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## Specifications for communication between CascEff IET and Incident Management Tools

```
@Path("/")
public class IET_IMT_Service {

    @GET
    @Path("/case/{caseId}")
    public Response printMessage(@Path
        return Response.status(200).en
    }
}
```

|                             |                              |
|-----------------------------|------------------------------|
| Deliverable Number:         | D4.5                         |
| Date                        | July 30, 2017                |
| Due Date (according to DoW) | July 31, 2017                |
| Dissemination level         | PU                           |
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|                     |   |
|---------------------|---|
| Grant Agreement No: | 607665  |
| Coordinator:        | Anders Lönnermark at RISE Research Institutes of Sweden (SP)                                  |
| Project acronym:    | CascEff   |
| Project title:      | Modelling of dependencies and cascading effects for emergency management in crisis situations |

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## Executive Summary

This document describes the communication interface between the Incident Evolution Tool (IET) and Incident Management Tools (IMTs). Implementation details in the IET are treated, as well as data format consistency between IET, the ISO/TR 22351:2015(E) standard and the IMT.

The methodological framework has been divided as following:

- In a first part the choice of the standard to represent data message exchanges between IET and IMT is presented
- An objective was to provide a generic solution to link up the CascEff IET with any IMT. Generic use cases for IET/IMT linkups have been developed and are presented. These use cases are then used as basis for the other parts of the report.
- Then follows the ISO/TR 22351:2015 standard description
- Adequacy between IET data and chosen standard. In this part, there is a sum up of the different types of data used with the IET and how they match with the standard
- Implementation in IET
- Eventually, this last part aims at highlighting adaptations of the generic use cases to WIS and NoKeos, two IMTs present in the CascEff project.

The present document is willingly technical since it addresses the issue of IET-IMT communication at this level in order to help the reader who owns an IMT to consider an implementation by providing technical details.

The adaptation of generic IET-IMT link up use cases to real IMTs such as WIS and NoKeos is intended to show to the reader how he/she would implement them to another real IMT.



## Nomenclature

### Abbreviations

|       |  |
|-------|--|
| API   | Application Programming Interface  |
| DDP   | Distributed Data Protocol  |
| EMSI  | Emergency Management Shared Information  |
| IEM   | Incident Evolution Methodology   |
| IET   | Incident Evolution Tool  |
| IMT   | Incident Management Tool   |
| LAT   | Latitude - a geographic coordinate that specifies the north–south position of a point on the Earth's surface.  |
| LON   | Longitude - a geographic coordinate that specifies the east-west position of a point on the Earth's surface.   |
| REST  | Representational State Transfer. A way of providing interoperability between computer systems on the internet <sup>1</sup> using web services. REST-compliant Web services allow requesting systems to access and manipulate textual representations of Web resources <sup>2</sup> using a uniform and predefined set of stateless <sup>3</sup> operations. <sup>4</sup> |
| RPC   | Remote Procedure Calls – Calling code from another machine or software, different from where the call is made.   |
| WGS84 | A standard for use in cartography, geodesy, and navigation including GPS.  |

### Glossary

|          |  |
|----------|--|
| Consumer | A client using the API.                    |
| Endpoint | Refers to a URL on which the API is served |
| NoKeos   | A specific Incident Management Tool        |
| WIS      | A specific Incident Management Tool        |

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<sup>1</sup> <https://en.wikipedia.org/wiki/Internet>

<sup>2</sup> [https://en.wikipedia.org/wiki/Web\\_resource](https://en.wikipedia.org/wiki/Web_resource)

<sup>3</sup> [https://en.wikipedia.org/wiki/Stateless\\_protocol](https://en.wikipedia.org/wiki/Stateless_protocol)

<sup>4</sup> Wikipedia [https://en.wikipedia.org/wiki/Representational\\_state\\_transfer](https://en.wikipedia.org/wiki/Representational_state_transfer)



# 1 Introduction

## 1.1 Background

In CascEff an Incident Evolution Methodology (IEM) has been developed to identify and analyse cascading effects during incidents. It uses a six-step approach starting with identifying the case area to study and the relevant systems to include. The final step is to identify key decision points. The details of the IEM are presented in D4.2. Based on the IEM, an Incident Evolution Tool (IET) has been developed. It is a web-based tool with the content of the steps of the IEM implemented. In that sense the IET automates and visualizes the IEM.

The IET has been presented to and discussed with different groups of potential end users in order to learn both the usefulness of the IET and wished functionalities. Conclusions from such discussions are summarized in deliverables D5.2 and D5.3. One conclusion is that it would be useful to be able to connect the IET to existing Incident Management Tools (IMTs), to be able to communicate with the IET from different IMTs. In this way it would be possible to take advantage of both the functionalities of IMTs already in use by emergency managers and others, and the capacity of the IET to simulate cascading effects.

This deliverable (D4.5) reports the work performed in Task 4.4, but focuses on the technical part of communication between the IET and different IMTs and suggests a specification for such an implementation. Results from interviews and discussions with users of IMTs on the usefulness of making connection between IET and IMTs are presented and described in D5.2. That work has given input also to the technical part reported here.

## 1.2 Purpose of specification

The purpose of the specification presented in this report is to define the software interface between the CascEff IET and IMTs (or other external software). This is done by committing to using an existing standard to represent the data in the IET when communication externally via an *Application Programming Interface* (API). This specification is to be used by developers of IET for future implementation an API taking into account the cases below and using the standard chosen when communicating information between IET and IMT.



## 2 Choice of standard

The standard proposed for representing data messages in between IET and IMT is ISO/TR 22351:2015. Multiple other standards exist for emergency information data<sup>5</sup>. In D4.3 eight different standards were identified as interesting for further evaluation. The aim was to select a standard that was internationally recognized and in the end the ISO standard ISO/TR 22351:2015 was selected. In summary, the selection of this standard as starting point for the format of the transfer of information was based on the ISO/TR 22351:2015 standard being:

- an ISO standard;
- internationally recognized;
- developed to exchange incident data; and
- future oriented.

This ISO standard is based on the OASIS/EDXL standard and developed to exchange incident data between many Emergency Management applications. The WP4 Partners feel that this is the most future oriented option with the potential of a broader acceptance by software vendors in the Emergency Management space.

The ISO/TR 22351:2015 is hereafter known as “the Standard” or “Standard” in the subsequent chapters of this document. The Standard only contains a specification of data fields and data format and makes no assumptions on how data is exchanged. This document thus elaborates on multiple use cases and chooses one which is described in more detail.

---

<sup>5</sup> CascEff D4.3 Initial Structure for the implementation of the Incident Evolution Tool, June 30<sup>th</sup> 2015





### 3 Use cases

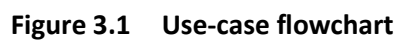
The objective of the IET is, through simulation, to enable proactive decision-making in the process of preparation for and responding to incidents involving cascading effects. To increase usefulness, the IET needs to be able to communicate with IMTs. There are many ways in which the IMT and IET can co-operate. On the highest level, the workflow (see Figure 3.1) foreseen is that an operator of an IMT decides to perform a simulation using the IET to better estimate cascading effects.

The overall user workflow is shown in Figure 3.1. It can be summarized in the following structured way:

1. The user uses an external system (e.g. IMT) and decides to perform a simulation in the IET.
2. The user registers an account in the IET.
3. The user performs the usual IET task of creating a case, defining needed systems, creating an initiating event etc.
4. Then, from the IMT, the user authenticates to the IET API and receives a login token. This token is used in subsequent requests to the IET API.
5. The user then uses the IMT to reference a case in the IET. The user sends the current incident location coordinate in WGS84 format to IET. A list of available cases for this coordinate and user shows up.
6. The IET returns the unique Case-ID for this case. This information is stored in the IMT in the data context of this incident. This links an incident in the IMT to a case in the IET.
7. The IMT user logs in to the web interface of the IET and requests a simulation to be performed. The simulation results are stored.
8. The IMT user requests the simulation results for the Case-ID received in step 6.
9. The IET returns each affected IET-system, effect type and geographical dispersion in the form of one or more Emergency Management Shared Information (EMSI see 4.2) messages, which then can be shared in the IMT to other recipients.

More details on the EMSI messages and their structure and content are given in chapter 4.2 Data fields in an EMSI. One advantage of using the EMSI format is that the standardized way of sending the information makes it relatively easy to interpret and translate the information to different languages.





The objective of the IET-IMT interface is to support multiple IMTs. NoKeos and WIS are relevant IMTs from the consortium which have been selected to help design the use cases. The objective of the use cases is to be generic so that they can be applied to other IMTs as well. The workflow described above gives rise to new use cases (red boxes) and multiple requirements on the IMT and IET communication (yellow boxes). The new generic use cases are presented in Table 3.1, while the new required functionality in the IET is presented in Chapter 6. The use cases describe what is aimed at achieving (from a user perspective) with the communication between IMTs and the IET.

**Table 3.1 Defined use-cases.**

| Use Case ID       | Description                |
|-------------------|----------------------------|
| <b>IET-IMT-01</b> | Logging in                 |
| <b>IET-IMT-02</b> | Selecting a case           |
| <b>IET-IMT-03</b> | Getting simulation results |

---

|                               |   |
|-------------------------------|---|
| <b>ID:</b>                    | IET-IMT-01  |
| <b>Version:</b>               | 1.0   |
| <b>Authors:</b>               | Criel, Xavier; Kempe, Marcus; Lönnermark, Anders  |
| <b>Title:</b>                 | Logging in  |
| <b>Main Success Scenario:</b> | <ol style="list-style-type: none"> <li>1. Upon trying to interact with the IET from the IMT it asks for credentials (username, password) as a popup.</li> <li>2. The user provides the credentials and logs in to IET (username/password).</li> <li>3. A unique token is returned from the IET. This token has an optional timeout and can be used to authenticate to the IET for subsequent operations.</li> </ol> |
| <b>Extension 01A:</b>         | <p><b>Invalid credentials</b></p> <p>If Userid/password does not successfully authenticate the user in the IET, the IMT receives an error message that the credentials are invalid. If the IET credentials needs to be restored, this can be done on the login screen of the IET.</p>   |
| <b>Frequency of Use:</b>      | Upon first use of the IET for that IMT user or if the token has timed out.  |

---

|                               |   |
|-------------------------------|---|
| <b>ID:</b>                    | IET-IMT-02  |
| <b>Version:</b>               | 1.0   |
| <b>Authors:</b>               | Criel, Xavier; Kempe, Marcus; Lönnermark, Anders  |
| <b>Title:</b>                 | Selecting a case in the IET from the IMT user interface   |
| <b>Main Success Scenario:</b> | <ol style="list-style-type: none"> <li>1. The user creates a case in the IET.</li> <li>2. From within the user interface of the IMT. A function to get cases from IET is called. LAT and LON for the incident are sent with the call.</li> <li>3. The IET responds with an array of strings with all case ID:s located at the supplied coordinate.</li> <li>4. Which case to refer to is selected by the user in this list.</li> <li>5. The case ID is stored in the incident information within the IMT</li> </ol> |
| <b>Extension 02A:</b>         | <p><b>No case at location</b></p> <p>If no case is found at the location. An empty list is shown to the</p>   |



|                               |   |
|-------------------------------|---|
|                               | user.   |
| <b>Frequency of Use:</b>      | Once every time the IMT user wants to reference an IET case to an incident.   |
| <hr/>                         |   |
| <b>ID:</b>                    | IET-IMT-03  |
| <b>Version:</b>               | 1.0   |
| <b>Authors:</b>               | Criel, Xavier; Kempe, Marcus; Lönnermark, Anders  |
| <b>Title:</b>                 | Getting simulation results  |
| <b>Main Success Scenario:</b> | <ol style="list-style-type: none"> <li>1. The user clicks a button “Get simulation result” or similar in the user interface of the IMT-</li> <li>2. The IET responds with an array of EMSI messages in the form of serialised strings.:</li> <li>3. In addition to the EMSI messages, results are also sent as separate files: <ul style="list-style-type: none"> <li>• Tree view in jpg format</li> <li>• Map view in jpg format</li> <li>• Pdf format of IET report including tree view, map view and simulation log results</li> <li>• .shp file with affected systems.</li> </ul> </li> <li>4. The IMT can then store these messages, or distribute them to other parties.</li> </ol> |
| <b>Extension 03B:</b>         | <b>Error in the parameters</b> <ol style="list-style-type: none"> <li>1. An error code indicating all errors in the request is returned to the IMT: <ol style="list-style-type: none"> <li>a. invalid user token</li> <li>b. no case found</li> <li>c. invalid request (request structure wrong)</li> <li>d. invalid incident location.</li> </ol> </li> </ol>  |
| <b>Frequency of Use:</b>      | Once every time the IMT user wants to run an IET simulation.  |

In the following chapters is described how to achieve the functionality described by the use cases. In Chapter 4 the main content of the standard and its component are described, while Chapter 5 is devoted to matching the parameters in the IET to the structured format in the standard.



## 4 ISO/TR 2231:2015

### 4.1 Description

The ISO/TR 2231:2015 facilitates interoperability in communication between information systems. The Standard defines a structured data message called Emergency Management Shared Information (EMSI). An EMSI message describes a part of the operational picture at a particular time<sup>6</sup>. This means that an EMSI message is a way of structuring data in a message. This message can then be transferred using a suitable method between the information systems such as IMTs or IETs. This means that a reasonable method needs to be suggested how communications should be performed on a logical level between IMT and IET.

### 4.2 Data fields in an EMSI

The main data component in the Standard is the *Emergency Management Information Sharing* (EMSI) data structure. This structure contains four main elements:

- CONTEXT: Identification of the EMSI
- EVENT: Description of the event
- (RESOURCE): Allocated or available resources for the event (optional)
- (MISSION): Description of mission(s)

The EMSI Structure thus contains information on an individual event of some sort. The types of events that can be represented are numerous. An example is a report of a collision between two cars. But it can also be the response of rescue personnel to this location. Furthermore, it can be information about that a hazardous material has been released and the result of a pollution dispersion model. An EMSI can also be trivial, containing only an updated temperature on the incident site for example. For more detailed information on the data fields in the Standard, please see the Standard.

In Chapter 5, suggestions are given for how to correlate the IET parameters with the EMSI elements and codes given in the standard. The definitions of these elements and codes are given in Table 4.1 - Table 4.6, divided in different types.

**Table 4.1 Selected Event elements, sub-elements** Fel! Bokmärket är inte definierat.

| Element name  | Definition  | Type                           |
|---------------|---|--------------------------------|
| EGEO          | Provides the geographical location of the event.            | Group                          |
| EGEO TYPE     | Describes the type of area.                                 | string (maximum 80 characters) |
| EGEO DATIME   | Describes the date and time for this geographical location. | Date and time                  |
| EGEO POSITION | Provides the position of the EGEO element.                  | Group                          |
| EGEO WEATHER  | Describes the weather at the location.                      | string (maximum 40 characters) |

<sup>6</sup> ISO/TR 22351:2015(E)



**Table 4.2 Selected EVENT EGEO TYPE codes.<sup>7</sup>**

| Element name | Definition                  | Comments  |
|--------------|-----------------------------|---|
| GEN          | General purpose area        |   |
| INCRD        | Incident ground             | Location of the emergency incident.   |
| DGR          | Polluted/<br>dangerous area |   |
| SGA          | Slow go area                | An area that is trafficable with difficulty.                                |
| NGA          | No go area                  | An area that is not trafficable.  |
| CMB          | Combat-related area         |   |
| IMPTPT       | Impact point                | The point at which a projectile, bomb or re-entry vehicle strikes on earth. |

**Table 4.3 Selected EVENT EGEO WEATHER codes.<sup>7</sup>**

| Element name | Definition       | Comments   |
|--------------|------------------|--|
| TMPsxx       | Temperature      | This item provides the temperature in Celsius degrees. s is the sign (+ or -) and xx is the temperature itself: TMP + 15 for a temperature of 15 °C above 0, TMP-04 for a temperature of 4 °C under 0. |
| ICY          | Icy conditions   |  |
| HUM          | Humid conditions |  |

**Table 4.4 Selected EVENT ETYPE CATEGORY codes.<sup>7</sup>**

| Element name  | Definition             | Comments                            |
|---------------|------------------------|-------------------------------------|
| EXP           | Explosion              |                                     |
| GND           | Ground Event           |                                     |
| (/GND)<br>EQK | Earthquake             | impact given through SCALE element) |
| POL           | Pollution              |                                     |
| HPP           | High pressure products | (Including steam...)                |
| FLD           | Flood                  |                                     |

<sup>7</sup> ISO/TR 22351:2015(E)



|     |                       |   |
|-----|-----------------------|---|
| FIR | Fire                  |   |
| CHM | Chemicals             | Substance produced by or used in a chemical process |
| HLT | Health                |   |
| NDS | Notifiable disease    |   |
| PSW | Public safety/welfare |   |
| TRP | Transport             |   |

**Table 4.5 selected RESOURCE RTYPE CLASS code.<sup>8</sup>**

| Element name | Definition     | Comments |
|--------------|----------------|----------|
| HUM          | Human resource |          |

**Table 4.6 Selected EVENT ETYPE ACTOR codes.<sup>8</sup>**

| Element name | Definition                        | Comments  |
|--------------|-----------------------------------|---|
| PPL          | People                            |   |
| SNS          | Cultural or political sensitivity |   |
| BEV          | Built environment                 |   |
| ANI          | Animals                           | The free-text element will contain detailed information about the species and other features. |
| DEA          | Status: dead                      | /ANI/DEA = An animal that has lost its life.  |
| VLN          | Distinctive vulnerability         |   |
| INJ          | Status: injured                   |   |
| EVC          | Evacuee                           | Term used to describe a person who have been evacuated from a dangerous place.                |
| DED          | Dead                              | Term used to describe a when a person or animal is deprived of life.                          |

### 4.3 Protocol and data format

The Standard recommends using XML when implementing the EMSI. However, either XML, JSON or anything else can be used. It is recommended to go with either XML or JSON because they are easy to work with and is supported by most development tools.



## 5 Matching data from IET to the Standard

The data transferred as EMSI messages from the IET to the IMT are the simulation results. In the IET these are systems that have been affected. The relevant information is:

1. Location of system - Location is described using the EGEO (geographic location) field and TYPE /GEN/INCGRD to describe an incident location.
2. Estimated time of impact of the effect after propagation time - Impact time is described using the EGEO DATIME property which if present predicts future damage.
3. Estimated geographic dispersion of effect - A geographic area is described using the EGEO POSITION property which can describe a SURFACE with COORD (coordinates, using the WGS84 coordinate system) containing LAT and LON sub properties.
4. Effect type - Effect type is described using the EGEO TYPE<sup>Fel! Bokmärket är inte definierat.</sup> property. Effect types are one of the following in the IET and are matched respectively, where <SUBTYPE> can provide further detail, see Standard. Where no good match can be found between existing EMSI codes and the IET parameters, new codes have been suggested:
  - a. Explosion - /EXP/<SUBTYPE>
  - b. Ground movement - /GND/<SUBTYPE> (e.g. /GND/EQK for earthquake)
  - c. Radiation - /POL/<SUBTYPE>
  - d. Temperature - /WEATHER/TMPsxx (e.g. TMP+40 or TMP-10)
  - e. Wind pressure - NO MATCH. Suggested: /WEATHER/BARPRESxxxx (e.g. BARPRES1013 for 1013 hPa)
  - f. Industrial accident pressure – /EXP/HPP
  - g. Flood - /FLD/<SUBTYPE>
  - h. Humidity - /HUM/<SUBTYPE>
  - i. Fire - /FIR/<SUBTYPE>
  - j. Toxic effect - /DGR/CHM
  - k. Epidemic - /HLT/NDS
  - l. Public health degradation – No good match. Possibly also /HLT/NDS
  - m. Social effect – No good match. Suggested /PSW/<SUBTYPE>
  - n. Workforce degradation - No good match. Suggested /PSW/<SUBTYPE>
  - o. Energy service degradation – No good match. **New suggestion: /PSW/ESD<sup>9</sup>**
  - p. Transport service degradation – No good match. Possibly /DGR/SGA (or /DGR/NGA or e.g. /PSW/SGA or TRP/SGA
  - q. Communication service degradation – No good match. **New suggestion: /PSW/CSD<sup>9</sup>**
  - r. Water service degradation – No good match. **New suggestion: PSW/WSD<sup>9</sup>**
  - s. Food supply degradation – No good match. **New suggestion: PSW/FSD<sup>9</sup>**
  - t. Missile effect (mechanical effect) - /CMB/IMPTPT
  - u. Precipitation - /HUM/<SUBTYPE> or /ICY/<SUBTYPE>
5. Impact type and magnitude – There is nothing in the Standard that supports impact type and magnitude as sub-information to a greater event. This has to be done in free-text or the standard could be extended with an IMPACT property under each event. Below follow suggested codes for such an IMPACT property.

<sup>9</sup> New suggestion; not in the standard





- a. Economical – Direct economic cost – No good match. **New suggestion: PSW/ECO<sup>9</sup>**
- b. Social – People affected by social unrest - /PPL/SNS
- c. Social – People mistrusting authority – No good match. **New suggestion: /PPL/PMA<sup>9</sup>**
- d. Infrastructure – Number of users – No good match. **New suggestion: /BEV/NOU<sup>9</sup>**
- e. Infrastructure – Available make up capacity – No good match. **New suggestion: /BEV/MUC<sup>9</sup>**
- f. Infrastructure – Expected repair time – No good match. **New suggestion: /BEV/ERT<sup>9</sup>**
- g. Infrastructure – Expected repair cost – No good match. **New suggestion: /BEV/ERC<sup>9</sup>**
- h. Infrastructure – Life/property losses – No good match. **New suggestion: /BEV/PROP<sup>9</sup>**
- i. Environmental – Polluted land – No good match. **New suggestion: /POL/LAND<sup>9</sup>**
- j. Environmental – Polluted forest – No good match. **New suggestion: /POL/FOR<sup>9</sup>**
- k. Environmental – Polluted sea – No good match. **New suggestion: /POL/SEA<sup>9</sup>**
- l. Environmental – Dead animals - /ANI/DEA
- m. Human – Fatalities - /PPL/DED
- n. Human – Injuries - /PPL/VLN/INJ
- o. Human – People that has lost critical services – No good match. **New suggestion: /PSW/LCS<sup>9</sup>**
- p. Human – Mental health injuries – No good match. **New suggestion: /HLT/MHI<sup>9</sup>** Fell! Bokmärket är inte definierat. **alt PPL/MHI<sup>9</sup>**
- q. Human – Evacuated - /PPL/EVC
- r. Human – Homeless – No good match. **New suggestion: /PSW/HMLS<sup>9</sup>**



## 6 Implementation needed in IET for communication with IMTs

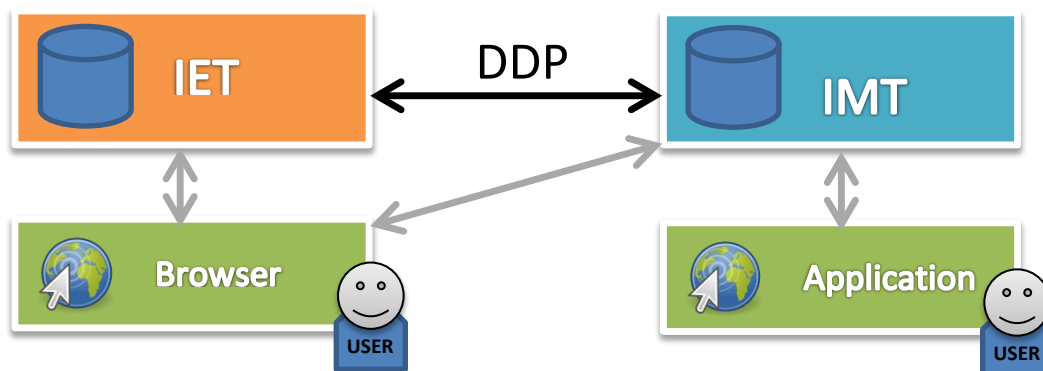
The IET has been developed as a stand-alone tool to be used together (in parallel) with already existing tools to complement the procedures and tools already in place at different end users. For making the work really efficient it is an advantage to be able to communicate information between the different tools, e.g. conditions from IMTs to the IET and results from cascading effects simulation from the IET back to the IMT. The overall user workflow is described in Chapter 3 and illustrated in Figure 3.1. To be able to do this, some additional implementation is needed in the IET and the IMTs. In this chapter different options for such implementation in the IET are given and argued for. Examples of options for implementation in IMTs are given in Chapter 7.

### 6.1 Communication with IET

Communication with the IET can be performed in three ways, DDP server-to-server communication (A), via REST endpoints (B) or through direct access to the database (C). Each one of the alternatives has its own advantages and disadvantages.

#### 6.1.1 DDP server-to-server communication and Meteor.js methods (A)

If the external system (IMT) needs to communicate with the IET from its own server to deliver information to the user, it can be done using the DDP-protocol<sup>10</sup> by writing a DDP-client<sup>11</sup>, see Figure 6.1. DDP is implemented using JSON over web sockets. This protocol is central to the inner workings of the Meteor.js framework and can also be used for creating arbitrary extensions to a Meteor.js application. The protocol works by calling Meteor.js methods. Those are in essence Meteor.js version of Remote Procedure Calls (RPC:s).



**Figure 6.1** IET - IMT communication architecture

The benefits that come with using DDP are that it is fast, has low overhead and reuses existing code and authorization mechanisms from the IET. From here on, the users are omitted in the figures.

<sup>10</sup> <https://github.com/meteor/meteor/blob/master/packages/ddp/DDP.md>

<sup>11</sup> [http://www.meteorpedia.com/read/DDP\\_Clients](http://www.meteorpedia.com/read/DDP_Clients)



### 6.1.2 REST endpoints (B)

Either a REST endpoint can be constructed on top of a DDP enabled client (1), or it can be included into the IET application directly using an add-on package called *simple:rest*<sup>12</sup> (2), see Figure 6.2. The advantages with using a REST endpoint is that it can be used out-of-the box from any application that supports making HTTP-calls. It also reuses authentication mechanisms from the IET.

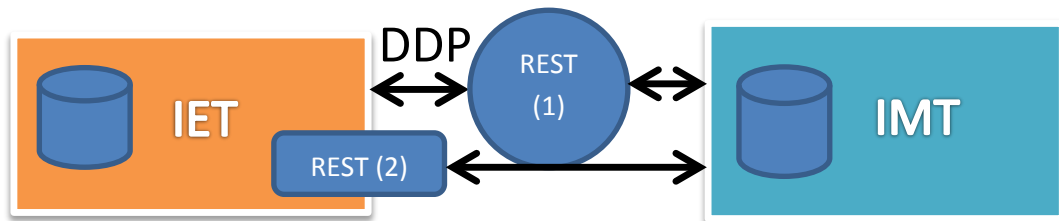


Figure 6.2 REST endpoint options.

### 6.1.3 Direct access to database (C)

A separate application can be created that accesses the MongoDB-database, which the IET uses concurrently (see Figure 6.3). In this case, no functionality has to be built into the IET to extract data. This separate application can contain all the logic to extract data directly from the IET to a specific IMT. The downside with this is that every IMT has to develop a specific MongoDB-database-adapter. The benefit is that the IET-logic and the IMT-logic can be separated because the IMT can extract the raw data from the IET database and is not dependent on what is exposed through API:s in the IET for example.

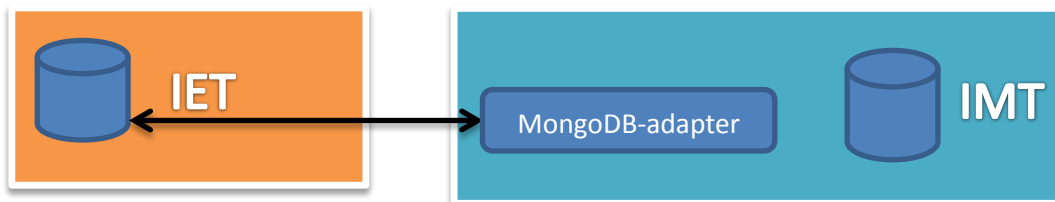


Figure 6.3 IET - IMT database access

## 6.2 Functions needed in the IET to enable communication

This section describes a “todo-list” of functions needed to be implemented to enable communication between the IMT and the IET. “API” refers to the interface endpoint provided by the tool for other software to connect to (i.e. an IMT). A “consumer” is a client using the API. It is also assumed that the IET is a web application that is run on a reachable server by the consumer. “Endpoint” refers to a URL on which the API is served. Authentication to use the API is granted by giving each user an access “token”. This token is sent on each request to the API via standardized headers to prevent caching of the token. The token times out after a

<sup>12</sup> <https://guide.meteor.com/data-loading.html#publications-as-rest>



configurable amount of time. When this happens, the consumer should authenticate again and get a new token.

### Logging in the user and providing an API token to the consumer - API

*Description:* An API key/token should be provided by the IET when a user sends a request to login. This token is used to access the API. A token expiry time should be used. This makes sure that tokens are not useable forever. Getting a new token is achieved by logging in via the API. This is done by letting the consumer supply username and password using basic authentication or passing the username and password in a payload, whereupon a new token is returned.

**Tip:** If a more sophisticated authentication method is needed because of sensitive information or IT-policies, consider using HMAC-SHA-2 (RFC 2104, RFC 4634), in which case the IET supplies both a **secret** and a **token** to the user. The secret and token are used to hash the data before communication starts between the consumer and the server. This enables verifying the data integrity on both sides. Even more authentication methods are available such as OAuth and OAuth2 which is not covered within the scope of this report.

If basic authentication is used, it is absolutely crucial to use TLS encryption (over HTTPS) on the endpoint side. This prevents someone from sniffing the basic authentication credentials. Using TLS encryption over HTTPS is in general considered a must, especially if the website handles user sensitive information. It also helps the consumer to identify the endpoint as valid.

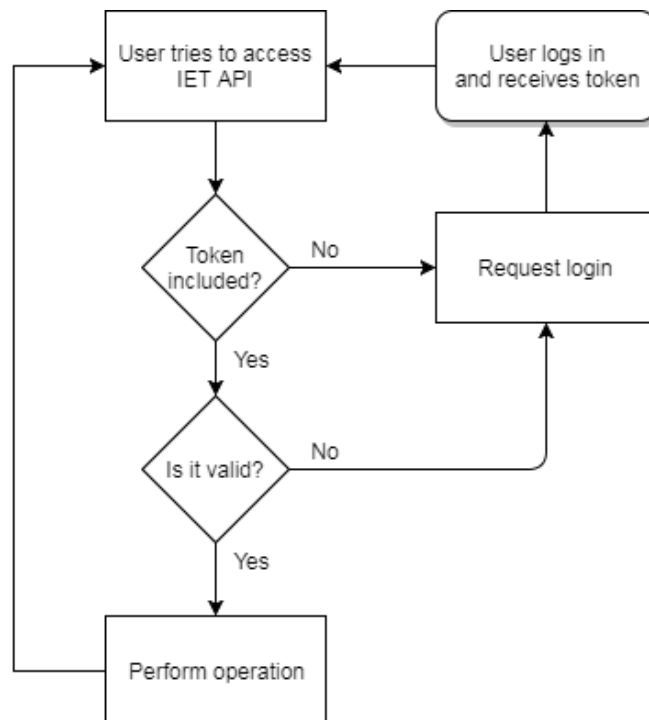
*Input:* Username and password

*Returns:* A new token for the user.

*Example HTTP call:* GET (HTTPS) /api/v1/token

*Headers:* Authorization-Basic

The login state-chart looks as follows:



**Figure 6.4** IET Login state-chart



### Endpoint for selecting a case - API

*Description:* The user selects an existing case in the IET database. This case has been created after an earlier incident or just prior to this selection. The IET responds with an array of cases existing on the supplied coordinate and belonging to the user whose token was provided. The access token must be sent in the headers.

*Input:* Coordinates for case (LAT and LON in WGS84 EPSG:4326 decimal degrees notation).

*Returns:* Data structure with case ID:s and names.

*Restrictions:* Only cases owned by the user are returned.

*Example HTTP call:* GET /api/v1/cases?coord=<lat dd.dddddd>,<lon dd.dddddd>

Headers: "Authorization: Bearer <token>"

### Endpoint for downloading a simulation result - API

*Description:* The user downloads a sequence of EMSI messages from the IET. The user provides a case id and gets back a data structure containing EMSI messages describing the spread effects.

*Example HTTP call:* GET /api/v1/case/simulation/result?id=<case\_id>.

Headers: "Authorization: Bearer <token>"



## 7 Implementation in IMTs

This section aims at presenting how the IET could be implemented in a working IMT. Two examples (WIS and NoKeos) are provided in order to help the reader consider how the implementation of the IET could be done with another used IMT.

### 7.1 WIS

This section details a solution for integrating the CasCEff IET with WIS.

#### 7.1.1 Incident management in WIS

Information sharing in WIS is based on events. When the event is detected, the first actor involved in handling the event will create an information-sharing area in WIS. Additional actors can be invited to participate, or join themselves.

WIS implements a read-permission model - within each event/information-sharing area actors can set permissions for other actors to see its posted information. Internally within each actor a further role-based permission model is implemented.

Information sharing within each event/area is largely based on free text notes, often in conjunction with attached files. It is also possible to specify a set of questions with required answer types (text, numerical value, etc.) that is sent to a number of actors, in order to facilitate structured information gathering and visualization.

WIS is implemented with an API that allows it to exchange data with other application. The existing implementation can be reused to some extent to communicate with the IET. Some aspects of the user interface and objects used in the system should also be possible to reuse to some extent. EMSI messages are not implemented or planned.

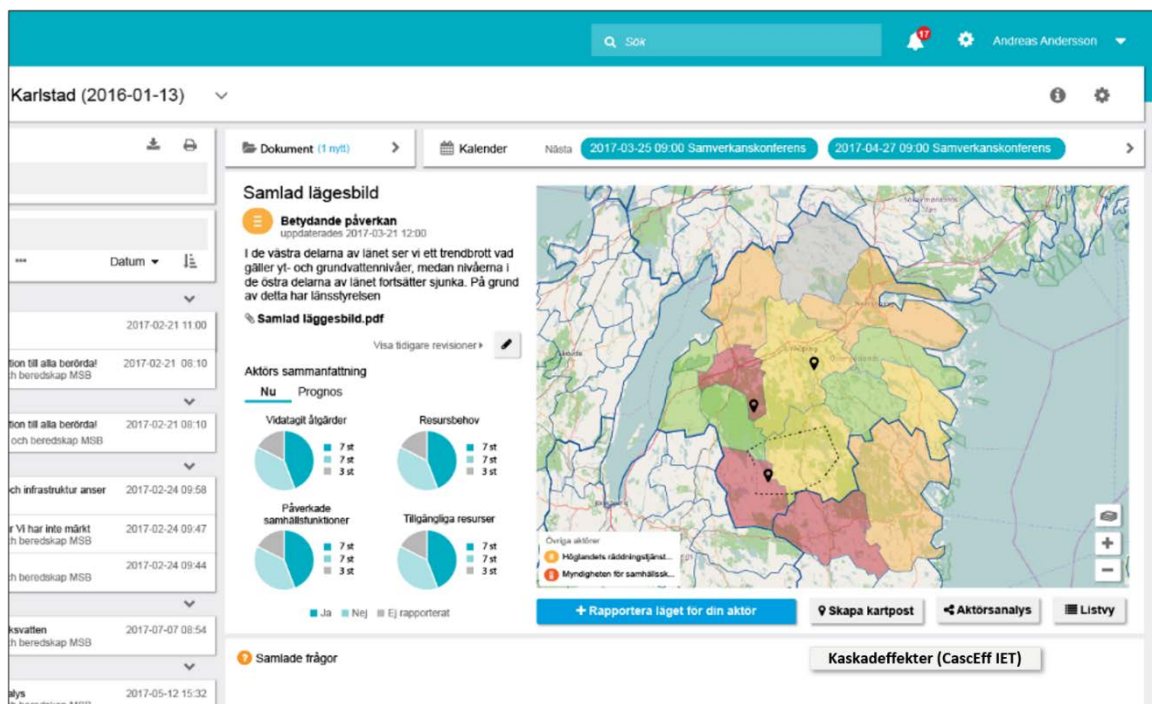


Figure 7.1 Overview of an event in WIS, with link to IET



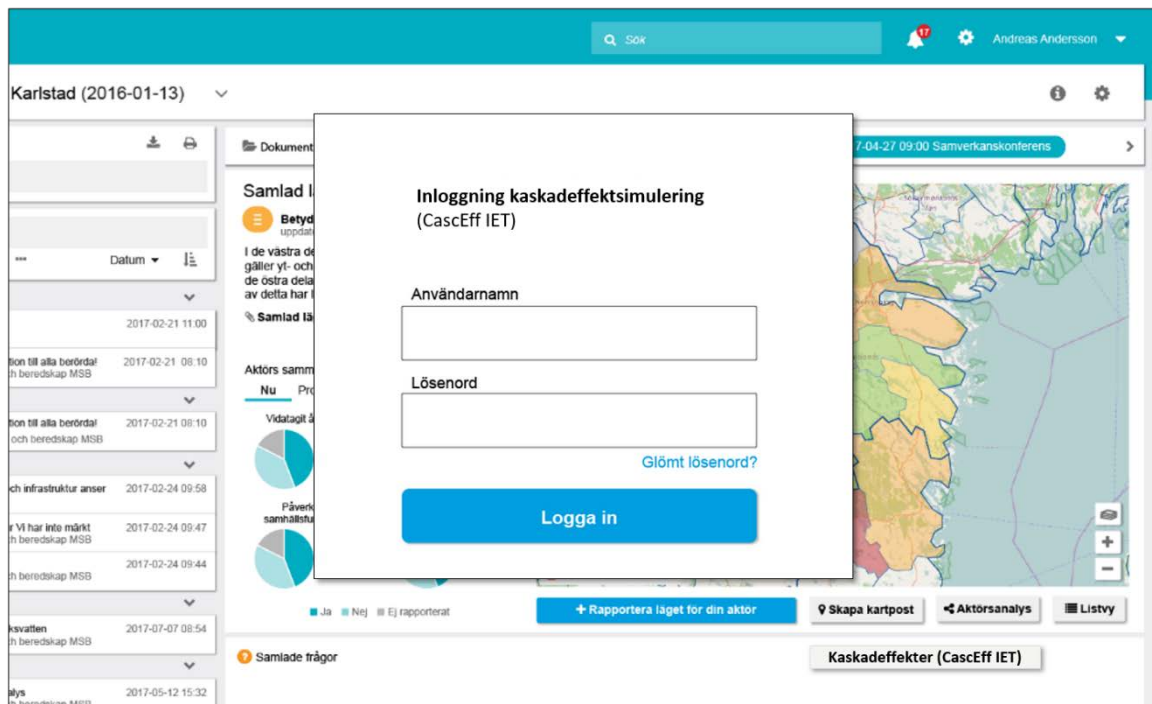
The IET simulations and results should be accessed from each specific WIS event, in order to easily connect simulation runs to the event.

### 7.1.2 Logging in (use case IET-IMT-01)

Logging in to the CascEff IET can typically be done in two ways:

1. As a prompt after requesting (case) information from IET
2. As part of the user settings, with selections for reconnection options

Option 1 is relatively simple to implement and has been selected for the purpose of this document.



**Figure 7.2** Login window to IET from WIS

However, from a user perspective in a more evolved solution, implementing option two with login features in the user settings is the preferred method. This method avoids multiple/recurring logins and offers the possibility of further enhancements related to the integration, such as session timeout variables.

### 7.1.3 Selecting a case (use case IET-IMT-02)

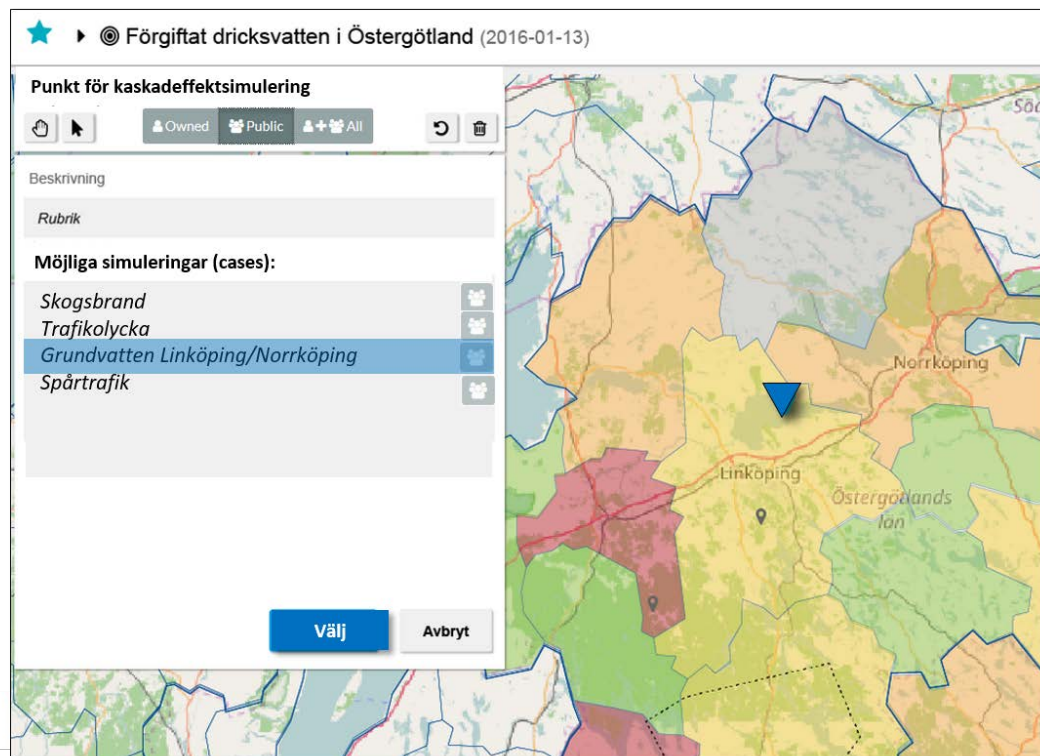
The selection of cases requires geographical data to filter the selection of possible relevant cases in the IET. WIS supports two main types of geographical data:

1. Affected by event. Geographical data connected to each event/incident, representing the administrative areas (national, regions, provinces and/or municipalities) that are currently affected by the event in some way, e.g. the event “Autumn storms October 2017” affecting all administrative regions/provinces on the entire west coast of Sweden.
2. Note with position data. Geographical information connected to a specific note within an event/incident. Can be a coordinate or area placed on the map, with related textual information.





As case selection requires a specific coordinate, option two with note data has been selected, as existing functionality in WIS can be developed relatively easily to implement these features.



**Figure 7.3 IET case selection by plotting location in WIS**

In the future, a more evolved solution could take advantage of the area data connected to a WIS event to suggest appropriate IET cases, especially with automatic logins as specified in the previous chapter.

#### **7.1.4 Getting simulation results (use case IET-IMT-03)**

The EMSI messages are consumed by WIS.

#### **7.1.5 Displaying simulation results**

Once the EMSI messages have been incorporated, these need to be parsed and displayed to the end user. Two main possibilities typically exists:

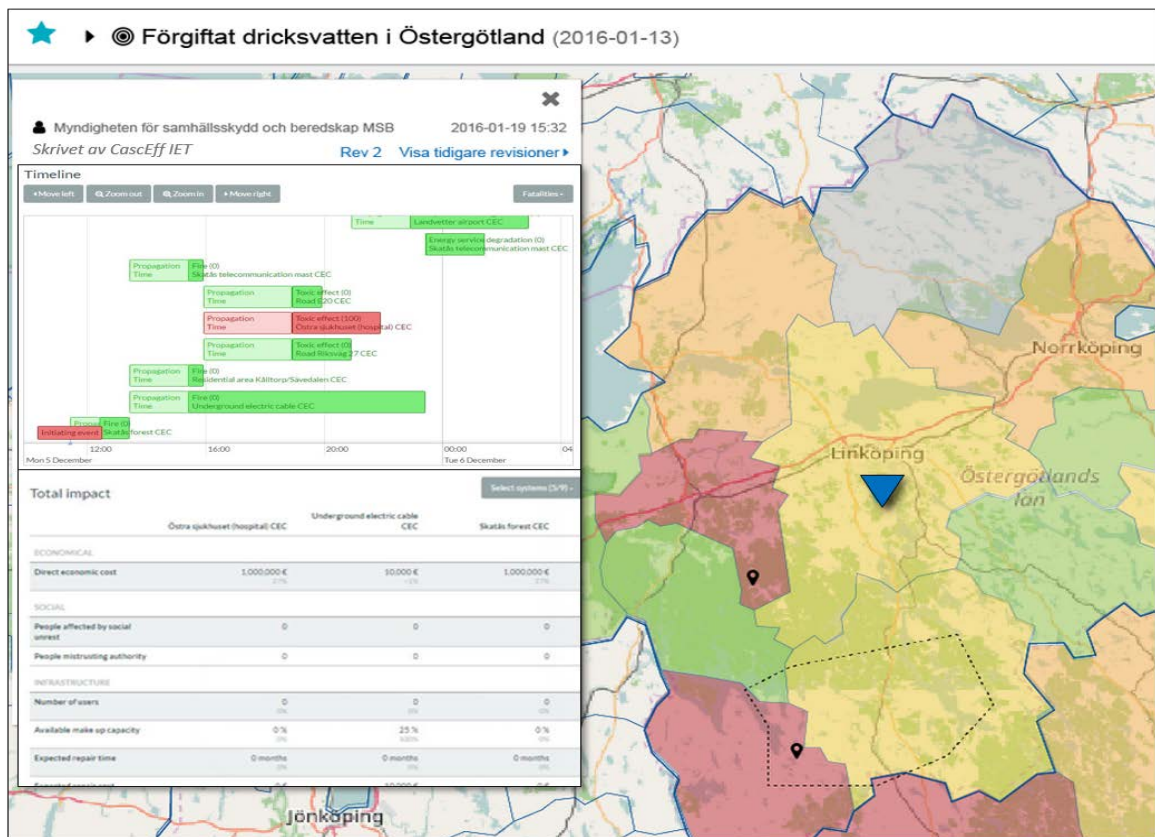
1. Incorporate the data into existing WIS data objects.
2. Incorporate the data into a standard format (e.g. PDF) and attach to the note in WIS.

WIS consists of a number of modular views for situation reports, documents, note flow and similar. Hence the result can be accessible from a number of views.

Incorporating the results into WIS data objects according to option one is the preferred solution, as it offers a much more integrated experience with the possibility of tailoring results to the specific event. The result should be accessible from multiple WIS areas, including the map view where the simulation run was started.

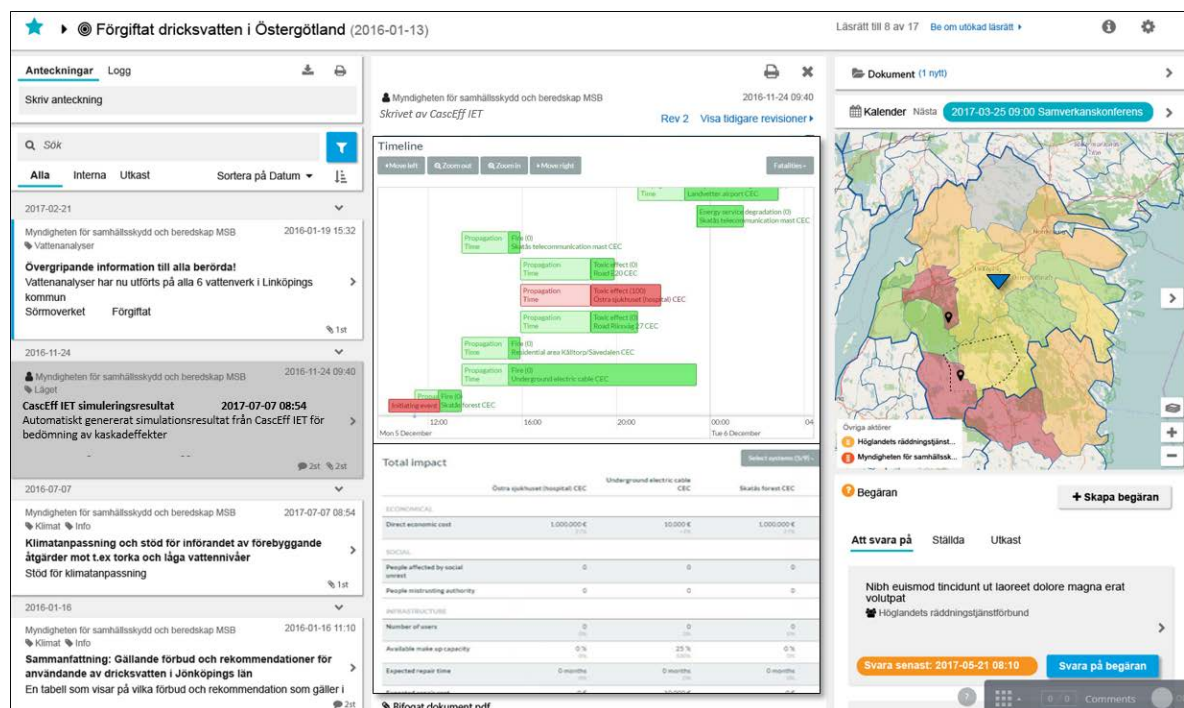






**Figure 7.4** IET simulation result in WIS, map view

The simulation result should also be represented in the regular WIS note flow.



**Figure 7.5 IET simulation result in WIS, note view**



There are also a number of benefits to implementing option two with results parsed, compiled and formatted into a standard format such as PDF that is uploaded to the IMT. This offers the possibility of offering centralized formatting rather than requiring each IMT to implement EMSI handling, parsing and displaying of results. As such it likely offers a quicker way to integrate IMT tools with the CascEff IET. A standard format also offers an easy way to distribute the result to any stakeholder that is not an IMT user. As such, a standardized format would likely be useful even if option 1 is implemented. WIS has a specific document area within each event that could be used for storing such standardized IET results.

|  |          |           |          |                  |            |
|--|----------|-----------|----------|------------------|------------|
| ★ ► © Förgiftat dricksvatten i Östergötland (2016-01-13) |          |           |          |                  |            |
| Dokument   |          |           |          |                  |            |
| Alla   | Interna  |           |          |                  |            |
|  |          | Synlighet | Revision | Senast ändrad    | Aktör      |
| ▼ Dokument   | (1 nytt) |           |          |                  |            |
| Anteckningar från fältet                                 |          | Intern    | 2        | 2016-01-13 13:23 | Eksjö kom  |
| sörmoverket.jpg  |          | Intern    |          | 2016-01-13 13:20 | Gislaveds  |
| Bifogad fil  |          | Delad     |          | 2017-02-21 08:10 | Högländet  |
| Kalenderhändelse gammal                                  |          | Delad     |          | 2016-04-15 11:02 | Länsstyrel |
| Lägesrapport med bild                                    |          | Intern    |          | 2016-01-21 10:06 | Myndighet  |
| Protokoll Samverkansmöte                                 |          | Delad     |          | 2016-03-08 14:00 | Nässjö kom |
| ► Filer från noteringar                                  |          |           |          |                  |            |
| ► Filer från sammanfattning                              |          |           |          |                  |            |
| ▼ Filer från CascEff IET simuleringar                    |          |           |          |                  |            |
| CascEff simulering 2017-07-14.pdf                        |          |           |          | 2017-07-14 08:54 | Myndi      |
| CascEff simulering 2017-09-18.pdf                        |          |           |          | 2017-09-18 15:46 | Myndi      |

Figure 7.6 IET simulation result documents in WIS document view



## 7.2 NoKeos

This section describes the implementation concept of the CascEff IET with NoKeos. The idea is to implement this concept into NoKeos once the IET web service is available.

### 7.2.1 Incident management in NoKeos

When an incident is created in NoKeos, it starts a process to collect structured data about the incident, its location, and scenario type. A role based authorization system enables Silver and Gold command level emergency managers and agencies, to read, update or validate the incident parameters. Based on the scenario the system interrogates users on incident data specific to their role (i.e. Fire fighter officers and emergency services in Silver Command, Gold Command, ...). As data is validated by the appropriate command level, a rules engine will suggest processes to be activated. When the user decides to activate a process (i.e. off-site evacuation) the rules engine will dispatch tasks and new questions to the appropriate users. All changes to incident parameters, task status changes and comments are automatically logged in the NoKeos log database.

Users share situational awareness through a command & control center screen and a GIS map with location of incident, effect areas and user enriched data.

NoKeos supports GIS data sharing through .shp files and links to other applications using scenario specific hyperlinks.

A web service architecture will be used to interface with external applications such as the IET. Through this architecture NoKeos will be able to share its structured data as well as GIS layers with external applications.

Incident data from within NoKeos should be passed to the IET using this web service interface. Additional dialogue boxes to support user interaction on the IET responses are needed. Based on this incident data and the case the user selected the IET can then perform simulations. Output of those simulations (GEO layer with affected systems, tree view and a log of the simulation results) should be stored in the NoKeos database. The user should be able to share simulation results through the NoKeos incident data and the GIS map with other NoKeos users. Depending on the simulated outgoing effects NoKeos could also suggest the user to activate relevant scenarios to improve decision support for incident commanders.

### 7.2.2 Logging in (use case IET-IMT-01)

When the user clicks on the 'Cascading Effect modelling' hyperlink and there is no valid IET login token, the user gets prompted to enter his IET credentials. If he checks the box 'remember my ID' the user's IET credentials are saved in the NoKeos user profile.

If the response from the IET is 'invalid credentials', an authentication error message is displayed in the login dialogue box and the user is prompted to re-enter his credentials.

Upon a successful login, the IET login token is stored in the NoKeos user profile.



The screenshot displays the NoKeos application interface for a 'BASF Product Leak acrylate K330' incident. The interface is divided into several panels:

- Type & size:** A table with columns 'Validated' and 'Suggested'. It lists incident types like 'Tankfire', 'Nuclear transport accident', 'Fluid leak' (medium), and 'Gas emission'.
- Phase:** A dropdown menu showing 'Operational Coordination'.
- General info:** Fields for 'Incident' (BASF Product Leak acrylate), 'Started' (7/7/2017 11:23:32), 'Elapsed' (0d-0h-9m-10s), 'Phase' (Operational Coordination), and 'User name' (Dir CP-OPS Antwerpen).
- Incident data:** A table with columns 'Validated' and 'Suggested'. It lists parameters like 'Facility' (BASF Antwerpen), 'Address' (Scheldelaan 600 - Haven 725), 'Zipcode' (2040), 'Municipality' (Antwerpen), 'Province' (Antwerpen), 'Facility activity' (Chemie), 'People on site' (3200), 'Meeting point' (Poort 1), 'GIS X (Latitude)', 'GIS Y (Longitude)', 'Victims' (Yes), 'expected victims' (5), 'Economical impact', 'Social impact', 'Objects involved' (Reactor K330), and 'major accident' (Yes).
- Cascading Effect modelling:** A central panel with a 'Login' prompt for 'Userid' (xcriel@fprisk.com) and 'Password' (\*\*\*\*\*). Below the login prompt, there are sections for 'Besluitvorming en communicatie', 'Informatie vergaren', 'Markeer op GIS kaart', 'Bepaal perimeters en advies aan de bevolking', 'Informatie vergaren', 'Strategie bepalen opvang en behandeling slachtoffers', 'Opstarten MIP', and 'Informatie vergaren'.
- Links:** A list of links including 'Cascading Effect modelling', 'Ericards interventiekaarten gevaar', 'International Chemical Safety Card', 'Conversie mg/m³ - ppm', 'Neerslag radar', 'KMI', and 'vooruitzichten stormweer'.
- Crisisorganisation:** A list of roles including 'incident commander', 'Silver Command', '112 centre', 'Observers', 'CP Police', 'D1/Dir-FB', 'Private fire brigade', 'D2/Dir-Med', 'Private medical centre', 'D3/Dir-Pol', 'Security', 'D4/Dir-Log', 'D5/Dir-Info', 'Industrial CMT', and 'Industrial ERT'.

**Figure 7.7 NoKeos prompt for IET user credentials**

### 7.2.3 Selecting a case (use case IET-IMT-02)

An optional incident parameter in NoKeos is location (using coordinates). It also has a map view delimited by a geo area where the incident location is indicated using an icon. The coordinates that will be send in the EMSI message will be evaluated according to this priority list:

1. coordinates in the location parameter;
2. coordinates of the incident icon in the GIS map;
3. coordinates of the map boundaries.

The results with the list of relevant cases will be presented to the user for selection. If the response from the IET is 'No case at location' the user will receive an error message 'No existing cases. Please create a case in the IET first'.

### 7.2.4 Getting simulation results (use case IET-IMT-03)

The EMSI response will be logged into the NoKeos log database for future reference/auditing. The different EMSI response strings will be used to update the NoKeos database as follows:

1. SimResult: pdf with simulation results
2. NoKeos Map – Simulation layer: .shp file.

### 7.2.5 Displaying simulation results

The results will be displayed through the structured simulation result data fields and as a special layer in the NoKeos Map. Structured output fields such as impact and outgoing effects will result in an update of the suggested relevant scenario and relevant incident data fields (as indicated by orange markers in Figure 7.8 below).





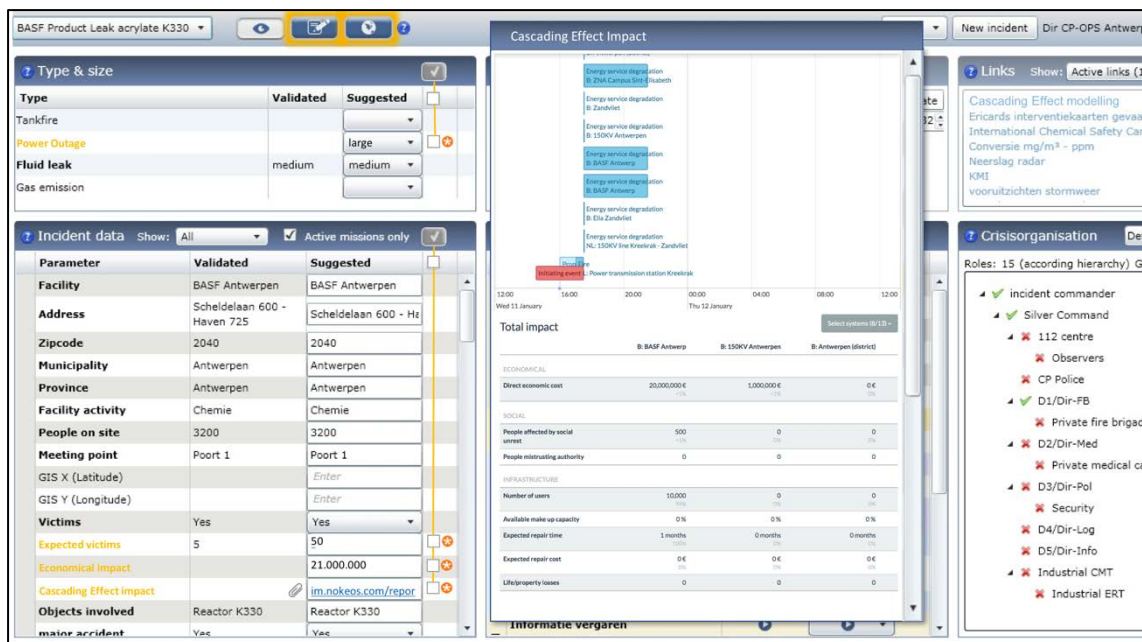


Figure 7.8 Simulation output in the NoKeos command & control screen

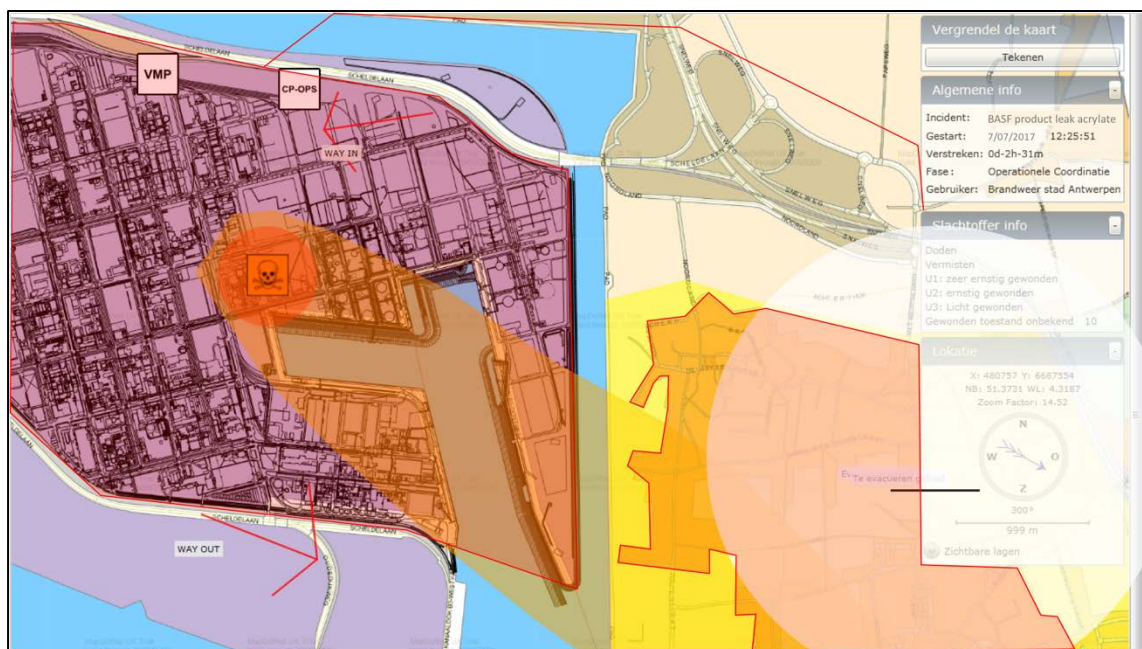


Figure 7.9 NoKeos map with IET results layer



## 8 Conclusions

Ways of communicating and transfer data between IMTs and the IET have been suggested and elaborated. These are based on three general use cases:

- Logging in to the IET from an IMT
- Selecting a case in the IET from the IMT user interface, and then run a simulation
- Getting simulation results from the IET back to the IMT

For data format consistency between the IET and the IMT, the ISO/TR 22351:2015(E) standard and its EMSI message format was selected as basis for the transfer of information. To make such information transfer possible, both the IET and existing IMTs need to be adjusted. Different options and implementation needs were identified and elaborated on for the IET, as well as for two in the project existing IMTs: WIS and NoKeos.

Much information is stored in different IMTs ranging from free form text information to strictly structured information. If an IMT makes sure to structure the information as EMSI messages, these can be fed directly into the IET to create cases, add information on systems etc. This, however, increases the complexity, e.g. sending EMSI-messages directly from an IMT to IET to build up a case or system. With experience from future implementation in IMTs and the use of IMTs in connection with the IET can most probably give rise to optimizations of the implementations and more efficient information transfer.

