



*Platform for European Medical Support
During Major Emergencies*

D4.7 Event Evaluation for Biological Events





PULSE

Platform for European Medical Support during major emergencies

WP4 - Tools

Deliverable D4.7 - Event evaluation for biological event

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Abstract:
The purpose of this document is to provide a supporting document about the software component of Deliverable D4.7 "Event evaluation for biological event" of WP4 "Tools". The document describes the tool aiming at computing the expected time evolution of the geographical spread of a biological event.

Keywords:
ENSIR, Event evaluation for biological event, epidemics evolution, SARS scenario



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1 List of acronyms

Acronym	Definition
DSVT	Decision Support Validation Tool
ENSIR	Enhanced SIR
GUI	Graphical User Interface
JVM	Java Virtual Machine
SCGT	Surge Capacity Generation (support) Tool
SIR	Susceptible-Infected-Recovered
SOAP	Simple Object Access Protocol
WHO	World Health Organization
WSDL	Web Services Description Language



2 Executive Summary

The aim of the deliverable D4.7 is to describe the PULSE ENSIR Tool, one of the software components composing the PULSE Platform Architecture.

This tool aims at computing the expected time evolution of the geographical spread of a biological event and it is the implementation of the mathematical model of epidemics evolution defined in T3.6 of WP3. This model is an extended version of the classical SIR (Susceptible - Infected - Removed) model: a class of disease spread models where individuals are susceptible to a disease, contract the disease and then recover, becoming immune to future infections after recovery, or die from the disease. With respect to the classical SIR models, where the evolution of the disease is described in terms of nonlinear ordinary or delay differential equations, geographic factors are taken into account, allowing for disease spread with different rates depending on the social, logistic and physical characteristics of the environment.

The ENSIR tool provides its functionality through a SOAP-based Web Service and the *Decision Support and Validation Tool (DSVT)*, described in more detail in D4.1, is the only architectural component that directly interfaces with it; the DSVT invokes the ENSIR tool interface in order to obtain the possible evolution of the epidemic outbreak.



3 Introduction

3.1 Scope of the Document

This document is a covering document to support the software delivery D4.7 – Event evaluation for biological event.

This report summarizes the software component delivery and provides high level details on the architecture, technologies and underlying libraries on which the software component has been developed.

3.2 Structure of the Document

This document is structured into the following sections.

- Description of the *ENSIR tool* objective.
- Main functionalities of the *ENSIR tool*.
- Description of the *ENSIR tool* internal architecture and relation of this component with other elements of the PULSE platform architecture;
- List of technologies adopted for the implementation of the *ENSIR tool*
- List of underlying 3rd party libraries used for *ENSIR tool* implementation and summary of the corresponding licenses
- Software Test/Validation

3.3 Relation with other Deliverables

The work presented in this deliverable is related to the following WP2, WP3 and WP4 deliverables:

- D2.2 - Use case specification [1] – This document describes the use cases related to two PULSE reference scenarios: SARS-like epidemics and Stadium crush.
- D3.1 – Context Models [3] – This documents contains the description of the event evolution model which is the core of the ENSIR tool.
- D4.1 – Decision support Validation tool [2] – It is the tool that invokes the API provided by the ENSIR tool. The DSVT provides a GUI where the user can see the result of the epidemic outbreak simulation.



4 Tool description

4.1 Objective

The objective of the ENSIR Tool is to provide the expected evolution of the spatial distribution of an epidemic. The tool applies to the SARS Scenario.

ENSIR (ENhanced SIR) is an evolution of well-known SIR (Susceptible - Infected - Recovered) and SEIR models. In a SEIR model, each individual can assume one over 4 possible states, partitioning the individuals into 4 subpopulations:

1. Susceptibles S: members of the population who are susceptible to the infectious agent, not yet infected but they may become infected.
2. Exposed E: members of population infected by the SARS virus, in the incubation period, asymptomatic, possibly infectious (without infectivity or with very low infectivity).
3. Infectious I: members of the population who are infected and infectious with strong infectivity.
4. Recovered R: members of the population who have recovered from the disease with full immunity against reinfection, or members who died, or those that are either isolated or quarantined.

Given a time horizon T and a sampling time δt , the function computes the expected evolution of the epidemics, starting from a spatial initial distribution of exposed (E_{start}) and infected (I_{start}) individuals within n_e and n_i cells of a grid partitioning the considered area. The dimension of the grid is $[num_rows \times num_columns]$. The event type corresponds to the SARS epidemics. Given a number $num_facilities$ of possible resource types (e.g. specialized hospitals) to allocate for the treatment, in the vector $asset_vec$ it is possible to specify the availability of each resource type. The number of time samples obtained in the interval $(0:T)$ with time step δt is denoted by $length_T$. The function returns the temporal evolution of the cumulative subpopulations (i.e. summed over all the cells of the grid) of Susceptibles, Exposed, Infectious, Recovered (vectors of dimension equal to $length_T$), along with the evolution of the total count of infected people.

The input/output structure of the service is the following:

INPUT

1. Exposed Matrix E_{start} : matrix dimension $[n_e \times 3]$, with each row containing [cell row_index, cell column_index, number of exposed in the cell at initial time].
2. Infected Matrix I_{start} : matrix dimension $[n_i \times 3]$, with each row containing [cell row_index, cell column_index, number of infected in the cell at initial time].
3. Asset vector $asset_vec$, vector dimension $[num_facilities]$, each entry nonnegative integer.
4. Time horizon (T), nonnegative real number.
5. Time step δt , nonnegative real number.
6. Event type $event_type$ (default: SARS).

OUTPUT

1. Evolution of the subpopulation counts $[S, E, I, R]$, matrix dimension $[length_T \times 4]$.
2. Evolution of the infected subpopulation I_{tot} , vector dimension $[length_T]$.

4.2 Functionalities

The following section has been extracted from the description of the evolution model for biological events contained in D3.1 [3].

The ENSIR tool is the prediction of the spatial-temporal evolution of an epidemics, taking into account different factors, allowing for disease spread with different rates depending on the social and logistic characteristics of the interested area.

The main geographic and social factors taken into account are:

- the number/density of population in the interested area;
- the 'natural' connectivity of population, which may depend on the geography of the area;
- the connectivity by means of transportation, daily flights, etc.

With respect to SEIR, ENSIR considers the values of the subpopulation (S_i , E_i , I_i , R_i) in each cell i , and determines the rates of variations of (S_i , E_i , I_i , R_i) in cell i as a function of the subpopulations (S_j , E_j , I_j , R_j) of each neighbouring cell j of i .

To this aim, it is possible to choose among three different types of neighbourhood function of cell i (NBD(i)):

1. Complete graph (Fig. 1): all cells are neighbour of cell i , including the cell i ;

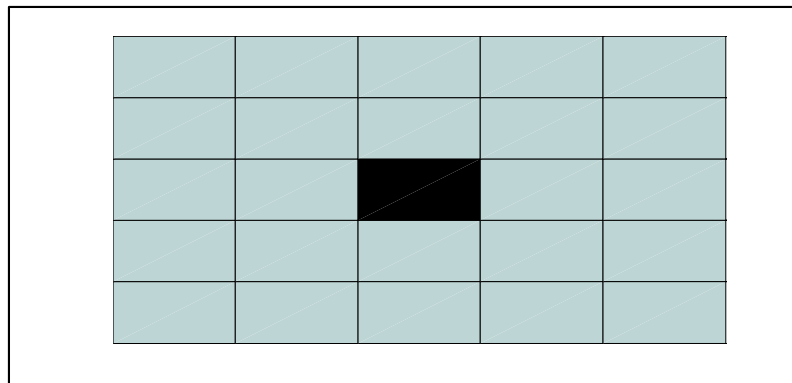


Figure 1: Complete graph

2. Moore neighbourhood (Fig. 2): cell j is neighbour of cell i if $\max(|c_j - c_i|, |r_j - r_i|) \leq 1$, where r_i , r_j are the row indices of cell i , j , and c_i , c_j are the column indices of cell i , j , respectively.

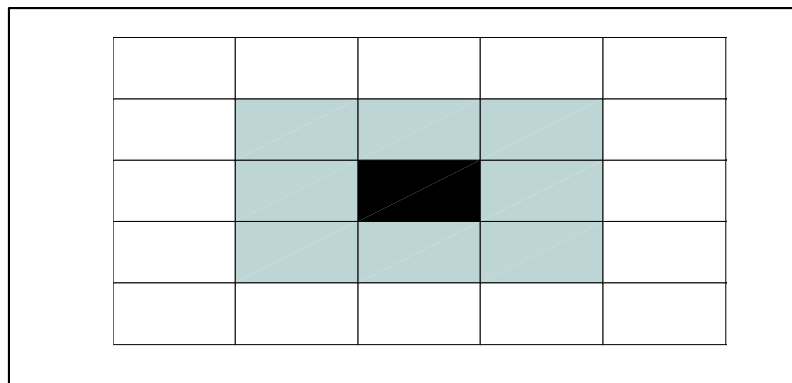


Figure 2: Moore neighborhood

3. Von Neumann neighborhood (Fig. 3): cell j is neighbour of cell i if: $|c_j - c_i| + |r_j - r_i| \leq 1$.

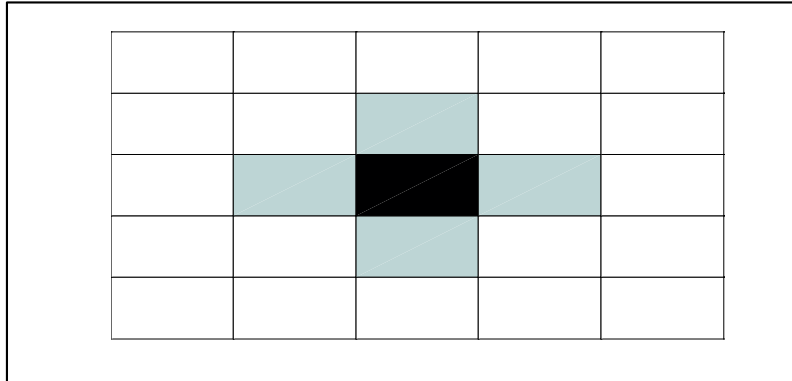


Figure 3: Von Neumann neighbourhood

As already mentioned, ENSIR takes into account geographic, social and logistic factors of the relevant environment. An example is given in Figure 4, where an area including northern and central Italy is considered and is partitioned according to a grid of dimensions [num_rows x num_columns], with num_rows=num_columns=20. The total number of cells num_cells = num_rows* num_columns is equal to 400.

In ENSIR, three matrices are allocated to manage the information regarding population and connectivity:

1. M_{pop} : Initial Population Matrix, with dimension [num_rows x num_columns], where each entry is an integer value counting the population of the corresponding cell. An example is provided in Figure 5, using different colors for different population densities.
2. M_{conn} : Rate of 'natural' connectivity between cells, with dimension [num_cells x num_cells], where each entry is a nonnegative real number; $M_{conn}(i,j)$ is a function of the physical distance between the centres of cell i and cell j and of the populations of cells i and j . $M_{conn}(i,i)$ is set equal to a strictly positive number to take into account the internal infectivity (within the same cell).
3. M_{vol} : Connectivity Matrix by the daily transportations (flights) between cells, dimension [num_cells x num_cells], each entry is a nonnegative integer.

The connectivity affect the rate of spatial-temporal transmission of the epidemics between the corresponding cells.

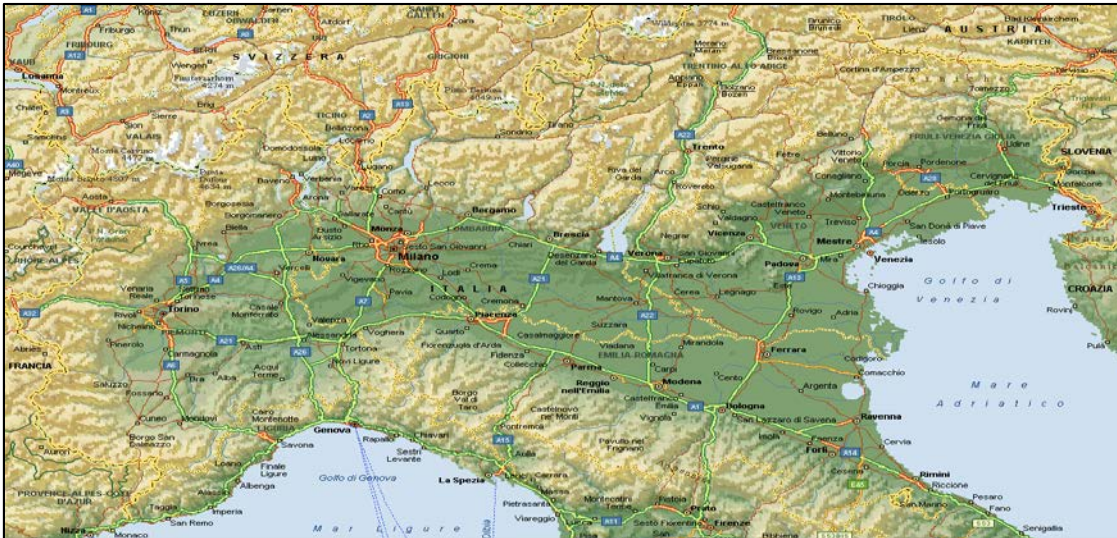


Figure 4: Example of interested area, Northern and Central Italy

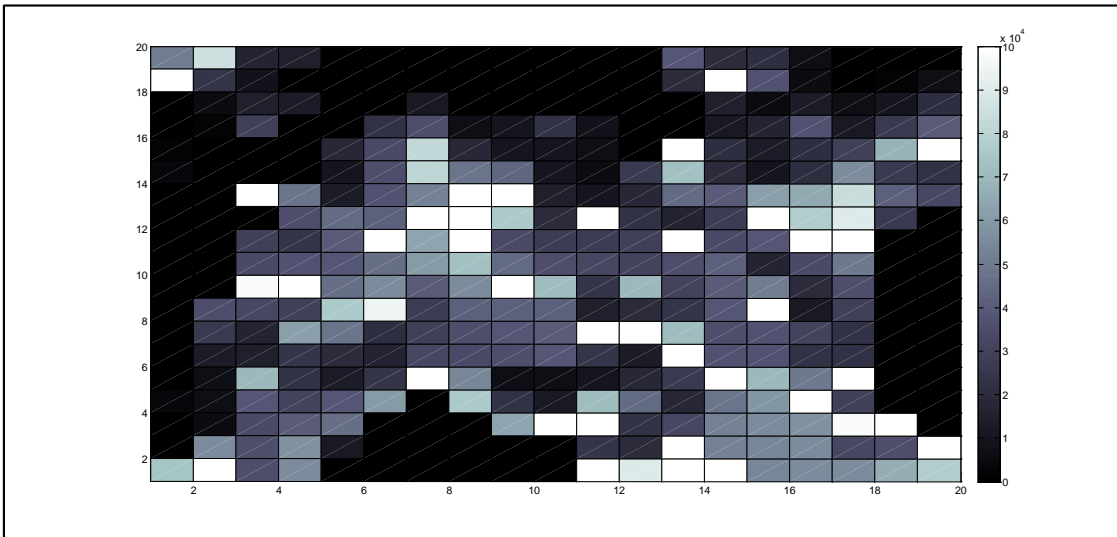


Figure 5: Example of Initial Population Matrix M_{pop} for Northern and Central Italy

4.3 Relations with WP2 Use Cases

Part of the work carried out in WP2, was focused on the definition of a set of interesting use cases for PULSE; these cases have been detailed in the deliverable D2.2 [1]. ENSIR functionalities described in section 4.2 can actually be used by DSVT in different situations for post crisis evaluations. Three of these situations are described in just as many use cases, let's see what.

1. [UC-SARS LIKE - 01] *Weak signal detection and surveillance.*
This case concerns the situation in which a weak signal is detected and, as consequence, some surveillance actions are triggered. The ENSIR component plays an important role in the action reported in point 4.e.5: if a user with a WHO role decides to categorize the received weak signal and, in turn, the signal is considered as "relevant", the user can decide to display the possible evolution of the SARS-like event related to that weak signal. The ENSIR component is in charge of performing this task, in fact it allows to visualize on



a geographic map the prediction of the spread of the disease, based on all the available signals marked as “relevant” for that specific event.

2. [UC-SARS LIKE – 06] *ECDC recommendations*.
This case refers to assessment of the evolution of an ongoing epidemic crisis performed during the periodic ECDC meetings, with the consequent creation of the relative recommendations. Similarly, to the previous use case, the ENSIR component is used (together to the DSVT) to display on a geographic map the prediction of the possible spread of the disease. This simulation, that is based on the trend of probable and confirmed SARS cases, is highlighted in point 6 of the use case.
3. [UC-SARS LIKE – 07] *National Authority periodic assessment*.
Also this case is focused on the assessment of the evolution of an ongoing epidemic crisis. However, this time, such evaluation is performed during the meeting of the national steering group, also with the aim to issue appropriate communications to the media about the crisis. In this context, the ENSIR component plays a relevant role in point 7, where the user can ask to visualize a simulation of the epidemic evolution by considering the actual hospital resources.



5 Architecture

5.1 Software Component Architecture

The ENSIR tool is constituted by a sub-module called ENSIR Engine that implements a Web Service equipped with a SOAP-based interface. This interface provides the same functionalities defined for the WP3 prototype (described in D3.1 [3]) and that are based on the context models defined within the same work package. More info can be found in 5.1.1.

An external GUI client has been also defined to facilitate the development and testing of the ENSIR Engine prototype. A short description of this client is provided in section 5.1.2.

5.1.1 ENSIR Engine

The ENSIR Engine has been implemented in PHP language, and provides a Web Service interface bases on the SOAP protocol. In such a way, an external client (e.g. the DSVT in the PULSE context) is able to send requests even in another programming language (i.e. Java) with respect to the server, though respecting the SOAP specifications.

The SCGT interface is described through the Web Services Description Language (WSDL) and is located at the following URL: <http://biomat1.iasi.cnr.it/webservices/pulse/M18/webservice.wsdl> (hosted in the CNR/IASI server). You can find the WSDL file in Annex A.1.

Figure 6 shows the input parameters defined into the WSDL file. The keywords “Parameters” and “Results” (in EnsirParameters and EnsirResults) are used to define the input and output of the server function, matching (in number and type) the input and output described in Section 4.1.



```
<complexType name="EnsirParameters">
  <sequence>
    <element name="exposeds_at_start" type="tns:ListOfExposedsAtStart" maxOccurs="1"/>
    <element name="infectives_at_start" type="tns:ListOfInfectivesAtStart" maxOccurs="1"/>
    <element name="assets" type="tns:ListOfFacilitiesStadium" maxOccurs="1"/>
    <element name="t_fin" type="xsd:double" maxOccurs="1"/>
    <element name="delta_t" type="xsd:double" maxOccurs="1"/>
    <element name="event_type" type="xsd:integer" maxOccurs="1"/>
  </sequence>
</complexType>
<complexType name="EnsirResults">
  <sequence>
    <element name="susceptibles_population" type="xsd:double" maxOccurs="unbounded"/>
    <element name="exposeds_population" type="xsd:double" maxOccurs="unbounded"/>
    <element name="infectives_population" type="xsd:double" maxOccurs="unbounded"/>
    <element name="recovered_population" type="xsd:double" maxOccurs="unbounded"/>
    <element name="total_infecteds" type="xsd:double" maxOccurs="unbounded"/>
  </sequence>
</complexType>
<xsd:element name="EnsirParameters" type="tns:EnsirParameters"/>
<xsd:element name="EnsirResults" type="tns:EnsirResults"/>
```

Figure 6: Input parameters

As shown in Figure 7, the request and response messages exploit Parameters (inputs) and Results (output) respectively:

```
<message name="ensirRequest">
  <part name="ensirpar" element="tns:EnsirParameters"/>
</message>
<message name="ensirResponse">
  <part name="ensirres" element="tns:EnsirResults"/>
</message>
```

Figure 7: WSDL messages

The operation “EnSIR”, as shown in Figure 8, matches the name of the corresponding PHP function files on the Web Server and it is the operation that can be invoked by an external ENSIR tool client.



```
<operation name="EnSIR">
<input message="tns:ensirRequest"/>
<output message="tns:ensirResponse"/>
</operation>
```

Figure 8: WSDL operation

5.1.2 GUI client

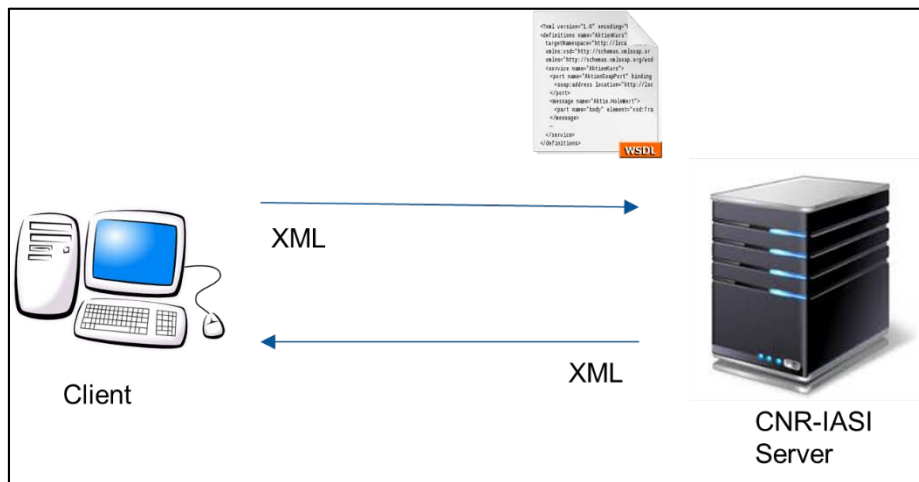


Figure 9: Scheme of the client-server implementation of tool

As shown in Figure 9, a Graphical User Interface (GUI) has been designed for getting the inputs from the human user. The GUI has been implemented in the Java programming language by means of the Swing components in Oracle's Netbeans IDE. The prototype is distributed in the form of Java Archive (.jar) and is executable on any computer with a Java Virtual Machine (JVM) installed on it.

Figure 10 shows an example of Java methods, called "enSIR" that is able to invoke the Web Service for the two scenarios.

```
private static EnsirResults enSIR(EnsirParameters ensirpar)
{
    PULSEWebServices service = new PULSEWebServices();
    PULSEModelsPortType port = service.getPULSEModelsPort();
    return port.enSIR(ensirpar);
}
```

Figure 10: Java client example

5.2 Component relation to overall PULSE architecture

Figure 11 shows a component diagram of the PULSE Platform Architecture where the



relation between *ENSIR* and *DSVT* is highlighted. These two components interact each other through the *IEpidemicEvolution* interface. In particular, *DSVT* invokes the *ENSIR* Web Service and, contextually, provides a set of input parameters concerning the actual status of the crisis (e.g., probable and confirmed SARS cases, assets) and the time range to be considered for simulating the epidemic evolution. The *ENSIR* component elaborates the incoming data and returns the expected evolution of the crisis during the specified time range. The *DSVT*, in turn, shows that prediction on a geographic map as described in the deliverable D4.1 [2].

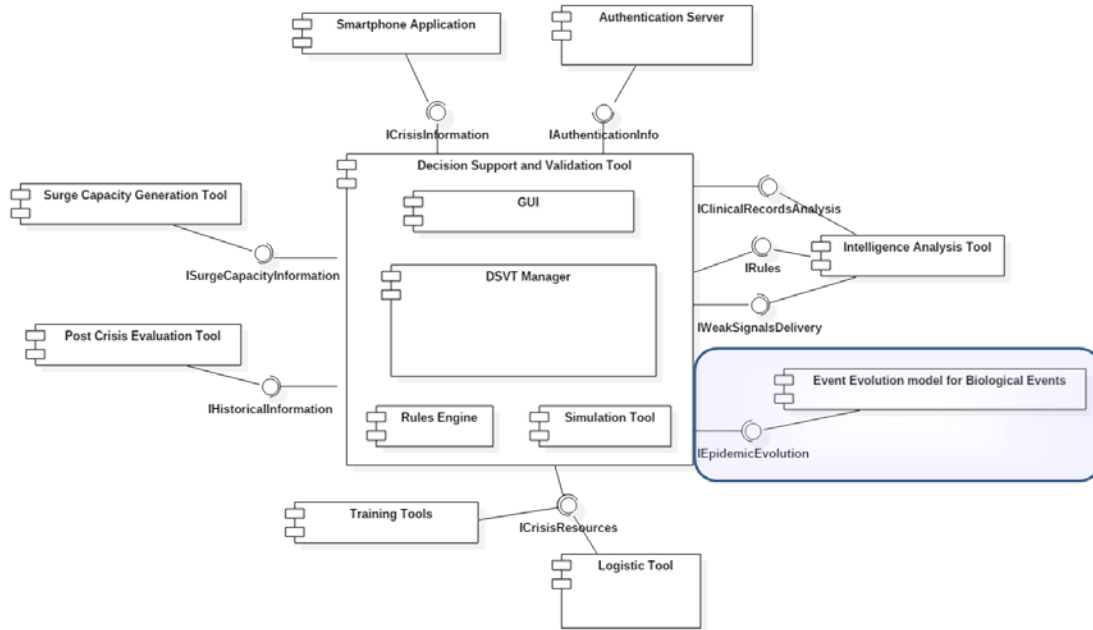


Figure 11: PULSE Platform Architecture – Component diagram



6 Component Technologies

6.1 List of core technologies

The core technologies adopted for the implementation of the SCGT are:

- *SCGT Engine:*
 - **PHP:** it is a popular general-purpose scripting language that is especially suited to web development. It has been used to define the Web Service exposed by the SCGT (see 5.1.1) and to implement, as software solution, the mathematical model defined in WP3.
 - **Apache HTTP Server:** it is an open-source HTTP server and it is the most popular web server on the Internet since 1996. It hosts the PHP web application that exposes the Web Service described in 5.1.1.
- *Example client:*
 - **Java:** The test client has been developed by using the Java programming language

6.2 3rd Party libraries and licenses

Below is a list of third party libraries/frameworks used and the licenses under which they are distributed.

Table 1: 3rd party libraries and licenses

Product	Version	Vendor	License
PHP	5	PHP Group	PHP License 3.01
Apache HTTP Server	2.4	Apache Software Foundation	Apache 2.0
Java SE Development Kit	8	Oracle	Oracle Binary Code License Agreement
Beans Binding	1.2.1	Java.net	GNU LESSER GENERAL PUBLIC LICENSE
Swing Layout Extensions	1.0.4	Java.net	GNU LESSER GENERAL PUBLIC LICENSE



7 Software Test/Validation

The ENSIR tool (T.4.7) which is object of the present deliverable exploits as basic modelling layer the corresponding model described in T3.6, which is exposed as a webserver. The web service is called with a subset of inputs selectable by the user by means of the tool graphical GUI, while some other inputs are fixed.

Parameter tuning and implementation refinements are object of future deliverables in the final year of the project (M19-M30), wherein the processes of integration and validation/trials in WP6-WP7 will provide further occasion for tuning the model/tool parameters as a consequence of the lessons learnt, of the procedures from the WP5 deliverables and of the application of the PULSE platform in realistic conditions for the considered scenario. The integrated PULSE platform will also allow to set a larger set of parameters and to retrieve some results in a graphical form. In Figure 12 you can find the initial population matrix that has been used for testing.

	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10	x11	x12	x13	x14	x15	x16	x17	x18	x19	x20
y1	25815	239144	38823	42623	9373	8623	0	0	34350	11211	461	2452	0	0	6575	15971	0	11967	0	1766
y2	58566	84554	15883	14620	0	0	0	0	0	0	0	0	30832	20127	21351	7292	0	1138	1295	2121
y3	125885	24520	8586	1239	0	0	0	0	0	0	0	0	19719	103582	36496	5907	0	2527	7678	4597
y4	1282	5618	15574	12511	0	0	11499	0	0	0	0	0	0	14716	6076	13966	6624	9455	21741	4091
y5	1225	2281	29304	0	0	22724	34499	7380	18483	22043	9168	0	0	11932	15975	35993	11684	25624	48423	13298
y6	2393	0	0	0	18307	33674	82717	18491	9631	18558	6575	0	117285	21082	13915	28653	28430	67418	98528	35883
y7	3516	0	0	0	18410	35282	80816	48174	42795	10867	5247	26217	73404	20256	9963	21770	55347	25487	22338	41529
y8	0	0	128466	47130	12925	36264	52848	124778	118756	14854	10850	18133	45263	39688	61828	64232	83375	41830	32084	36806
y9	0	0	35407	44998	48631	133227	284308	76524	18841	196858	23241	17123	26640	113693	76804	89376	25986	0	34445	0
y10	0	0	29546	23658	48202	151313	63387	1383256	34292	26566	27457	28349	318483	34247	38858	249295	264919	0	0	35625
y11	0	0	34339	37270	38736	46835	59474	72113	44529	35547	31502	29925	35889	41854	16742	33312	49882	0	0	0
y12	0	0	97712	945850	46835	54935	39356	55734	158604	71184	23454	69813	29963	48276	50598	28233	35057	0	0	0
y13	379	35726	32583	29440	75983	94034	27428	41581	41745	41989	15407	20883	24837	30882	133492	12136	28986	0	0	0
y14	0	26391	17057	61891	48234	28566	28468	39824	38384	49146	283922	171975	78393	35888	36985	29870	22755	0	0	0
y15	0	13195	15126	24882	19055	16132	31746	33385	35884	38015	24287	12923	217688	36436	36710	22893	24242	0	0	0
y16	0	6597	68774	22748	13209	23939	608826	54675	7845	7593	10560	17877	25194	418349	69607	49307	164854	0	0	0
y17	4078	7563	38168	30458	38626	60595	0	75965	23168	11312	71661	44533	17485	47480	58583	176887	29087	0	0	0
y18	0	5828	34313	48554	46795	0	0	62829	192491	132762	23240	32482	52951	55727	57115	96921	147393	0	0	0
y19	0	55167	35897	56516	11004	0	0	0	0	0	24931	19474	281730	51563	53645	55380	31448	35230	155946	0
y20	74445	344460	35881	55331	0	0	0	0	0	0	158568	89204	140865	429311	54512	54946	55163	66568	77973	44976

Figure 12: Initial Population Matrix M_{pop} for Northern and Central Italy



References

- [1] PULSE Project Deliverable – D2.2 Use case specification
- [2] PULSE Project Deliverable – D4.1 Decision Support Validation tool
- [3] PULSE Project Deliverable – D3.1 Context Models



Appendix A

A.1 WSDL

```
<?xml version="1.0" encoding="UTF-8" ?>
<definitions name="PULSEmodels"
  targetNamespace="http://biomat1.iasi.cnr.it/webservices/pulse/M
18/"
  xmlns:tns="http://biomat1.iasi.cnr.it/webservices/pulse/M18/"
  xmlns:soap="http://schemas.xmlsoap.org/wsdl/soap/"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema"
  xmlns:soapenc="http://schemas.xmlsoap.org/soap/encoding/"
  xmlns:wSDL="http://schemas.xmlsoap.org/wsdl/"
  xmlns="http://schemas.xmlsoap.org/wsdl/">

  <types>
    <schema xmlns="http://www.w3.org/2001/XMLSchema"
      targetNamespace="http://biomat1.iasi.cnr.it/webservices/pulse/M
18/">
      <xsd:import
        namespace="http://schemas.xmlsoap.org/soap/encoding/" />
      <xsd:import
        namespace="http://schemas.xmlsoap.org/wsdl/" />
      <complexType name="Therapy">
        <sequence>
          <element name='code' type='xsd:integer'
            maxOccurs='1' />
          <element name='ther_A_delta'
            type='xsd:double' maxOccurs='1' />
          <element name='ther_A_alpha'
            type='xsd:double' maxOccurs='1' />
          <element name='ther_B1_delta'
            type='xsd:double' maxOccurs='1' />
          <element name='ther_B1_alpha'
            type='xsd:double' maxOccurs='1' />
          <element name='ther_B2_delta'
            type='xsd:double' maxOccurs='1' />
          <element name='ther_B2_alpha'
            type='xsd:double' maxOccurs='1' />
          <element name='ther_B3_delta'
            type='xsd:double' maxOccurs='1' />
          <element name='ther_B3_alpha'
            type='xsd:double' maxOccurs='1' />
          <element name='ther_C1_delta'
            type='xsd:double' maxOccurs='1' />
          <element name='ther_C1_alpha'
            type='xsd:double' maxOccurs='1' />
          <element name='ther_C2_delta'
            type='xsd:double' maxOccurs='1' />
          <element name='ther_C2_alpha'
            type='xsd:double' maxOccurs='1' />
          <element name='ther_D1_delta'
            type='xsd:double' maxOccurs='1' />
          <element name='ther_D1_alpha'
            type='xsd:double' maxOccurs='1' />
          <element name='ther_D2_delta' type='xsd:double' maxOccurs='1' />
        </sequence>
      </complexType>
    </schema>
  </types>
</definitions>
```



```

                                <element name='ther_D2_alpha'
type='xsd:double' maxOccurs='1' />
                                <element name='ther_D3_delta'
type='xsd:double' maxOccurs='1' />
                                <element name='ther_D3_alpha'
type='xsd:double' maxOccurs='1' />
                                <element name='ther_E_delta'
type='xsd:double' maxOccurs='1' />
                                <element name='ther_E_alpha'
type='xsd:double' maxOccurs='1' />
                                </sequence>
                                </complexType>
                                <complexType name="ListOfTherapies">
                                  <sequence>
                                    <element name='therapy'
type='tns:Therapy' maxOccurs='unbounded' />
                                  </sequence>
                                </complexType>
                                <complexType name="PatientStatus">
                                  <sequence>
                                    <element name='x_A' type='xsd:double'
maxOccurs='1' />
                                    <element name='x_B1' type='xsd:double'
maxOccurs='1' />
                                    <element name='x_B2' type='xsd:double'
maxOccurs='1' />
                                    <element name='x_B3' type='xsd:double'
maxOccurs='1' />
                                    <element name='x_C1' type='xsd:double'
maxOccurs='1' />
                                    <element name='x_C2' type='xsd:double'
maxOccurs='1' />
                                    <element name='x_D1' type='xsd:double'
maxOccurs='1' />
                                    <element name='x_D2' type='xsd:double'
maxOccurs='1' />
                                    <element name='x_D3' type='xsd:double'
maxOccurs='1' />
                                    <element name='x_E' type='xsd:double'
maxOccurs='1' />
                                    <element name='v_A' type='xsd:double'
maxOccurs='1' />
                                    <element name='v_B1' type='xsd:double'
maxOccurs='1' />
                                    <element name='v_B2' type='xsd:double'
maxOccurs='1' />
                                    <element name='v_B3' type='xsd:double'
maxOccurs='1' />
                                    <element name='v_C1' type='xsd:double'
maxOccurs='1' />
                                    <element name='v_C2' type='xsd:double'
maxOccurs='1' />
                                    <element name='v_D1' type='xsd:double'
maxOccurs='1' />
                                    <element name='v_D2' type='xsd:double'
maxOccurs='1' />
                                    <element name='v_D3' type='xsd:double'
maxOccurs='1' />
                                  </sequence>
                                </complexType>

```




```

                                <element name='v_E' type='xsd:double'
maxOccurs='1' />
                                </sequence>
                                </complexType>
                                <complexType name="PopulationStatus">
                                  <sequence>
                                    <element name='patient_status'
type='tns:PatientStatus'
                                maxOccurs='unbounded' />
                                    </sequence>
                                  </complexType>
                                <complexType name="ListOfIntegers">
                                  <sequence>
                                    <element name='int_element'
type='xsd:integer' maxOccurs='unbounded' />
                                    </sequence>
                                  </complexType>
                                <complexType name="Lesions">
                                  <sequence>
                                    <element name='lesion'
type='xsd:double' maxOccurs='unbounded' />
                                    </sequence>
                                  </complexType>
                                <complexType name="ListOfLesions">
                                  <sequence>
                                    <element name='pat_lesions'
type='tns:Lesions' maxOccurs='unbounded' />
                                    </sequence>
                                  </complexType>
                                <complexType name="Symptoms">
                                  <sequence>
                                    <element name='symptom'
type='xsd:integer' maxOccurs='unbounded' />
                                    </sequence>
                                  </complexType>
                                <complexType name="ListOfSymptoms">
                                  <sequence>
                                    <element name='pat_symptoms'
type='tns:Symptoms' maxOccurs='unbounded' />
                                    </sequence>
                                  </complexType>
                                <complexType name="ListOfFacilitiesStadium">
                                  <sequence>
                                    <element name='facilityStadium'
type='xsd:integer'
                                maxOccurs='unbounded' />
                                    </sequence>
                                  </complexType>
                                <complexType name="FacilitiesLevelsStadium">
                                  <sequence>
                                    <element name='facility_level_Stadium'
type='xsd:double'
                                maxOccurs='unbounded' />
                                    </sequence>
                                  </complexType>
                                <complexType name="ListOfFacilitiesLevelsStadium">
                                  <sequence>
                                    <element

```



```
name='facilities_levels_per_HT_Stadium'  
type='tns:FacilitiesLevelsStadium'  
maxOccurs='unbounded' />  
  </sequence>  
</complexType>  
<complexType name="ListOfFacilitiesSARS">  
  <sequence>  
    <element name='facilitySARS'  
type='xsd:integer' maxOccurs='unbounded' />  
  </sequence>  
</complexType>  
<complexType name="FacilitiesLevelsSARS">  
  <sequence>  
    <element name='facility_levelSARS'  
type='xsd:double'  
maxOccurs='unbounded' />  
  </sequence>  
</complexType>  
<complexType name="ListOfFacilitiesLevelsSARS">  
  <sequence>  
    <element  
name='facilities_levels_per_HT_SARS' type='tns:FacilitiesLevelsSARS'  
maxOccurs='unbounded' />  
  </sequence>  
</complexType>  
<complexType name="ListOfETDs">  
  <sequence>  
    <element name='etd' type='xsd:double'  
maxOccurs='unbounded' />  
  </sequence>  
</complexType>  
<complexType name="ListOfGCSs">  
  <sequence>  
    <element name='gcs' type='xsd:integer'  
maxOccurs='unbounded' />  
  </sequence>  
</complexType>  
<complexType name="ListOfISSs">  
  <sequence>  
    <element name='iss' type='xsd:integer'  
maxOccurs='unbounded' />  
  </sequence>  
</complexType>  
<complexType name="ListOfColorCodes">  
  <sequence>  
    <element name='code' type='xsd:integer'  
maxOccurs='unbounded' />  
  </sequence>  
</complexType>  
<complexType name="PatGenerateParameters">  
  <sequence>  
    <element name='num_people_in_area'  
type='xsd:integer'  
maxOccurs='1' />  
    <element name='event_code'  
type='xsd:integer' maxOccurs='1' />  
    <element name='event_severity'  
type='xsd:double' maxOccurs='1' />
```



```

                                <element name='event_longitude'
type='xsd:double'
                                maxOccurs='1' />
                                <element name='event_latitude'
type='xsd:double' maxOccurs='1' />
                                <element name='event_radius'
type='xsd:double' maxOccurs='1' />
                                </sequence>
                                </complexType>
                                <complexType name="ScenGenParameters">
                                <sequence>
                                <element name='num_bystanders'
type='xsd:integer'
                                maxOccurs='1' />
                                <element name='event_type'
type='xsd:integer' maxOccurs='1' />
                                <element name='event_size'
type='xsd:double' maxOccurs='1' />
                                <element name='event_longitude'
type='xsd:double'
                                maxOccurs='1' />
                                <element name='event_latitude'
type='xsd:double' maxOccurs='1' />
                                <element name='event_dimension'
type='xsd:double'
                                maxOccurs='1' />
                                <element name='event_min_latency'
type='xsd:double'
                                maxOccurs='1' />
                                </sequence>
                                </complexType>
                                <complexType name="FacilitiesModelParametersSARS">
                                <sequence>
                                <element name='num_patients'
type='xsd:integer' maxOccurs='1' />
                                <element name='delta_T'
type='xsd:double' maxOccurs='1' />
                                </sequence>
                                </complexType>
                                <complexType
name="FacilitiesModelParametersStadium">
                                <sequence>
                                <element name='num_patients'
type='xsd:integer' maxOccurs='1' />
                                <element name='delta_T'
type='xsd:double' maxOccurs='1' />
                                </sequence>
                                </complexType>
                                <complexType name="GeoLocalizedPatient">
                                <sequence>
                                <element name='health_status'
type='tns:PatientStatus'
                                maxOccurs='1' />
                                <element name='longitude'
type='xsd:double' maxOccurs='1' />
                                <element name='latitude'
type='xsd:double' maxOccurs='1' />
                                </sequence>

```



```
        </complexType>
        <complexType
name="GeoLocalizedPatientWithLatencyAndLesions">
            <sequence>
                <element name='health_status'
type='tns:PatientStatus'
                    maxOccurs='1' />
                <element name='longitude'
type='xsd:double' maxOccurs='1' />
                <element name='latitude'
type='xsd:double' maxOccurs='1' />
                <element name='latency'
type='xsd:double' maxOccurs='1' />
                <element name='lesions'
type='tns:Lesions' maxOccurs='1' />
            </sequence>
        </complexType>
        <complexType
name="GeoLocalizedPatientWithTriageAndETD">
            <sequence>
                <element name='health_status'
type='tns:PatientStatus'
                    maxOccurs='1' />
                <element name='longitude'
type='xsd:double' maxOccurs='1' />
                <element name='latitude'
type='xsd:double' maxOccurs='1' />
                <element name='triagecode'
type='xsd:integer' maxOccurs='1' />
                <element name='etd' type='xsd:double'
maxOccurs='1' />
            </sequence>
        </complexType>
        <complexType
name="GeoLocalizedPatientWithTriageAndETDAndSigns">
            <sequence>
                <element name='health_status'
type='tns:PatientStatus'
                    maxOccurs='1' />
                <element name='longitude'
type='xsd:double' maxOccurs='1' />
                <element name='latitude'
type='xsd:double' maxOccurs='1' />
                <element name='triagecode'
type='xsd:integer' maxOccurs='1' />
                <element name='etd' type='xsd:double'
maxOccurs='1' />
                <element name='signs' type='xsd:string'
maxOccurs='1' />
            </sequence>
        </complexType>
        <complexType name="ListOfGeoLocalizedPatients">
            <sequence>
                <element name='geo_localized_patient'
type='tns:GeoLocalizedPatient'
                    maxOccurs='unbounded' />
            </sequence>
        </complexType>
```



```

        <complexType
name="ListOfGeoLocalizedPatientsWithLatencyAndLesions">
        <sequence>
            <element
name='geo_localized_patient_with_latency_and_lesions'

            type='tns:GeoLocalizedPatientWithLatencyAndLesions'
maxOccurs='unbounded' />
        </sequence>
    </complexType>
    <complexType
name="ListOfGeoLocalizedPatientsWithTriageAndETD">
        <sequence>
            <element
name='geo_localized_patient_with_triage_and_etd'

            type='tns:GeoLocalizedPatientWithTriageAndETD'
maxOccurs='unbounded' />
        </sequence>
    </complexType>
    <complexType
name="ListOfGeoLocalizedPatientsWithTriageAndETDAndSigns">
        <sequence>
            <element
name='geo_localized_patient_with_triage_and_etd'

            type='tns:GeoLocalizedPatientWithTriageAndETDAndSigns'
maxOccurs='unbounded' />
        </sequence>
    </complexType>
    <complexType name="PatientEvolveParameters">
        <sequence>
            <element name='pat_status'
type='tns:PatientStatus'
                    maxOccurs='1' />
            <element name='therapy'
type='xsd:integer' maxOccurs='1' />
            <element name='t_fin' type='xsd:double'
maxOccurs='1' />
        </sequence>
    </complexType>
    <complexType name="SickEvoParameters">
        <sequence>
            <element name='pop_status'
type='tns:PopulationStatus'
                    maxOccurs='1' />
            <element name='assets'
type='tns:ListOfFacilitiesStadium'
                    maxOccurs='1' />
            <element name='delta_t'
type='xsd:double' maxOccurs='1' />
        </sequence>
    </complexType>
    <complexType name="SickEvoResults">
        <sequence>
            <element name='pop_status'
type='tns:PopulationStatus'
                    maxOccurs='1' />

```



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        </sequence>
    </complexType>
    <complexType name="DamagerParameters">
        <sequence>
            <element name='event_type'
type='xsd:integer' maxOccurs='1' />
            <element name='patients_lesions'
type='tns:ListOfLesions'
                maxOccurs='1' />
        </sequence>
    </complexType>
    <complexType name="DamagerResults">
        <sequence>
            <element name='pop_status'
type='tns:PopulationStatus'
                maxOccurs='1' />
        </sequence>
    </complexType>
    <complexType name="StatScoringParameters">
        <sequence>
            <element name='pop_status'
type='tns:PopulationStatus'
                maxOccurs='1' />
        </sequence>
    </complexType>
    <complexType name="StatScoringResults">
        <sequence>
            <element name='expected_time_of_death'
type='tns:ListOfETDs'
                maxOccurs='1' />
            <element name='glasgow_coma_scale'
type='tns:ListOfGCSs'
                maxOccurs='1' />
            <element name='injury_severity_score'
type='tns:ListOfISSs'
                maxOccurs='1' />
            <element name='color_code'
type='tns:ListOfColorCodes'
                maxOccurs='1' />
        </sequence>
    </complexType>
    <complexType name="SymptScoringParameters">
        <sequence>
            <element name='pop_symptoms'
type='tns:ListOfSymptoms'
                maxOccurs='1' />
        </sequence>
    </complexType>
    <complexType name="SymptScoringResults">
        <sequence>
            <element name='expected_time_of_death'
type='tns:ListOfETDs'
                maxOccurs='1' />
            <element name='glasgow_coma_scale'
type='tns:ListOfGCSs'
                maxOccurs='1' />
            <element name='injury_severity_score'
type='tns:ListOfISSs'
```



```

                maxOccurs='1' />
            <element name='color_code'
type='tns:ListOfColorCodes'
                maxOccurs='1' />
        </sequence>
    </complexType>
    <complexType name="PopulationEvolveParameters">
        <sequence>
            <element name='patient_parameters'
type='tns:PatientEvolveParameters'
                maxOccurs='unbounded' />
        </sequence>
    </complexType>
    <complexType name="Void">
        <sequence>
        </sequence>
    </complexType>
    <complexType name="ExposedsAtStart">
        <sequence>
            <element name='row' type='xsd:integer'
maxOccurs='1' />
            <element name='col' type='xsd:integer'
maxOccurs='1' />
            <element name='exposeds'
type='xsd:integer' maxOccurs='1' />
        </sequence>
    </complexType>
    <complexType name="ListOfExposedsAtStart">
        <sequence>
            <element name='exposeds_data'
type='tns:ExposedsAtStart'
                maxOccurs='unbounded' />
        </sequence>
    </complexType>
    <complexType name="InfectivesAtStart">
        <sequence>
            <element name='row' type='xsd:integer'
maxOccurs='1' />
            <element name='col' type='xsd:integer'
maxOccurs='1' />
            <element name='infectives'
type='xsd:integer' maxOccurs='1' />
        </sequence>
    </complexType>
    <complexType name="ListOfInfectivesAtStart">
        <sequence>
            <element name='infectives_data'
type='tns:InfectivesAtStart'
                maxOccurs='unbounded' />
        </sequence>
    </complexType>
    <complexType name="EnsirParameters">
        <sequence>
            <element name='exposeds_at_start'
type='tns:ListOfExposedsAtStart'
                maxOccurs='1' />
            <element name='infectives_at_start'

```



```

type='tns:ListOfInfectivesAtStart'
    maxOccurs='1' />
    <element name='assets'
type='tns:ListOfFacilitiesStadium'
    maxOccurs='1' />
    <element name='t_fin' type='xsd:double'
maxOccurs='1' />
    <element name='delta_t'
type='xsd:double' maxOccurs='1' />
    <element name='event_type'
type='xsd:integer' maxOccurs='1' />
    </sequence>
</complexType>
<complexType name="EnsirResults">
    <sequence>
        <element name='susceptibles_population'
type='xsd:double'
            maxOccurs='unbounded' />
        <element name='exposeds_population'
type='xsd:double'
            maxOccurs='unbounded' />
        <element name='infectives_population'
type='xsd:double'
            maxOccurs='unbounded' />
        <element name='recovered_population'
type='xsd:double'
            maxOccurs='unbounded' />
        <element name='total_infecteds'
type='xsd:double'
            maxOccurs='unbounded' />
    </sequence>
</complexType>

    <xsd:element name="triageParameters"
type="tns:PatientStatus" />
    <xsd:element name="triageResults"
type="xsd:integer" />
    <xsd:element name="popTriageParameters"
type="tns:PopulationStatus" />
    <xsd:element name="popTriageResults"
type="tns:ListOfIntegers" />
    <xsd:element name="patEvolveParameters"
type="tns:PatientEvolveParameters" />
    <xsd:element name="patEvolveResults"
type="tns:PatientStatus" />
    <xsd:element name="getTherapiesParameters"
type="tns:Void" />
    <xsd:element name="getTherapiesResults"
type="tns:ListOfTherapies" />
    <xsd:element name="popEvolveParameters"
type="tns:PopulationEvolveParameters" />
    <xsd:element name="popEvolveResults"
type="tns:PopulationStatus" />
    <xsd:element name="sickEvoParameters"
type="tns:SickEvoParameters" />
    <xsd:element name="sickEvoResults"
type="tns:SickEvoResults" />
    <xsd:element

```




```
name="facilitiesModelParametersStadium"
      type="tns:FacilitiesModelParametersStadium"
/>
      <xsd:element name="facilitiesModelResultsStadium"
type="tns:ListOfFacilitiesLevelsStadium" />
      <xsd:element name="facilitiesModelParametersSARS"
type="tns:FacilitiesModelParametersSARS" />
      <xsd:element name="facilitiesModelResultsSARS"
type="tns:ListOfFacilitiesLevelsSARS" />
      <xsd:element name="patGenerateParameters"
type="tns:PatGenerateParameters" />
      <xsd:element name="patGenerateResults"
type="tns:ListOfGeoLocalizedPatients" />
      <xsd:element name="ScenGenParameters"
type="tns:ScenGenParameters" />
      <xsd:element name="ScenGenResults"
type="tns:ListOfGeoLocalizedPatientsWithLatencyAndLesions" />
      <xsd:element name="statScoringParameters"
type="tns:StatScoringParameters" />
      <xsd:element name="statScoringResults"
type="tns:StatScoringResults" />
      <xsd:element name="symptScoringParameters"
type="tns:SymptScoringParameters" />
      <xsd:element name="symptScoringResults"
type="tns:SymptScoringResults" />
      <xsd:element name="damagerParameters"
type="tns:DamagerParameters" />
      <xsd:element name="damagerResults"
type="tns:DamagerResults" />
      <xsd:element
name="patGenerateWithTriageAndETDParameters"
      type="tns:PatGenerateParameters" />
      <xsd:element
name="patGenerateWithTriageAndETDAndSignsParameters"
      type="tns:PatGenerateParameters" />
      <xsd:element
name="patGenerateWithTriageAndETDResults"
type="tns:ListOfGeoLocalizedPatientsWithTriageAndETD" />
      <xsd:element
name="patGenerateWithTriageAndETDAndSignsResults"
type="tns:ListOfGeoLocalizedPatientsWithTriageAndETDAndSigns"
/>
      <xsd:element name="popETDParameters"
type="tns:PopulationStatus" />
      <xsd:element name="popETDResults"
type="tns:ListOfETDs" />
      <xsd:element name="EnsirParameters"
type="tns:EnsirParameters" />
      <xsd:element name="EnsirResults"
type="tns:EnsirResults" />
</schema>
</types>
```



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<message name="trriageRequest">
  <part name="trriagepar" element="tns:trriageParameters" />
</message>

<message name="trriageResponse">
  <part name="trriageres" element="tns:trriageResults" />
</message>

<message name="popTriageRequest">
  <part name="poptrriagepar"
element="tns:popTriageParameters" />
</message>

<message name="popTriageResponse">
  <part name="poptrriageres" element="tns:popTriageResults"
/>
</message>

<message name="patEvolveRequest">
  <part name="patevolvepar"
element="tns:patEvolveParameters" />
</message>

<message name="patEvolveResponse">
  <part name="patevolveres" element="tns:patEvolveResults"
/>
</message>

<message name="getTherapiesRequest">
  <part name="gettherpar"
element="tns:getTherapiesParameters" />
</message>

<message name="getTherapiesResponse">
  <part name="gettherres" element="tns:getTherapiesResults"
/>
</message>

<message name="popEvolveRequest">
  <part name="popevolvepar"
element="tns:popEvolveParameters" />
</message>

<message name="popEvolveResponse">
  <part name="popevolveres" element="tns:popEvolveResults"
/>
</message>

<message name="SickEvoRequest">
  <part name="sickevopar" element="tns:sickEvoParameters"
/>
</message>

<message name="SickEvoResponse">
  <part name="sickevores" element="tns:sickEvoResults" />
</message>

<message name="FacilitiesModelRequestStadium">
```



```
        <part name="facilitiesModelparStadium"
element="tns:facilitiesModelParametersStadium" />
    </message>

    <message name="FacilitiesModelResponseStadium">
        <part name="facilitiesModelresStadium"
element="tns:facilitiesModelResultsStadium" />
    </message>

    <message name="FacilitiesModelRequestSARS">
        <part name="facilitiesModelparSARS"
element="tns:facilitiesModelParametersSARS" />
    </message>

    <message name="FacilitiesModelResponseSARS">
        <part name="facilitiesModelresSARS"
element="tns:facilitiesModelResultsSARS" />
    </message>

    <message name="patGenerateRequest">
        <part name="patgeneratepar"
element="tns:patGenerateParameters" />
    </message>

    <message name="patGenerateResponse">
        <part name="patgenerateres"
element="tns:patGenerateResults" />
    </message>

    <message name="ScenGenRequest">
        <part name="scengenpar" element="tns:ScenGenParameters"
/>
    </message>

    <message name="ScenGenResponse">
        <part name="scengenres" element="tns:ScenGenResults" />
    </message>

    <message name="statScoringRequest">
        <part name="statscoringpar"
element="tns:statScoringParameters" />
    </message>

    <message name="statScoringResponse">
        <part name="statscoringres"
element="tns:statScoringResults" />
    </message>

    <message name="symptScoringRequest">
        <part name="symptscoringpar"
element="tns:symptScoringParameters" />
    </message>

    <message name="symptScoringResponse">
        <part name="symptscoringres"
element="tns:symptScoringResults" />
    </message>
```



```
<message name="damagerRequest">
  <part name="damagerpar" element="tns:damagerParameters"
/>
</message>

<message name="damagerResponse">
  <part name="damagerres" element="tns:damagerResults" />
</message>

<message name="patGenerateWithTriageAndETDRequest">
  <part name="patgeneratetriageetdpar"
element="tns:patGenerateWithTriageAndETDParameters" />
</message>

<message name="patGenerateWithTriageAndETDAndSignsRequest">
  <part name="patgeneratetriageetdpar"
element="tns:patGenerateWithTriageAndETDAndSignsParameters" />
</message>

<message name="patGenerateWithTriageAndETDResponse">
  <part name="patgeneratetriageetdres"
element="tns:patGenerateWithTriageAndETDResults" />
</message>

<message name="patGenerateWithTriageAndETDAndSignsResponse">
  <part name="patgeneratetriageetdres"
element="tns:patGenerateWithTriageAndETDAndSignsResults" />
</message>

<message name="popETDRequest">
  <part name="popETDpar" element="tns:popETDParameters" />
</message>

<message name="popETDResponse">
  <part name="popETDres" element="tns:popETDResults" />
</message>

<message name="ensirRequest">
  <part name="ensirpar" element="tns:EnsirParameters" />
</message>

<message name="ensirResponse">
  <part name="ensirres" element="tns:EnsirResults" />
</message>

<portType name="PULSEModelsPortType">
  <operation name="patTriage">
    <input message="tns:triageRequest" />
    <output message="tns:triageResponse" />
  </operation>
  <operation name="popTriage">
    <input message="tns:popTriageRequest" />
    <output message="tns:popTriageResponse" />
  </operation>
  <operation name="patEvolve">
    <input message="tns:patEvolveRequest" />
    <output message="tns:patEvolveResponse" />
  </operation>
</portType>
```



```
</operation>
<operation name="getTherapies">
  <input message="tns:getTherapiesRequest" />
  <output message="tns:getTherapiesResponse" />
</operation>
<operation name="popEvolve">
  <input message="tns:popEvolveRequest" />
  <output message="tns:popEvolveResponse" />
</operation>
<operation name="SickEvo">
  <input message="tns:SickEvoRequest" />
  <output message="tns:SickEvoResponse" />
</operation>
<operation name="FacilitiesModelSARS">
  <input message="tns:FacilitiesModelRequestSARS" />
  <output message="tns:FacilitiesModelResponseSARS"
/>
  </operation>
<operation name="FacilitiesModelStadium">
  <input message="tns:FacilitiesModelRequestStadium"
/>
  <output
message="tns:FacilitiesModelResponseStadium" />
  </operation>
<operation name="patGenerate">
  <input message="tns:patGenerateRequest" />
  <output message="tns:patGenerateResponse" />
</operation>
<operation name="ScenGen">
  <input message="tns:ScenGenRequest" />
  <output message="tns:ScenGenResponse" />
</operation>
<operation name="Damager">
  <input message="tns:damagerRequest" />
  <output message="tns:damagerResponse" />
</operation>
<operation name="StatScoring">
  <input message="tns:statScoringRequest" />
  <output message="tns:statScoringResponse" />
</operation>
<operation name="SymptScoring">
  <input message="tns:symptScoringRequest" />
  <output message="tns:symptScoringResponse" />
</operation>
<operation name="patGenerateWithTriageAndETD">
  <input
message="tns:patGenerateWithTriageAndETDRequest" />
  <output
message="tns:patGenerateWithTriageAndETDResponse" />
  </operation>
  <operation name="patGenerateWithTriageAndETDAndSigns">
    <input
message="tns:patGenerateWithTriageAndETDAndSignsRequest" />
    <output
message="tns:patGenerateWithTriageAndETDAndSignsResponse" />
  </operation>
  <operation name="popETD">
    <input message="tns:popETDRequest" />
```



```
        <output message="tns:popETDResponse" />
    </operation>
    <operation name="EnSIR">
        <input message="tns:ensirRequest" />
        <output message="tns:ensirResponse" />
    </operation>
</portType>

<binding name="PULSEModelsBinding"
type="tns:PULSEModelsPortType">
    <soap:binding style="document"
transport="http://schemas.xmlsoap.org/soap/http" />
    <operation name="patTriage">
        <soap:operation soapAction="patTriage" />
        <input>
            <soap:body use="literal" />
        </input>
        <output>
            <soap:body use="literal" />
        </output>
    </operation>
    <operation name="popTriage">
        <soap:operation soapAction="popTriage" />
        <input>
            <soap:body use="literal" />
        </input>
        <output>
            <soap:body use="literal" />
        </output>
    </operation>
    <operation name="patEvolve">
        <soap:operation soapAction="patEvolve" />
        <input>
            <soap:body use="literal" />
        </input>
        <output>
            <soap:body use="literal" />
        </output>
    </operation>
    <operation name="getTherapies">
        <soap:operation soapAction="getTherapies" />
        <input>
            <soap:body use="literal" />
        </input>
        <output>
            <soap:body use="literal" />
        </output>
    </operation>
    <operation name="popEvolve">
        <soap:operation soapAction="popEvolve" />
        <input>
            <soap:body use="literal" />
        </input>
        <output>
            <soap:body use="literal" />
        </output>
    </operation>
</binding>
</service>
</schema>
```



```
<operation name="SickEvo">
  <soap:operation soapAction="SickEvo" />
  <input>
    <soap:body use="literal" />
  </input>
  <output>
    <soap:body use="literal" />
  </output>
</operation>
<operation name="FacilitiesModelSARS">
  <soap:operation soapAction="FacilitiesModelSARS" />
  <input>
    <soap:body use="literal" />
  </input>
  <output>
    <soap:body use="literal" />
  </output>
</operation>
<operation name="FacilitiesModelStadium">
  <soap:operation soapAction="FacilitiesModelStadium" />
  <input>
    <soap:body use="literal" />
  </input>
  <output>
    <soap:body use="literal" />
  </output>
</operation>
<operation name="patGenerate">
  <soap:operation soapAction="patGenerate" />
  <input>
    <soap:body use="literal" />
  </input>
  <output>
    <soap:body use="literal" />
  </output>
</operation>
<operation name="ScenGen">
  <soap:operation soapAction="ScenGen" />
  <input>
    <soap:body use="literal" />
  </input>
  <output>
    <soap:body use="literal" />
  </output>
</operation>
<operation name="Damager">
  <soap:operation soapAction="Damager" />
  <input>
    <soap:body use="literal" />
  </input>
  <output>
    <soap:body use="literal" />
  </output>
</operation>
<operation name="StatScoring">
  <soap:operation soapAction="StatScoring" />
  <input>
    <soap:body use="literal" />
  </input>
  <output>
    <soap:body use="literal" />
  </output>
</operation>
```



```
</input>
</output>
  <soap:body use="literal" />
</output>
</operation>
<operation name="SymptScoring">
  <soap:operation soapAction="SymptScoring" />
  <input>
    <soap:body use="literal" />
  </input>
  <output>
    <soap:body use="literal" />
  </output>
</operation>
<operation name="patGenerateWithTriageAndETD">
  <soap:operation soapAction="patGenerateWithTriageAndETD"
/>
  <input>
    <soap:body use="literal" />
  </input>
  <output>
    <soap:body use="literal" />
  </output>
</operation>
<operation name="patGenerateWithTriageAndETDAndSigns">
  <soap:operation
soapAction="patGenerateWithTriageAndETDAndSigns" />
  <input>
    <soap:body use="literal" />
  </input>
  <output>
    <soap:body use="literal" />
  </output>
</operation>
<operation name="popETD">
  <soap:operation soapAction="popETD" />
  <input>
    <soap:body use="literal" />
  </input>
  <output>
    <soap:body use="literal" />
  </output>
</operation>
<operation name="EnSIR">
  <soap:operation soapAction="EnSIR" />
  <input>
    <soap:body use="literal" />
  </input>
  <output>
    <soap:body use="literal" />
  </output>
</operation>

  <documentation>PULSE Webservices - BioMatLab</documentation>

</binding>

<service name="PULSEWebServices">
```




```
<port name="PULSEModelsPort"
binding="tns:PULSEModelsBinding">
  <soap:address
location="http://biomat1.iasi.cnr.it/webservices/pulse/M18/services.p
hp" />
  </port>
</service>
</definitions>
```