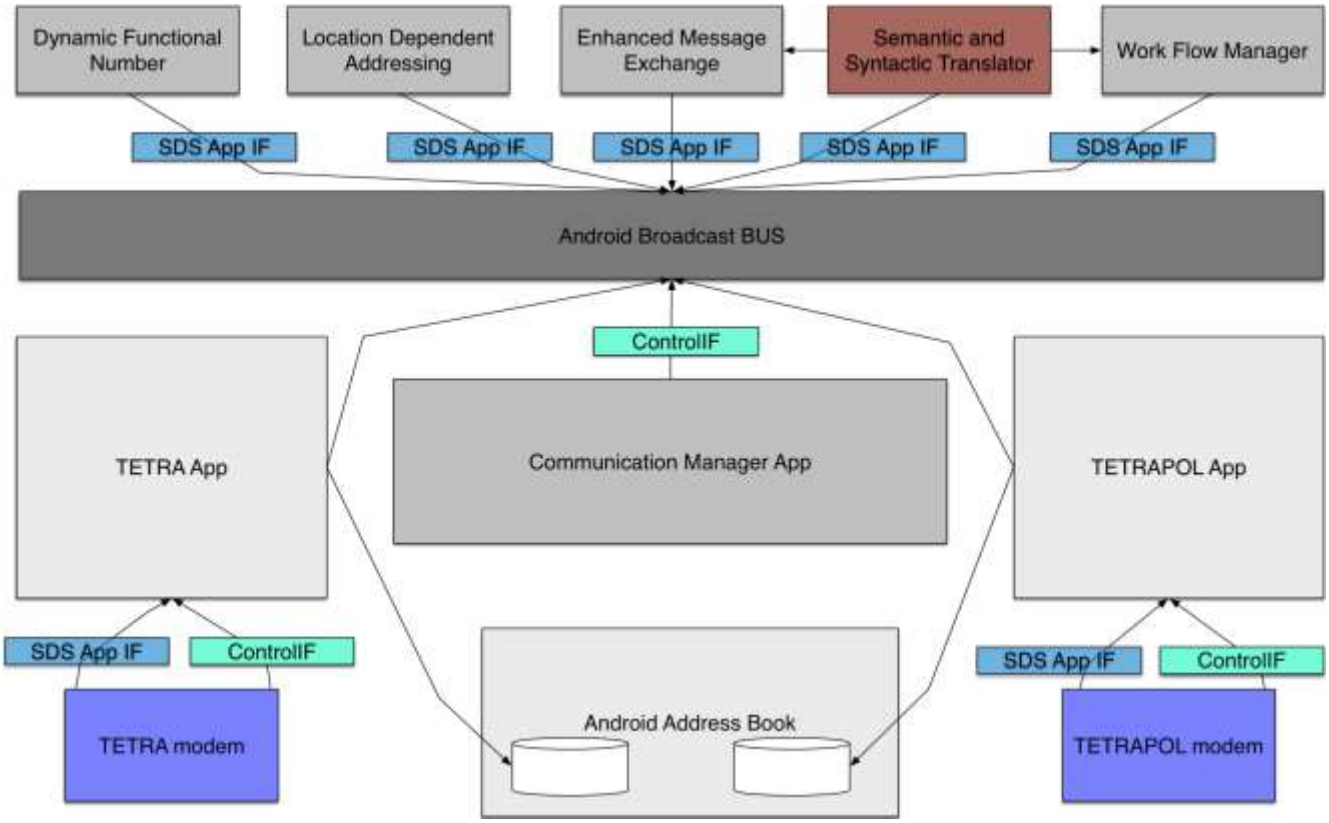

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Figure 1 The Semantic and Syntactic Translator inside the ISITEP Enhanced Terminal architecture

The Semantic and Syntactic Translator (SST) is illustrated in dark red colour (top). As it can be seen, the SST has a direct interface with the Enhanced Message Exchange Component, as well as the Workflow Manager, which is one of the interoperability applications (same with the SST), providing its translation service to both modules.

The selected architecture takes more advantages of the innovative technology offered by Android platform, while the different software components deployed inside the IET independent Android Application allowing an high level integration of the different software components. Each Android App can be developed independently, while the integration between them is guided by the Android framework. In relation to some of the rest components of the afore-presented architecture, some additional insights:

- The Communication Manager manages the access to the TETRA/ TETRAPOL App solving concurrency issues due to TETRA and TETRAPOL coverage overlapping. Moreover it offers an HMI that allows the end-user to set the Manual or Automatic handover.
- The TETRA App and the TETRAPOL App are able to export on the Android Broadcast BUS a common intent interface *SDS App IF* to send message across the TETRA or the TETRAPOL air interface, SDS App IF abstracts the radio interfaces (TETRA and the TETRAPOL) toward the ISITEP Added-Value applications.

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5 TRANSLATION TOOL AND DATABASE POPULATION

5.1 System Overview

The translation tool is decomposed to a set of components spread among an intermediate node, the translation engine and the database system. Those components comprise the logic, the communication and the representation aspects of the translation tool. In this section the system overview is given. More specifically in section5.1.1the developed functional architecture is introduced and high-level view of the modules and their inter-relation is given. Then, in section 5.1.2 we provide all the possible communication scenarios that may occur and the information exchange occurred in each case, while section 5.1.3 describes the deployment environment. Section 5.2 gives a brief description of the technical specifications of our deployment system. Finally, in the appendix of this document, the database file that includes the list of commands along with the respective translations, language IDs, etc.

5.1.1 Functional Architecture

In the context of this paragraph, we present the detailed functional decomposition of the introduced architecture to a set of components responsible to perform one or more tasks required for the translation procedure. Figure 2below captures the inter-relation between the functional components needed to fulfill the requirements for realizing the identified use cases. In addition each functional component comprises one or more functional elements responsible to perform a set of specific actions in the context of the task executed in the functional component.

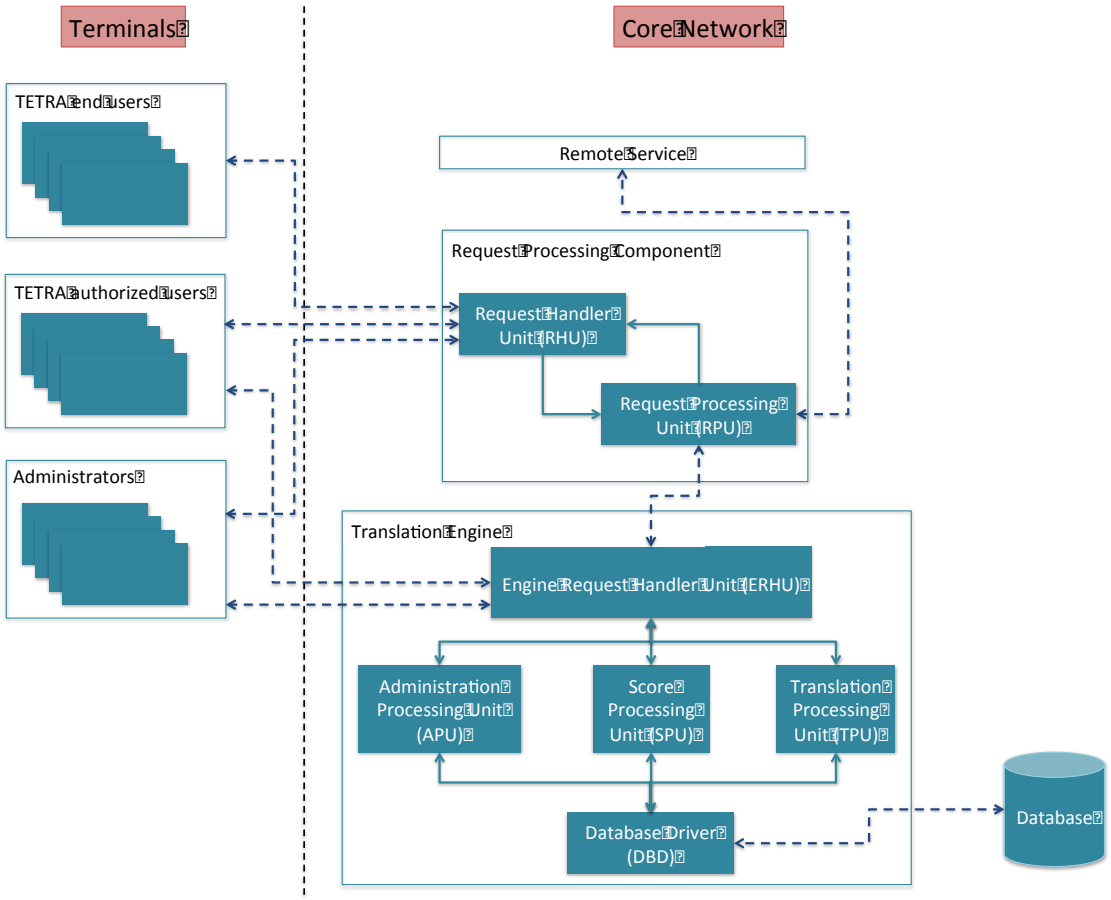

Figure 2: Functional Architecture

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As also depicted in the above figure, the following functional components have been identified:

- Request Processing Component
- Remote Service
- Translation Engine

Depending on the user type, it can be seen that different components of the core architecture interact with different user types. For example, the TETRA end users interact with sub-modules of the Request Processing Component only, which is the one responsible to receive the requests from the users, and forward them further. The TETRA authorized users may interact either with the Request Processing Component or the Translation Engine. Finally, the Administrators may interact also either with the Request Processing Component or the Translation Engine.

In the following sub-sections, some further details regarding the different components of the architecture are provided.

5.1.1.1 Request Processing Component (RPC)

The RPC is one of the main functional blocks of the described architecture. The RPC is in charge of performing the following tasks:

- Handling the requests from the terminals
- Contacting a remote service to retrieve target languages
- Sending translation requests to the translation engine
- Receiving translated commands from the translation engine
- Sending the translated commands to the terminals.

In order to accomplish the afore-mentioned tasks, the RPC comprises two functional sub-elements, i.e. the Request Handler Unit (RHU) and the Request Processing Unit (RPU), as it is illustrated in Figure 2 as well.

5.1.1.1.1 Request Handler Unit (RHU)

This component is one of two main elements of RPC. The RHU is responsible to perform the following actions:

- Receive the requests from the terminals
- Extract the following information elements from the received requests:
    - Source language
    - Command and
    - Target group identifier
- Pass the extracted information elements to the Request Processing Unit, and,
- Receive translated commands from the Request Processing Unit
- Send responses to the terminals.

5.1.1.1.2 Request Processing Unit (RPU)

The RPU is the second of the two sub-elements of RPC. RPU is responsible to perform the following tasks:

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- Contact the Remote Service component. Particularly:
  - Send the target group identifier, and,
  - Receive the target group languages
- Send the target group languages and the command to the Translation Engine component
- Receive from the Translation Engine the translated commands
- Pass the translated commands to the Request Processing Unit

The table that follows provides an overview of the RPC and its main functional elements, along with the primary functionalities of each one (Table 1):

Table 1 RPC, RHU and RPU functionality overview

Functional Element	Functionality
RPC	Handling the requests from the terminals
	Contacting a remote service to retrieve target languages
	Sending translation requests to the translation engine
	Receiving translated commands from the translation engine
	Sending the translated commands to the terminals.
RHU	Receive the requests from the terminals
	Extract information elements from the received requests (source language, command and target group identifier)
	Pass the extracted information elements to the RPU
	Receive translated commands from the RPU
	Send Responses to the terminals
RPU	Contact the Remote Service component (i.e., send the target group identifier and receive the target group languages)
	Send the target group languages and the command to the Translation Engine Component
	Receive from the Translation Engine the translated commands
	Pass the translated commands to the RPU

5.1.1.2 The Remote Service (RS)

As showed earlier in the functional architecture overview (Figure 2), one of the primary architecture components, besides RPC that was presented above, is the Remote Service. The RS is contacted by the RPU in order to provide the target languages. More specifically, the roles (i.e. tasks) of the RS component are the following:

- Receive from the RPC the target group identifier
- Map target group identifiers to target group languages and
- Send target group languages to the RPU

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5.1.1.3 The Translation Engine (TE)

The last of the main functional architecture's components is the Translation Engine. TE component is responsible to perform the following tasks:

- Receive from the Request Processing Component the target group languages and the source command
- Prepare the query statement and execute query to the DB,
- Retrieve query results from the DB, and,
- Send to the Request Processing Component the translated commands.

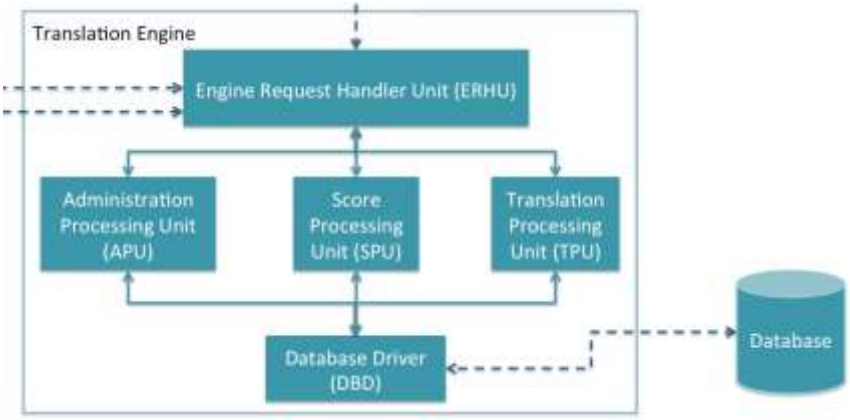

Figure 3 Translation Engine sub-components

For practical reasons we provide the architecture of the TE in Figure 33. As it is illustrated, TE comprises five main sub-components, i.e.:

- The Engine Request Handler Unit (ERHU)
- The Administration Processing Unit (APU)
- The Score Processing Unit (SPU)
- The Translation Processing Unit (TPU)
- The Database Driver (DBD)

In the following sub-sections, we provide some further insights with regard to each one of the afore-mentioned sub-components.

5.1.1.3.1 The Engine Request Handler Unit (ERHU)

The Engine Request Handler Unit (ERHU) plays similar role to the RHU of the Request Processing Component. More specifically, ERHU handles the communication of the TE with the RPU in case of translation requests and the communication of the TE component with Authorized Users and Administrators in case of submitting/updating the score of a translation or editing database entries respectively. Particularly, ERHU shall:

- Receive from the Request Processing Component the target group languages and the source command in case of a translation request,
- Receive from the Authorized Users message related to the score of a translation,

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- Receive from an Administrator an update message related to data entries in the Database,
- Identify the type of request received and forward the request to Administration Processing Unit, Score Processing Unit or Translation Processing Unit accordingly,
- Receive from the Translation Processing Unit the translated commands,
- Receive from Administration Processing Unit the successful transaction message,
- Receive from Score Processing Unit successful score query message,
- Send to the Authorized User the successful score query message,
- Send to the Administrator the successful transaction message, and,
- Send to the Request Processing Component the translated commands.

5.1.1.3.2 The Administration Processing Unit (APU)

The second of the five TE sub-components is APU. Administration Processing Unit (APU) is responsible to perform the following actions:

- Receive the update/edit request from the ERHU,
- Prepare the edit object query to be executed,
- Forward this query to the Database Driver,
- Receive from the Database Driver the query response, and,
- Send a successful transaction message to the ERHU.

5.1.1.3.3 The Score Processing Unit (SPU)

The Score Processing Unit (SPU) is responsible to perform the following actions:

- Receive the submit/update score message from the ERHU,
- Prepare the submit/update score query to be executed,
- Forward this query to the Database Driver,
- Receive from the Database Driver the query response, and,
- Send a successful score submission message to the ERHU.

5.1.1.3.4 The Translation Processing Unit (TPU)

The Translation Processing Unit (TPU) is responsible to perform the following actions:

- Receive the translation request elements from the ERHU,
- Prepare the translation query to be executed,
- Forward this query to the Database Driver,
- Receive from the Database Driver the query response, and,
- Send the translated command set to the ERHU.

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5.1.1.3.5 The Database Driver (DBD)

Finally, the last of the five TE sub-components, DBD is responsible to perform the following actions:

- Receive from APU, SPU or TPU queries to be executed,
- Execute queries to the Database,
- Receive query results, and,
- Send query results to APU, SPU or TPU.

Before proceeding in the Communication Scenarios in the next section, we provide an overview table that illustrates the tasks, which are performed by each one of the afore-presented components, along with their sub-modules (Table 2):

Table 2 TE, ERHU, APU, SPU, TPU and DBD functionality overview

Functional Element	Functionality
TE	Receive from the Request Processing Component the target group languages and the source command
	Prepare the query statement and execute query to the DB
	Retrieve query results from the DB
	Send to the RPC the translated commands
ERHU	Receive from the Request Processing Component the target group languages and the source command in case of a translation request
	Receive from the Authorized Users message related to the score of a translation
	Receive from an Administrator an update message related to data entries in the Database
	Identify the type of request received and forward the request to APU, SPU or TPU accordingly
	Receive from the TPU the translated commands
	Receive from APU the successful transaction message
	Receive from the SPU successful score query message
	Send to the Authorized User the successful score query message
	Send to the Administrator the successful transaction message
	Send to the Request Processing Component the translated commands
APU	Receive the update/edit request from the ERHU
	Prepare the edit object query to be executed
	Forward this query to the Database Driver
	Receive from the Database Driver the query response
	Send a successful transaction message to the ERHU
SPU	Receive the submit/update score message from the ERHU
	Prepare the submit/update score query to be executed
	Forward this query to the Database Driver
	Receive from the Database Driver the query response

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	Send a successful score submission message to the ERHU
TPU	Receive the translation request elements from the ERHU
	Prepare the translation query to be executed
	Forward this query to the Database Driver
	Receive from the Database Driver the query response
	Send the translated command set to the ERHU
DBD	Receive from APU, SPU or TPU queries to be executed
	Execute queries to the Database
	Receive query results
	Send query results to APU, SPU or TPU

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5.1.2 Communication Scenarios

In this section we present all the possible communication scenarios between any of the involved actors (i.e., TETRA users, TETRA authorized users and Administrators) with the Translation Tool. More specifically the following four scenarios have been identified:

1. Successful translation of a command
2. Unsuccessful translation of a command
3. Submit score for a translation
4. Update the Database (i.e., add, remove or update entries)

For each one of the scenarios, a subset of the Functional Components and their respective Functional Elements are active. Table 3 that follows illustrates the mapping of each scenario with the respective functional components:

Table 3 Communication scenarios - Functional Components mapping

Scenario	Functional Element	Functionality
1	Successful translation of a command	ERHU, TPU, DBD, DB
2	Unsuccessful translation of a command	ERHU, TPU, DBD, DB
3	Submit score for a translation	ERHU, SPU, DBD, DB
4	Update the Database	ERHU, APU, DBD, DB

In the following subsections we present each one of the communications scenarios, along with the main steps, as well as the message sequence chart (information flow) of the scenario that comprises the actor and the respective components.

5.1.2.1 Scenario 1: Successful translation of a command

Initially, we illustrate the steps of the first scenario in Table 4, along with their description.

Table 4 Scenario 1 steps

Step Number	Description
1	A request for translation is sent by the client to the RHU
2	ERHU is processing the request
3	ERHU is extracting the query from the request
4	ERHU is sending a request to TPU
5	TPU is preparing the query
6	TPU makes a query to the DBD to get the command ID

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7	DBD sends an execute commands to the DB
8	DB is responding with a raw query response
9	DBD responds back to the TPU with the command ID
10	TPU is requesting afterwards a request for the translation for the particular command ID
11	DBD sends a respective execute commands to the DB
12	DB is responding with a raw query response
13	DBD responds with a raw translated command back to the TPU
14	TPU is processing the response with the translated command
15	TPU sends the processed translated response back to the ERHU
16	ERHU is generating the final response and encapsulates it in a HTTP message
17	ERHU sends the response back to the client

In 4 the messages exchanged in case of a successful translation are represented. Initially, a client sends a translate request to the Request Handler Unit of the Request Processing Component. The ERHU will check the request, extract the elements required for the query and forward them to the Translation Processing Unit. Translation Process Unit will prepare the query statement and send it the Database Driver. The Database Driver that maintains the connections to the database will execute the query and send the results back to the TPU. TPU then, prepares the response forwards it to the handler, which will encapsulate the message to an HTTP response and send it to the clients.

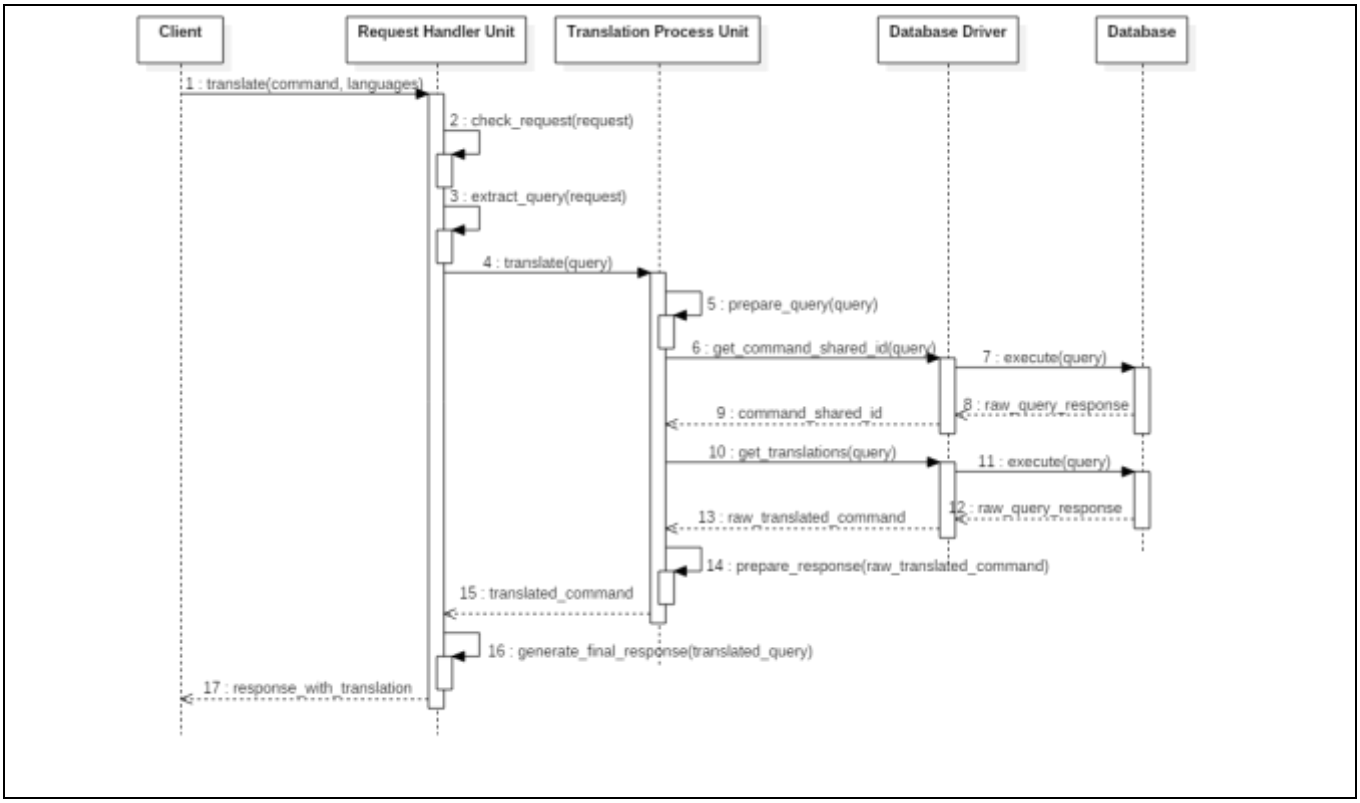

Figure 4: Successful translation of a command

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5.1.2.2 Scenario 2: Unsuccessful translation of a command

Similarly, we present the steps of the second scenario. It must be noted that an unsuccessful command translation may be due to

a) free text is submitted
b) writing error takes place during the command submission

Table 5 Scenario 2 steps

Step Number	Description
1	A request for translation is sent by the client to the ERHU
2	ERHUis processing the request
3	ERHUis extracting the query from the request
4	ERHUis sending a request to TPU
5	TPU is preparing the query
6	TPU makes a query to the DBD to get the command ID
7	DBD sends an execute commands to the DB
8	DB is responding with a raw query response
9	DBD responds with a "*ID not found*" message back to the TPU
10	TPU responds accordingly to the ERHU("*translation not found*")
11	ERHUresponds accordingly to the client ("*translation not found*")

In Figure 5 the messages exchanged in case of an unsuccessful translation are shown. Steps 1-8 are the same as in the case of successful translation. However, the translation is not found in the database and the DBD sends a translation not found message to the TPU. TPU then, prepares the response forwards it to the handler, which will encapsulate the message to an HTTP response and send it to the clients.

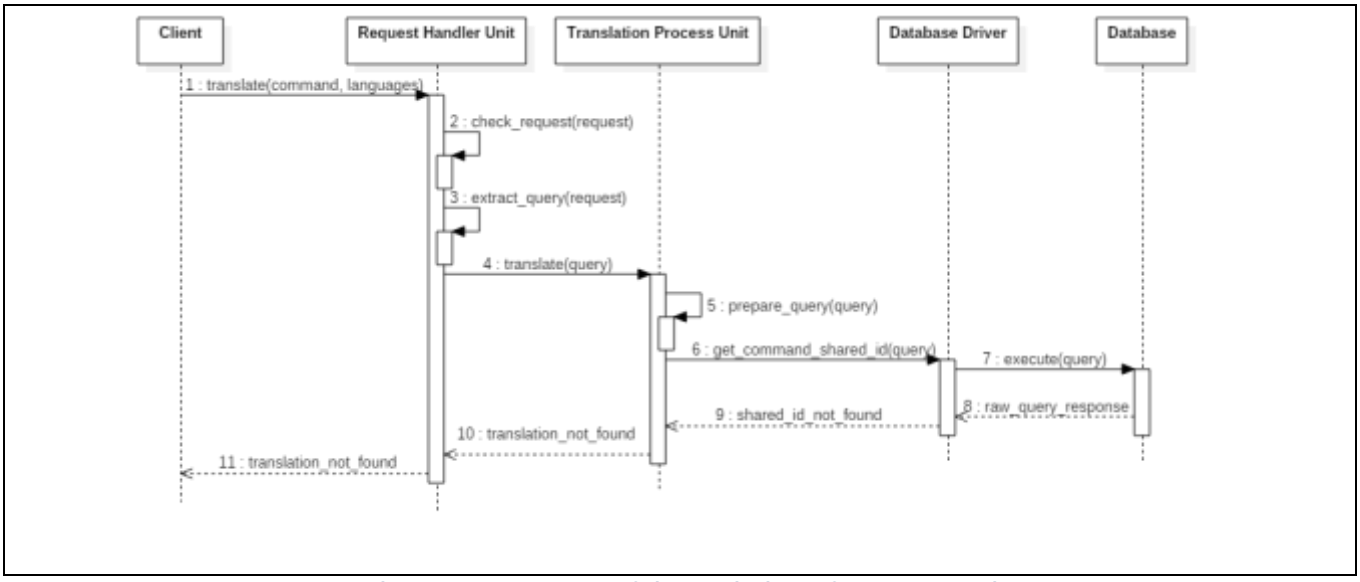

Figure 5: Unsuccessful translation of a command

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5.1.2.3 Scenario 3: Submit score for a translation

The steps of the third scenario are illustrated in Table 6:

9	**ERHU is extracting the score command from the client's request**
10	ERHU sends a query for the score command submission to the SPU
11	SPU is processing the received query
12	SPU sends the respective processed request to the DBD
13	DBD sends an execute command to the DB
14	DB responds with a successful response back to the DBD
15	DBD responds with a successful response back to the SPU
16	SPU responds with a successful response back to the ERHU
17	ERHU responds with a *successful score submission* back to the client

In Figure 6 the messages exchanged in case of the score submission scenario are shown. As only Authorized Users are allowed to submit scores, steps 1-6 show the authentication process of a client that will allow it to proceed to score submission. More specifically, a client contacts the Engine Request Handler Unit and sends a login request. The RHU will prepare the query and send this to the DBD, which executes the query to the Database through its active connection. The response is sent to the ERHU, which grants or rejects the login request and sends a corresponding message back to the user. The authorized user is now capable to submit score for a command. In step 7 the authorized user sends a score command to the ERHU, which will extract the query elements and send them to the SPU. SPU then will prepare the query and send it to the DBD, which will execute the query and send back to the SPU the results. SPU prepares the response message and send it to the ERHU. Finally, ERHU encapsulates the message to an HTTP response and sends it to the authorized client.

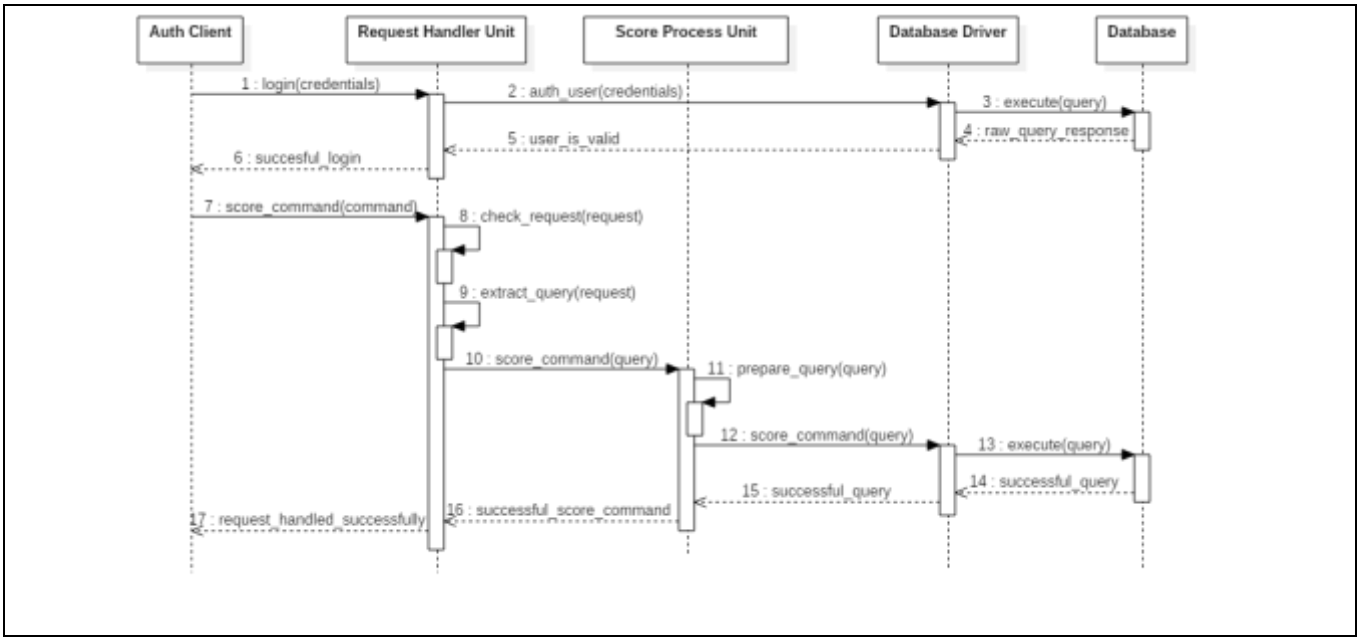

Figure 6

Table 6 Scenario 3 steps

Step Number	Description

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1	The user is logging in using own *credentials*
2	ERHU is making a request to the DBD for confirming the *credentials* of the user
3	DBD is sending an execute command to the DB
4	DB is responding to the DBD
5	DBD is confirming to the RHU the validity of the user
6	ERHU is notifying the user about the successful login
7	The use r is sending a score command to the ERHU
8	ERHU is evaluating the request by the client
9	ERHU is extracting the score command from the client's request
10	ERHU sends a query for the score command submission to the SPU
11	SPU is processing the received query
12	SPU sends the respective processed request to the DBD
13	DBD sends an execute command to the DB
14	DB responds with a successful response back to the DBD
15	DBD responds with a successful response back to the SPU
16	SPU responds with a successful response back to the ERHU
17	ERHU responds with a *successful score submission* back to the client

In Figure 6 the messages exchanged in case of the score submission scenario are shown. As only Authorized Users are allowed to submit scores, steps 1-6 show the authentication process of a client that will allow it to proceed to score submission. More specifically, a client contacts the Engine Request Handler Unit and sends a login request. The RHU will prepare the query and send this to the DBD, which executes the query to the Database through its active connection. The response is sent to the ERHU, which grants or rejects the login request and sends a corresponding message back to the user. The authorized user is now capable to submit score for a command. In step 7 the authorized user sends a score command to the ERHU, which will extract the query elements and send them to the SPU. SPU then will prepare the query and send it to the DBD, which will execute the query and send back to the SPU the results. SPU prepares the response message and send it to the ERHU. Finally, ERHU encapsulates the message to an HTTP response and sends it to the authorized client.

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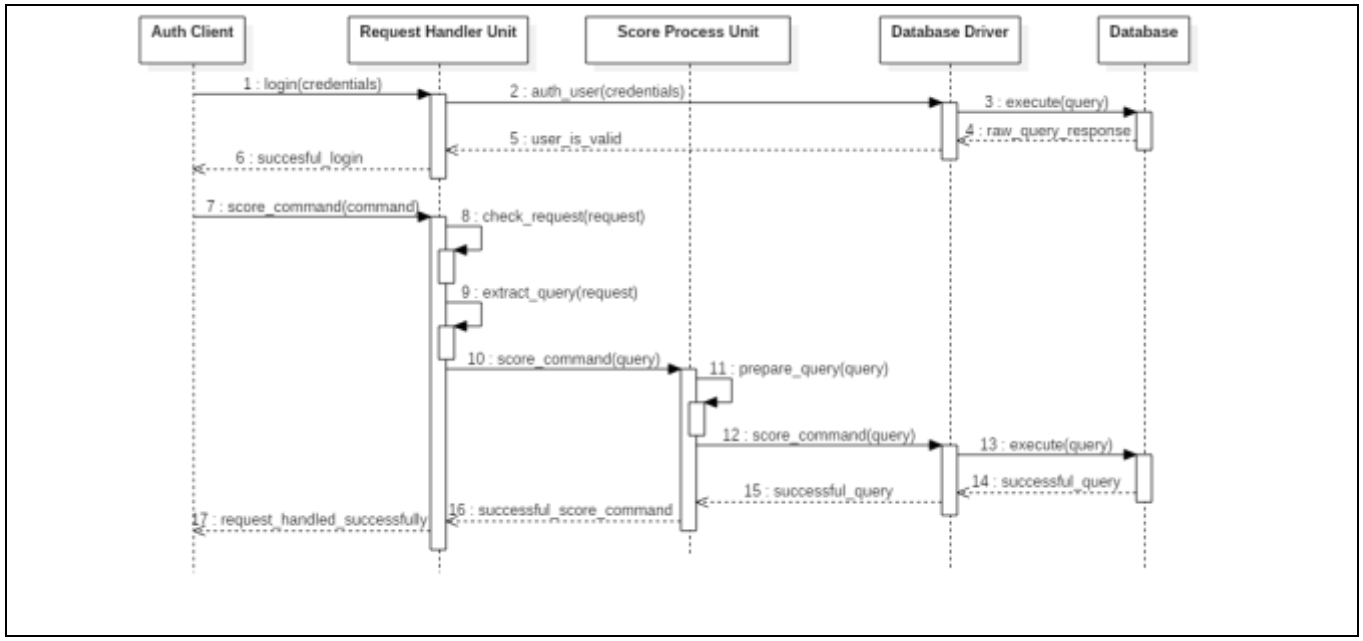

Figure 6: Score submission steps

5.1.2.4 Scenario 4: Update the Database

Finally, the steps of the last communication scenario are described in Table 7:

Table 7 Scenario 3 steps

Step Number	Description
1	Admin is logging into the system using *credentials*
2	ERHUis making a request to the DBD for confirming the credentials of the user
3	DBD is sending an execute command to the DB
4	DB is responding to the DBD
5	DBD is confirming to the ERHU the validity of the user
6	ERHU notifies the user (admin) about the successful login
7	Admin makes a request to the ERHU for editing an object in the DB
8	ERHU is evaluating the request
9	ERHU is extracting the query from the request
10	ERHU makes a request for editing the object to the APU
11	APU is processing the request by the RHU
12	APU makes a request to the DBD
13	DBD sends an *execute command* to the DB
14	DB responds with a *successful transaction* about the transaction
15	DBD responds with a *successful transaction* message to the APU
16	APU responds with a *successful transaction* message to the ERHU
17	ERHU responds with a *successful request* message to the Admin

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Figure 7 highlights the messages exchanged in case of the update database scenario. As only Administrators are allowed to perform such operations, steps 1-6 show the authentication process of the Administrator. The authentication process is the same as the one in the score submission scenario. After the administrator has been granted access to perform updates in the database, the administrator sends an edit object configuration request (step 7) to the ERHU, which in turn, will extract the query elements and send them to the APU. APU then will prepare the configuration update query and send it to the DBD, which will execute the query and send back to the APU the results. APU prepares an acknowledgement response message and send it to the ERHU. Finally, ERHU encapsulates the message to an HTTP response and sends it to the administrator.

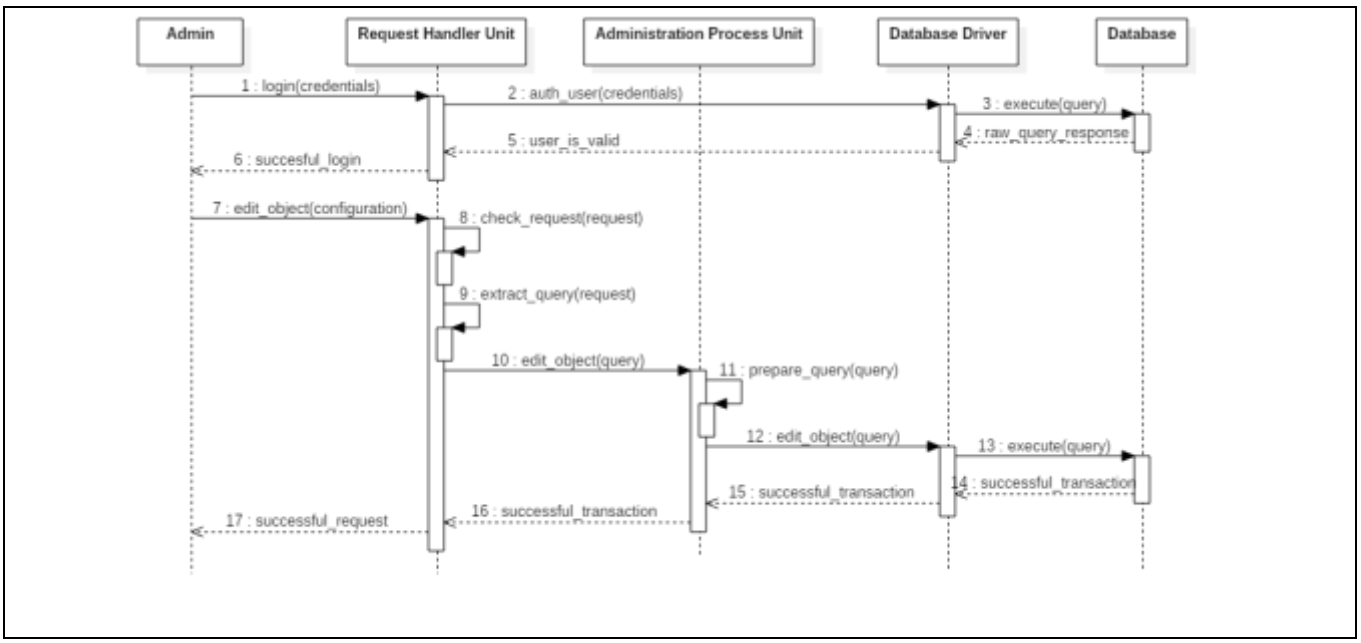

Figure 7: Update database steps

5.1.3 Deployment Environment

In this section the technical specifications of the deployment system that has been used for the system evaluation is provided. The specifications that will follow comprise the Database specifications, the PC capabilities and all the rest prerequisites required for the validation. All the specs are provided in Table 8.

Table 8 Deployment environment

Specification name		Value
Database	MySQL community server version[4]	5.6.24
PC Capabilities	CPU	Dual core Intel Core i5-3317U (-HT-MCP-) cache: 3072 KB Clock speeds: max: 2600 MHz 1: 803 MHz 2: 891 MHz 3: 900 MHz 4: 811 MHz

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	RAM	8 GB
	HDD	SSD 250 GB
	Network Connectivity	Ethernet 100 Mbit/s
Other	Django version	1.8.2
	Python version[5]	2.7.8

5.2 Translator Tool APIs and Database Schema

5.2.1 Translator tool APIs

In this section we provide a brief description of the fundamental methods developed for the translation tool. Table 9below lists the names of methods and a brief description of their functionality.

Table 9 Methods descriptions

Method	Description
populatedb(input_file)	Reads the input file and store its contents in the database, this internally uses the classes from the *models.py* in order to store each python class instance as an entry in the corresponding MySQL table
deleteall()	This deletes all the data from the database tables. This uses the classes from models.py and their API to delete the data, example is shown below(next row)
CommandText.objects.delete()	This deletes all the objects from the DB
Language.objects.delete()	This deletes all the objects from the DB
translate(request)	This is the main function, which handles translation requests. Internally it uses the Django model objects to query the DB without the use of SQL.
CommandText.objects.filter (text=command_text)	This queries the DB and gets (filters) the command with text equal to command_text

5.2.2 Database Schema and API

In this subsection we present the methodology followed for the initialization of the database schema and therefore accessing and modifying the database tables. The translator tool has been developed in Python script language and Django has been used for creating the

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database. As described in previous deliverable the database schema contains the following three MySQL tables:

- Language
- CommandText
- CommandExtras

These are modelled as python classes and are transformed through Django to MySQL tables. Django is an open-source high-level Python Web framework that encourages rapid development and clean, pragmatic design. Django attempts to support as many features as possible on all database back-ends. It supports MySQL 5.5 and higher and includes several storage engines (e.g., MyISAM, InnoDB).Figure 8 below shows the Enhanced Entity Relationship (EER) model of the translator DB schema. As shown in the figure, each one of the three table has an id attribute that plays the role of primary key. The *CommandText* has an attribute named *language_id_id*that is foreign key to the primary key of the Language table. Similarly, *CommandExtras* has an attribute named *command_id_id*that is foreign key to the primary key of the *CommandText* table. The schema follows a 3rd Normal Form (3NF), meaning that it does not have any partial or transitive dependencies.

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Figure 8 Translator DB schema

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6 REQUIREMENTS MAPPING BETWEEN THE TRANSLATOR TOOL AND THE TETRA AND TETRAPOL APPS

In this section we provide a mapping between the requirements of the TETRA, as well as the TETRAPOL apps, –as these have been reported in [1] and the Translator Tool. For each one of the reported requirements, it is indicated whether the specific requirements applies directly or indirectly to the Semantic and Syntactic Translator as well.

It must be noted, that in [2], all the functional, as well as non-functional requirements of the translator tool have been reported in detail.

The description of a requirement is formulated using the terms “must", "must not", "required", "shall", "shall not", "should", "should not", “recommended", "may", and "optional", as described in IETF RFC 2119. Definitions of these terms are reproduced here:

- “must”, "required" or "shall" mean that the definition is an absolute requirement of the specification
- “must not” or “shall not” mean that the definition is an absolute prohibition of the specification
- “should” or “recommended” mean that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course
- “should not” or “not recommended” mean that there may exist valid reasons in particular circumstances when the particular behaviour is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behaviour described with this label
- “may” or the adjective "optional" mean that an item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because the vendor feels that it enhances the product while another vendor may omit the same item.

6.1 TETRA app requirements mapping

Initially, we list the requirements of the TETRA app, as these were discussed in [1]. The requirements of the TETRAPOL app are identical, so we skip the duplication of them in this section. At the end of this section we provide an overview table, which makes the mapping between them and the translator tool, i.e. which of the requirements reflect (either directly or indirectly) to the Semantic and Syntactic Translator (SST).

ID	Description
Req_01	The TETRA App shall be able to export its services running in the background without displaying the user interface.
Discussion and impact on the Semantic and Syntactic Translator	
Applies to the SST: the translator service tools are running in the background during the requests-responses between the respective components (Translation Engine, ERHU, APU, SPU, etc.)	

ID	Description

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Req_02	The TETRA software HMI shall be activated only when requested by the end-user or automatically to manage an incoming call.
Discussion and impact on the Semantic and Syntactic Translator	
Applies to the SST partially: the translated commands are shown to the user automatically after received and translated	

ID	Description
Req_03	The TETRA App shall export the registration status on the TETRA network in the Android Broadcast BUS (broadcast intent).
Discussion and impact on the Semantic and Syntactic Translator	
Applies to the SST: as also illustrated in Figure 1	

ID	Description
Req_04	The TETRA App shall provide an Icon on the Android Toolbar to inform the user about the registration status on the TETRA Network.
Discussion and impact on the Semantic and Syntactic Translator	
Does not apply to the SST	

ID	Description
Req_05	TETRA App shall expose (via Intent) an activation service to be invoked by Communication Manager App (App CTRL If) in order to enable the Communication Manager App to recall the TETRA software HMI.
Discussion and impact on the Semantic and Syntactic Translator	
Applies to the SST: as also illustrated in Figure 1	

ID	Description
Req_06a	The TETRA App shall provide the App CTRL If, this interface is composed by the following broadcast INTENT:Activate TETRA Service command: this command shall be sent by the Communication Manager App to enable the TETRA App to attach to active groups and manage incoming speech calls, and incoming SDS.
Discussion and impact on the Semantic and Syntactic Translator	
Does not apply to the SST	
ID	**Description**
Req_06b	The TETRA App shall provide the App CTRL If, this interface is composed by the following broadcast INTENT:Deactivate TETRA Service command: this command shall be sent by the Communication Manager App in order to disable the TETRA App; when the TETRA App is deactivated it shall provide the registration status to the ISITEP App but it shall detach from any group and

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	reject/discharge the incoming individual speech calls / SDSs.
Discussion and impact on the Semantic and Syntactic Translator	
Does not apply to the SST	

ID	Description
Req_07	The TETRA App shall export Short Data Service to/from the TETRA infrastructure to third party applications through the SDS App IF.
Discussion and impact on the Semantic and Syntactic Translator	
Applies to the SST: as also illustrated in Figure 1, SST also uses the SDS App IF interface with the Broadcast Bus.	

ID	Description
Req_08	The TETRA App shall register SDS service into the Android Broadcast BUS, whenever the TETRA infrastructure is available.
Discussion and impact on the Semantic and Syntactic Translator	
Applies to the SST: as also illustrated in Figure 1, SST also uses the SDS App IF interface with the Broadcast Bus.	

ID	Description
Req_09	The TETRA App shall de-register the SDS service from the Android Broadcast BUS whenever the TETRA infrastructure is not available.
Discussion and impact on the Semantic and Syntactic Translator	
Applies to the SST: as also illustrated in Figure 1, SST also uses the SDS App IF interface with the Broadcast Bus.	

ID	Description
Req_10	It shall be possible for the LDA App and for the DFN App to modify TETRA address book stored inside the Android Address Book and the TETRA App shall be able to access to address data managed by LDA App and DFN App.
Discussion and impact on the Semantic and Syntactic Translator	
Does not apply to the SST	

6.2 TETRAPOL app requirements mapping

As also indicated earlier, as reported in [1], TETRAPOL app's requirements are identical, as a result, the same mapping applies.

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6.3 Requirements Mapping Overview

After the detailed listing of requirements, we provide the overview of the mapping between the TETRA(POL) apps' requirements and the Translator Tool ones.

Req ID	**01**	**02**	**03**	**04**	**05**	**06a/b**	**07**	**08**	**09**	**10**
Applies	Yes	(Yes)	Yes	No	Yes	No/No	Yes	Yes	Yes	No

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7 CONCLUSIONS

This document comprises a detailed report of a Semantic and Syntactic Translator designed for TETRA/TETRAPOL end users. As reported in the present document, the main scope of this application is to bridge the heterolingual gap between users operating on TETRA terminals –and in particular- in emergency conditions, where communication and temporal constraints are critical. Initially, the document provides an overview of the overall system: the actors that are involved, as well as the main use cases are presented, while the functional and non-functional requirements are reported as well. Based on the afore-mentioned, the required architecture is then defined and illustrated, comprising a 3-tier client server application. The sections that follow the system's overview provide more in-depth insights in relation to the implementation choices of the proposed solution, such as the database type selection and the language that was used for the development of the application. The next section focuses on the translator tool, its functional architecture, the deployment environment, the APIs of the translator, as well as several communication scenarios between the Translator Tool and the different involved actors. The last section realises a mapping between the functional requirements of the TETRA app and the Semantic and Syntactic Translator functionality.

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8 REFERENCES

[1] ISITEP deliverable D5.1.2, “Inter System Interoperability for TETRA-TETRAPOL Networks”

[2] ISITEP deliverable D5.5.3, “Semantic/Syntactic Translator Engine Design Description”

[3] REST API tutorial, [Online],http://www.restapitutorial.com

[4] MySQL website, [Online], https://www.mysql.com

[5] Python programming language website, [Online], https://www.python.org

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APPENDIX

In this section we provide more insights in relation to the processed DB file that was used during the translation process.

Raw Dataset

The initial commands file that was processed was in Excel format. All the words in the file were in English. Afterwards, the file was exported into a csv file. In order to efficiently translate the list into the three languages (FR, DE, IT) an electronic dictionary was used in combination with a script. The resulted csv (processed DB file) is analysed below.

Processed DB file

The file that must be included in the database is in .csv format with the following header:

#command,shared_id,language,description(optional)

- *command*: the word/sentence to be stored
- *shared*_id: the same command in different languages has the same shared_id
- *language*: the language of the command

The table that follows illustrates the list of the commands included in the processed database file, along with the respective shared IDs, as well as the respective language:

Command	Shared ID	Language
accomplished	1	EN
experimenté	1	FR
ausgeführt	1	DE
action	2	EN
procès	2	FR
aktion	2	DE
processo	2	IT
action	3	EN
procès	3	FR
aktion	3	DE
processo	3	IT

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activity	4	EN
vigueur	4	FR
aktivität	4	DE
occupazione	4	IT
addition	5	EN
addition	5	FR
addition	5	DE
additional	6	EN
autre	6	FR
nachträglich	6	DE
advance	7	EN
avancer	7	FR
erhöhung	7	DE
avvicinarsi	7	IT
aerial	8	EN
antenne	8	FR
antenne	8	DE
antenna	8	IT
ahead	9	EN
en	9	FR
geradeaus	9	DE
avanti	9	IT
air support	10	EN
allocate	11	EN
zugeteilt	11	DE
alone	12	EN
seul	12	FR
allein	12	DE
solo	12	IT
alternate	13	EN
alterner	13	FR

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abwechselnd	13	DE
am	14	EN
bin	14	DE
ammunition	15	EN
munitions	15	FR
munition	15	DE
among	16	EN
au	16	FR
mitten	16	DE
analysis	17	EN
analyse	17	FR
analyse	17	DE
annex	18	EN
anhang	18	DE
another	19	EN
supplémentaire	19	FR
andere	19	DE
altro	19	IT
appear	20	EN
paraître	20	FR
parere	20	IT
approval	21	EN
agrément	21	FR
billigung	21	DE
approvazione	21	IT
area	22	EN
aire	22	FR
bereich	22	DE
area	23	EN
aire	23	FR
bereich	23	DE

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arrival	24	EN
fourniture	24	FR
ankunft	24	DE
arrivo	24	IT
assebly	25	EN
asset	26	EN
acquisition	26	FR
aktivposten	26	DE
assistant	27	EN
adjoint	27	FR
assistent	27	DE
assistente	27	IT
attach	28	EN
attacher	28	FR
fissare	28	IT
attachment	29	EN
attachement	29	FR
anfügung	29	DE
automatic	30	EN
automatique	30	FR
automatik	30	DE
available	31	EN
gültig	31	DE
disponibile	31	IT
back	32	EN
dos	32	FR
heck	32	DE
quartiere	32	IT
between	33	EN
au	33	FR
dazwischen	33	DE

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brief	34	EN
court	34	FR
auftrag	34	DE
corto	34	IT
brief	35	EN
court	35	FR
auftrag	35	DE
corto	35	IT
briefing	36	EN
einweisung	36	DE
capture	37	EN
attraper	37	FR
prendere	37	IT
chain of command	38	EN
chief	39	EN
chef	39	FR
anführer	39	DE
commissario	39	IT
classification	40	EN
einordnung	40	DE
close up	41	EN
code	42	EN
code	42	DE
codice	42	IT
collection	43	EN
collection	43	FR
sammlung	43	DE
gruppo	43	IT
column	44	EN
rubrique	44	FR
druckspalte	44	DE

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combat	45	EN
bekämpfung	45	DE
commander	46	EN
befehlshaber	46	DE
comandante	46	IT
communication	47	EN
faire- part	47	FR
kommunikation	47	DE
annunzio	47	IT
concealed	48	EN
kaschierte	48	DE
concept	49	EN
auffassung	49	DE
conduct	50	EN
procédé	50	FR
dirigieren	50	DE
comportarsi	50	IT
contact	51	EN
contact	51	FR
ansprechpartner	51	DE
contatto	51	IT
convoy	52	EN
geleit	52	DE
coordinate	53	EN
koordinate	53	DE
coordinates	54	EN
koordinaten	54	DE
corrrect	55	EN
cover	56	EN

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abattre	56	FR
abdeckung	56	DE
percorrere	56	IT
cpcheck point	57	EN
critical	58	EN
bedenklich	58	DE
critical	59	EN
bedenklich	59	DE
danger	60	EN
danger	60	FR
gefahr	60	DE
pericolo	60	IT
dark	61	EN
obscur	61	FR
dunkel	61	DE
blu	61	IT
date	62	EN
rencontre	62	FR
datum	62	DE
appuntamento	62	IT
daylight	63	EN
tageslicht	63	DE
luce	63	IT
deception	64	EN
täuschung	64	DE
defencive	65	EN
defend	66	EN
défendre	66	FR
difendere	66	IT
define	67	EN
définer	67	FR

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definire	67	IT
departure	68	EN
départ	68	FR
abfahrt	68	DE
partenza	68	IT
desired	69	EN
begehrte	69	DE
destroy	70	EN
abaisser	70	FR
distruggere	70	IT
detach	71	EN
detachment	72	EN
commando	72	FR
ablösung	72	DE
brigata	72	IT
detailed	73	EN
ausführlich	73	DE
details	74	EN
details	74	DE
determined	75	EN
bestimmt	75	DE
determined	76	EN
bestimmt	76	DE
develop	77	EN
développer	77	FR
svilupparsi	77	IT
device	78	EN
appareil	78	FR
einheit	78	DE
apparecchio	78	IT
direct	79	EN

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direct	79	FR
direkt	79	DE
destro	79	IT
discover	80	EN
découvrir	80	FR
scoprire	80	IT
dismount	81	EN
scendere	81	IT
disprove	82	EN
drawing	83	EN
dessin	83	FR
nachziehend	83	DE
disegno	83	IT
drill	84	EN
forer	84	FR
abrichten	84	DE
drop	85	EN
sabaisser	85	FR
abfall	85	DE
diminuire	85	IT
due date	86	EN
duration	87	EN
dauer	87	DE
each	88	EN
chaque	88	FR
jede	88	DE
ogni	88	IT
early	89	EN
de	89	FR
baldig	89	DE
di	89	IT

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effective	90	EN
wirksam	90	DE
efficace	90	IT
element	91	EN
élément	91	FR
element	91	DE
ingrediente	91	IT
elevation	92	EN
emporheben	92	DE
elsewhere	93	EN
ailleurs	93	FR
anderswo	93	DE
altrove	93	IT
emergency	94	EN
crise	94	FR
not	94	DE
crisi	94	IT
enemy	95	EN
ennemi	95	FR
feind	95	DE
nemico	95	IT
engage	96	EN
ensure	97	EN
equipment	98	EN
apparatur	98	DE
essential	99	EN
essentiel	99	FR
hauptsache	99	DE
estimation	100	EN
abschätzung	100	DE
evacuation	101	EN

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entleerung	101	DE
evening	102	EN
soir	102	FR
abend	102	DE
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factor	105	EN
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beneficio	118	IT
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grille	119	FR
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guidance	120	EN
anleitung	120	DE
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accueillir	121	FR
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hqheadquarters	124	EN
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durchsickern	132	DE
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abnahme	138	DE
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examiner	141	FR
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issuance	143	EN
ausgabe	143	DE
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proclamer	144	FR
ausgabe	144	DE
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clef	145	FR
passfeder	145	DE
chiave	145	IT
lead	146	EN
plomb	146	FR
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piombo	146	IT

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mann	156	DE
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höchster	159	DE
massimo	159	IT
meal	160	EN
repas	160	FR
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fiore	160	IT
means	161	EN
moyen	161	FR
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arnesi	161	IT
medecin	162	EN
medical evacuation	163	EN
medical	164	EN
medizinisch	164	DE
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männer	165	DE
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naval	176	EN
flotten	176	DE
navigation	177	EN
navigation	177	DE
next	178	EN
prochain	178	FR
nächste	178	DE
accanto	178	IT
non	179	EN
nicht	179	DE
not	180	EN
ne	180	FR

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huile	185	FR
Öl	185	DE
olio	185	IT
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un	188	FR
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opportunity	191	EN
occasion	191	FR
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reconnaissance	201	FR
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erlaubnis	204	DE
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personnel	205	EN
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phase	206	EN
phase	206	FR
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appliquer	207	FR
ort	207	DE
chiesa	207	IT
placed	208	EN
plaziert	208	DE
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pm	211	EN
nachmittags	211	DE
point	212	EN
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messer	212	DE

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possible	214	FR
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probable	222	EN
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radio	230	FR
radio	230	DE
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raer	231	EN
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geschwind	233	DE
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ration	234	DE
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formulierte	251	DE
resupply	252	EN
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stream	279	EN
ruisseau	279	FR
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ruscello	279	IT
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feldstärke	280	DE
forza	280	IT
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devoir	290	FR
pensum	290	DE
compito	290	IT
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terrain	292	FR
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time	294	EN
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time	295	EN
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tempo	295	IT

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nachlauf	296	DE
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uniforme	298	FR
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unité	299	FR
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recours	300	FR
anwendung	300	DE
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usefull	301	EN
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arme	308	FR
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arma	308	IT
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temps	309	FR
weder	309	DE
tempo	309	IT
what	310	EN
quoi	310	FR
das	310	DE
che	310	IT
when	311	EN
lorsque	311	FR
als	311	DE
quando	311	IT
who	312	EN
qui	312	FR
das	312	DE
why	313	EN
pourquoi	313	FR
aber	313	DE
with	314	EN
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ankopplung	314	DE
a	314	IT
without	315	EN
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zone	317	FR
bereich	317	DE
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zone	318	EN
zone	318	FR
bereich	318	DE
cintura	318	IT
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illustrer	319	FR
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make issue	321	EN

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