Mediterranean Database Overview

EC DEVCO - GRANT CONTRACT: ENPI/2014/347-006

"Mediterranean Project"

Task 5 "Med-TSO's Database"

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LIST OF ACRONYMS

AC	Administrative Controller
CED	Data Center
DB	Database
DBMED	Med-TSO database object of current document
DBMS	Database management system
EC	European Commission
HW	Hardware
IAAS	Infrastructure as a Service
RDBMS	Relational Database Management System
SAAS	Software as a Service
SQL	Structured Query Language
SW	Software

1 INTRODUCTION

Med-TSO is the Association of the Mediterranean Transmission System Operators (TSOs) for electricity, operating the High Voltage Transmission Networks of 18 Mediterranean Countries.

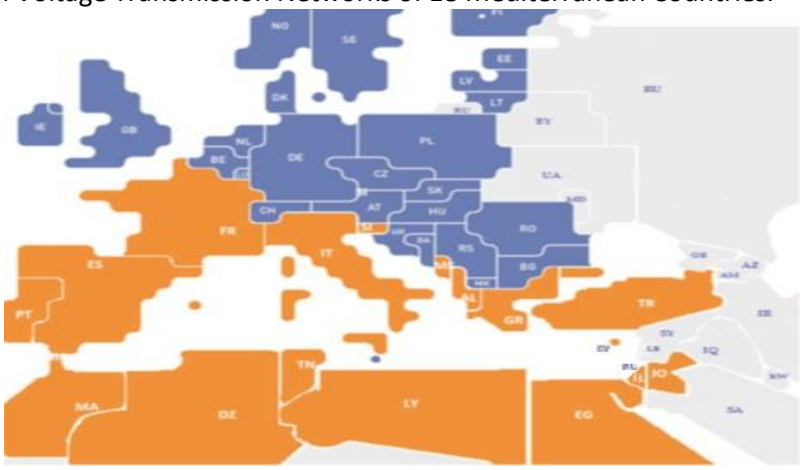

Fig. 1.1: Med-TSO members in orange in the figure

DBMED is Med-TSO database developed to collect, store and exchange information among the Members for the purposes of its core activities: namely Network Analysis and Market Studies and an Adequacy section will store, country by country, historical data on adequacy and related components like generation, NTC values, demand evolution, other statistics and reporting.

The logically is organized into three sections:

a) ***Network*** – network data for load flow calculations (only), with import/export interface in different formats;

b) ***Market*** – data necessary for market studies, without duplicating network data section;

c) ***Adequacy*** - historical and statistical data, for adequacy studies and reporting purposes, without duplicating the previous data sets.

The object of the user guide is the Network section, Market and Adequacy section will be object of subsequent development.

The data perimeter covered by DBMED is the whole Mediterranean Region plus equivalent and simplified models of the neighboring Power Systems.

The database activities are within Task 5, actions from 5.1 to 5.6, of the Mediterranean Project, funded by the European Commission through the Grant Contract “EXTERNAL ACTIONS OF THE EUROPEAN UNION - ENI / 2014 / 347-006” , whose obligations are transferred in the obligations of the present document. The activity is funded by the EC and subject to all EU standard procedures.

2 DBMED ARCHITECTURE

DBMED is a central database with a dedicated server and web application that ensure safe access to information for members of Med-TSO, also considering possible different authorization levels. Web application also allows members to provide or export network and data in the agreed formats:

- SPIRA: asci file separated by pipe
- CGMES (2.4.1.5): *. xml files[1]
- PSS-E: Ver.33/34 *.raw file (*.sav is a binary that cannot be produced from third parties) or CGMES[2]
- DIGSILENT: CGMES or PSS-E Ver.33 *.raw file[3] (*.pfd is a binary that cannot be produced from third parties)
- an additional open format in MS Excel that can be used also from other tools

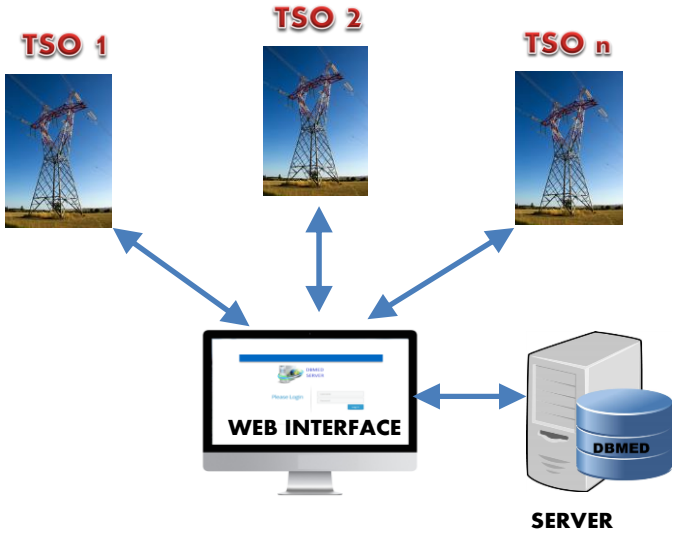

Fig. 2.1: DBMED illustrative structure

Main aspects to be considered in the definition of the architecture:

- Database for data storing requirements
- Web based application running on a dedicated server
- Multi-user platform
- Speed to access data and present it to the users
- Privacy and security data
- Access to the DB and its process has to be authorized at different levels of credentials and protected by individual passwords
- Redundancy requirements against long unavailability of SW and HW and loss of information

[1] In order to obtain a CGMES format, in addition to standard network data, is necessary to comply with several rules and to include additional data [1] not necessary for load-flow analysis; as described in other parts of this offer it is possible to use CGMES only to export network derived from this format or specifically prepared to this purpose

[2] CGMES is available as an additional component

[3] Import of the additional formats in DIGSILENT is included in standard version while it is possible to include an additional component to obtain also the export

- Definition of cost and solutions

The users of the application are located in different countries. The application is a web application with three tier architecture in which presentation, application processing, and data management functions are physically separated.

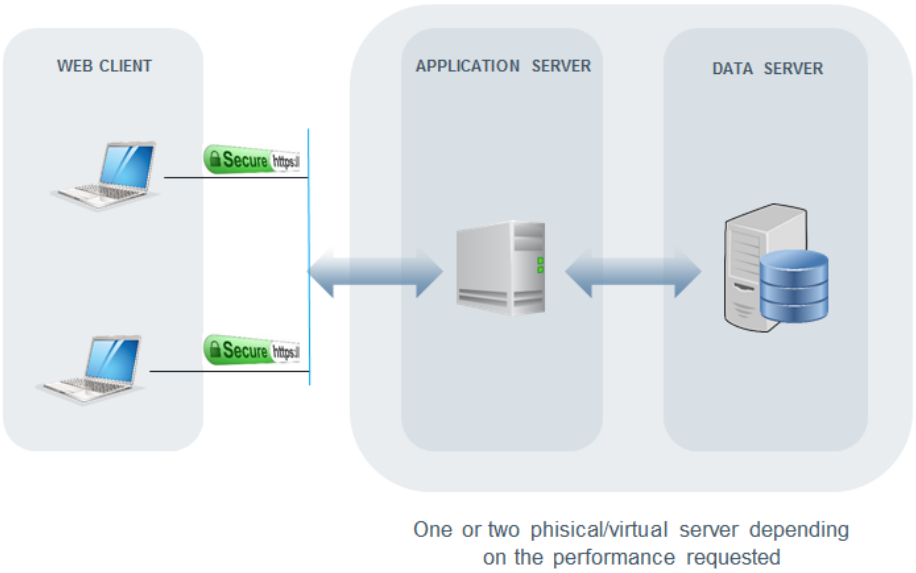

Fig. 2.2: Three tier architecture

Generally three tier architecture provides a model by which developers can create flexible and reusable applications. A three-tier architecture is typically composed of a presentation tier (web client), a domain logic tier (application server), and a data storage tier (data server).
The solution requires that the users are provided with Internet access.
The application is developed with Extjs framework and Java, for the frontend application, and use Oracle/MySQL for the backend database. The application runs on Tomcat webserver.

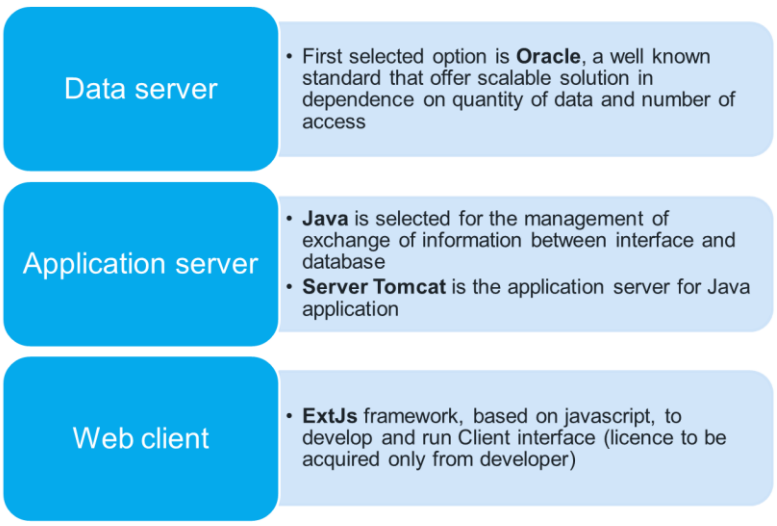

Fig. 2.3: Application selected for the three tier architecture

2.1 Data Server

The primary function of a data server is to store data and provide access to the other systems. The use of a physical or virtual data server, separated from application server, is advisable both for performance reasons and security ones:

- dedicated server to access database and answer to application server requests (application server remains dedicated to interactions with web client)
- a physical separation of the database server from the server directly exposed to the network

2.2 ORACLE database

Oracle database is a relational database management system (RDBMS) from the Oracle Corporation.
The system is built around a relational database framework in which data objects may be directly accessed by users (or an application front end) through structured query language (SQL). Oracle is fully scalable relational database architecture and is often used by global enterprises, which manage and process data across wide and local area networks. The Oracle database has its own network component to allow communications across networks.
The key advantages of Standard Edition 2 (SE2) - ORACLE DB solution are as follows:

- worldwide leader in database application
- runs on most major platforms, including Windows, UNIX, Linux and Mac OS
- scalable solution for amount of data or number of users
- possibility to have in-house cloud solutions
- different license cost level in relation with the requirements

2.3 Application Server

An application server is a server program in a distributed network that provides the logic for an application program and it is a part of a three-tier application that handles all application operations between users and an organization's backend applications or databases.
The application server interprets the request, asks to data server information (if needed), prepares the answer and sends it as HTML, JavaScript and other files.
The solution selected from CESI is based on:

- **Java** is the language selected for the management of exchange of information between interface and database.
- **Tomcat Server** is an open source software implementation (Web server) of the Java technologies.

2.3.1 JAVA language

Java was designed with a few key principles in mind:

- **Ease of Use:** The fundamentals of Java came from a programming language called C++. Although C++ is a powerful language, it is complex in its syntax and inadequate for some of Java's requirements. Java built on and improved the ideas of C++ to provide a programming language that was powerful and simple to use.

- **Reliability:** Java needed to reduce the likelihood of fatal errors from programmer mistakes. With this in mind, object-oriented programming was introduced. When data and its manipulation were packaged together in one place, Java's was robust.
- **Security:** As Java was originally targeting mobile devices that would be exchanging data over networks, it was built to include a high level of security. Java is probably the most secure programming language to date.
- **Platform Independence:** Programs need to work regardless of the machines it is being executed on. Java was written to be a portable language that doesn't care about the operating system or the hardware of the computer or device it is running on.

Java's popularity can be traced to it being a robust, secure, easy to use, and portable programming language.

2.3.2 Tomcat

Apache Tomcat is an open source web server that is developed by Apache software foundation[4].
It basically makes Java Web applications to run on host and server based system and it is configured on local host port 8080.
Tomcat is developed and maintained by an open community of developers.

2.4 Web Client

The web client is the only part of the architecture that interact directly with the user; it is a program capable of communicating with Web servers, requesting and receiving information from them, and processing it for display or other uses. The user browser interprets the answer and presents a web page as result of the user request. The user interacts with the application through these webpages.
In case of physical server application server and web client can reside on the same machine or in two separate machines, which has higher performance.

[4] https://www.apache.org/

Fig. 2.4: How three tier architecture acts

EXT JS solution has been selected as the alternative that present more flexibility and availability of pre-designed features available even if with a license cost in respect to other open source solutions.

3 PRIVACY AND SECURITY

Using the computer and a browser, the user connects via Internet with the application by using https protocol.
The application must provide secure access by requiring user authentication, using traffic encryption (https protocols) and digital certificate to ensure the ensure of the security and reliability of the connection.

3.1 HTTPS Protocol

HTTPS (also called HTTP over Transport Layer Security) is a communications protocol for secure communication over a computer network which is widely used on the Internet. HTTPS consists of communication over Hypertext Transfer Protocol (HTTP) within a connection encrypted by Transport Layer Security. The main motivation for HTTPS is authentication of the visited website and protection of the privacy and integrity of the exchanged data. For this reason is always used from bank.

A domain name for the web space for the application has been acquired.

3.2 Certificate Authority

Certificate Authority is an organization that is trusted to sign digital certificates and verifies identity and legitimacy of company or individual that requested a certificate and if the verification is successful, Certificate Authority issues signed certificate.
When server presents certificate to client during SSL handshake, client will attempt to verify signature against a list of 'known good' signers. Web browsers normally come with lists of Certificate Authority that they will implicitly trust to identify hosts. If the authority is not in the list, as with some sites that sign their own certificates, the browser will alert the user that the certificate is not signed by a recognized authority and ask the user if they wish to continue communications with unverified site.

3.3 Users classification and roles

The roles assigned the users to enable them to access data or operate on it. The main roles proposed are presented in the following:

Administrative Controller	• Manage (create, update, cancel) all users (externals included) and TSO Administrators • Has all the activities of TSO Administrator and also manages external TSO data • Manage archiving ("freezing") of networks • Manages list of "aggregate" (cases) • Manages list of official Xnodes • Manages uploading of merged networks • Is the TSO Administrator of a fictitious TSO merged networks
TSO administrator	•Manage, through Administrative Controller, authorization for users of the specific TSO (externals excluded) •View all information of all TSOs and access to the shared ones •Upload data of the specific TSO •Manage TSO data and edit the editable ones •Export data of the specific TSO in different formats for following download •Transmits by mail or by phone to the controller the permissions to be assigned to the TSOs • Download TSOs shared data
Viewer	• View all information of the TSO • Download TSOs data
Guest (activated in the design but not granted at this step of DBMED)	• External to Med-TSO association (i.e. EC) • Request permission directly to Administrative Controller (not through a TSO Administrator) • Procedure for permission to be agreed between TSOs and controlled Administrative Controller • View only specific aggregated information based on the authorization provided by Administrative Controller

Fig. 3.1: Standard users, permission and access

4 IMPORT AND EXPORT MODELS

4.1 Available external data format

External DBMED formats that contain load-flow calculation information change depending on the tool that produces or uses them.

The following figure shows data format compatible with each computing tool.

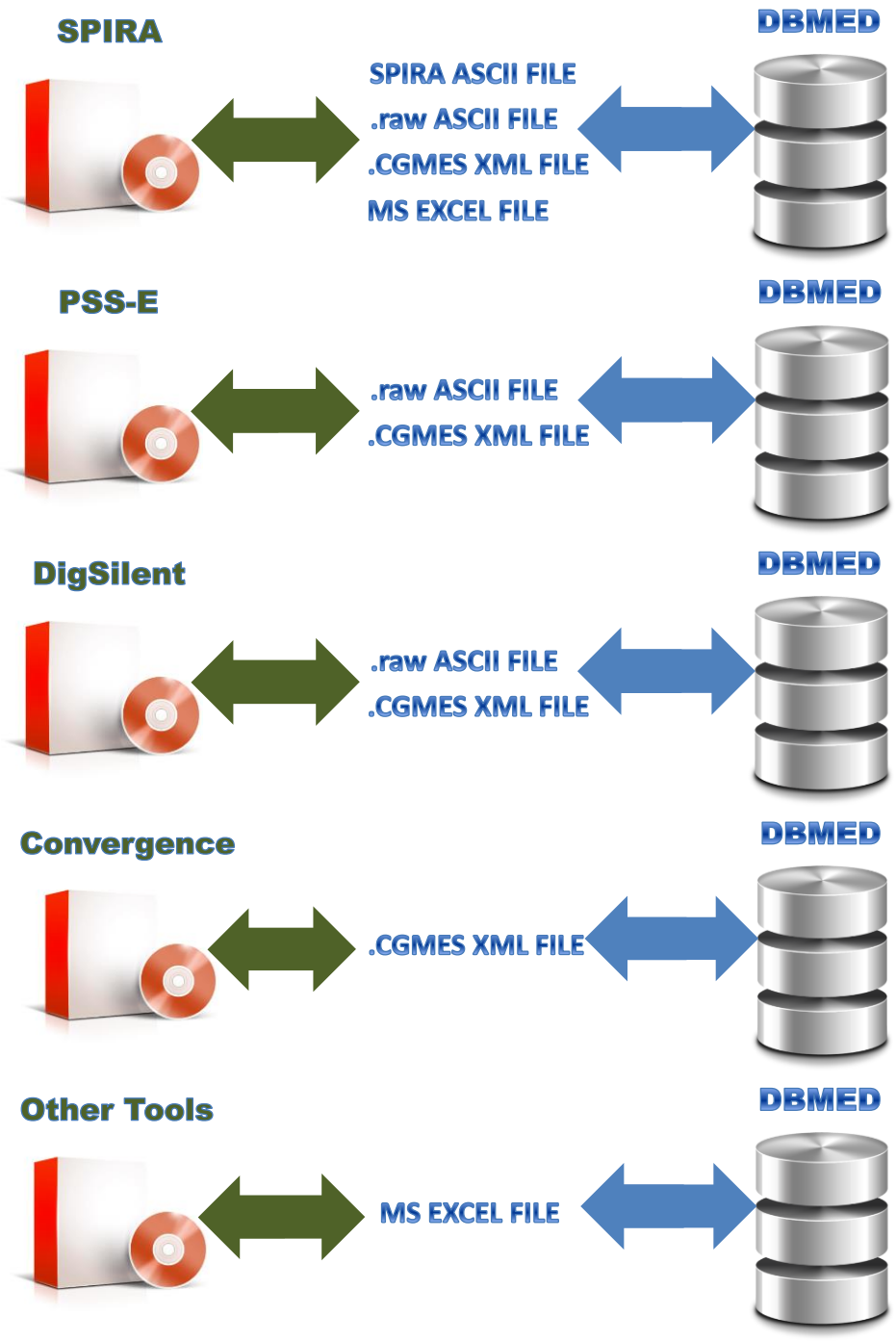

Fig. 4.1: Network data format managed from DBMED and possible data exchanges

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