"M&S DECISION MAKING SUPPORT FOR CRISIS, DISASTER MANAGEMENT & CLIMATE CHANGE IMPLICATIONS"

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INTRODUCTION

Military Relevance

NATO develops capabilities to be ready, on a case-by-case basis and by consensus, to contribute to effective crisis management and disaster prevention. This enables the Alliance to actively engage in crisis management and disaster response, including non-Article 5 crisis response operations. The Alliance is therefore encouraging the joint training of military and civilian personnel to help build trust and confidence.

Participant Nations

CMDR COE (chair), DEU (co-chair), AUT, BGR, SLO, USA, JFTC, NCIA, ACT

Industry

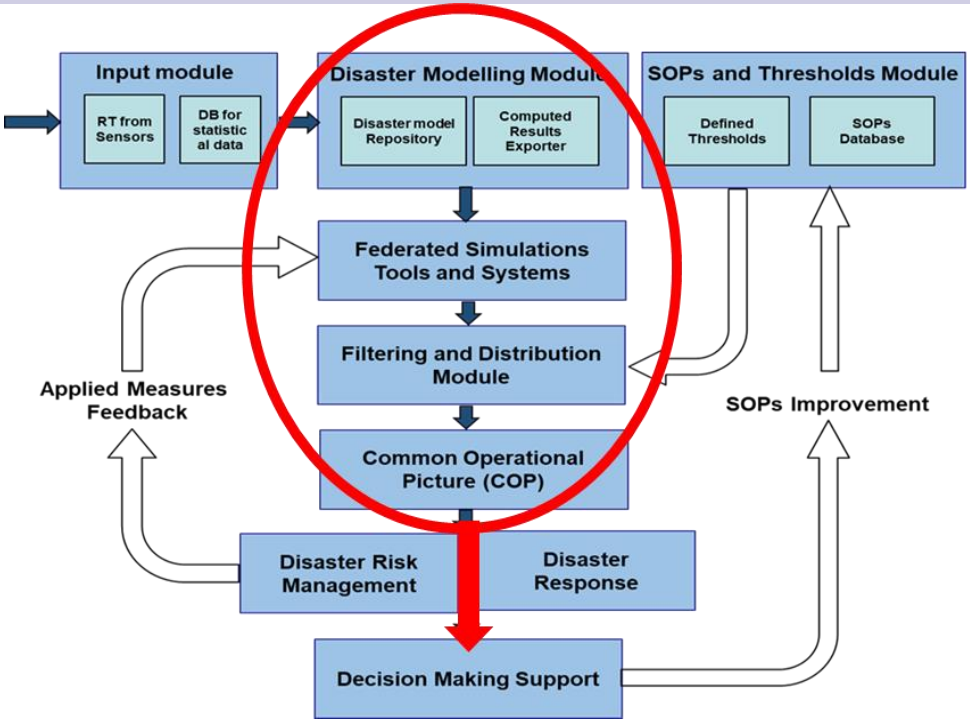
IABG, MASA, Bohemia Interactive

Academia

University of Bundeswehr, University of Genoa, Bulgarian Academy of Science, BGR National Institute of Meteorology and Hydrology,
JFTC, CMDR COE, M&S CoE, JCBRN-D COE, DAT COE

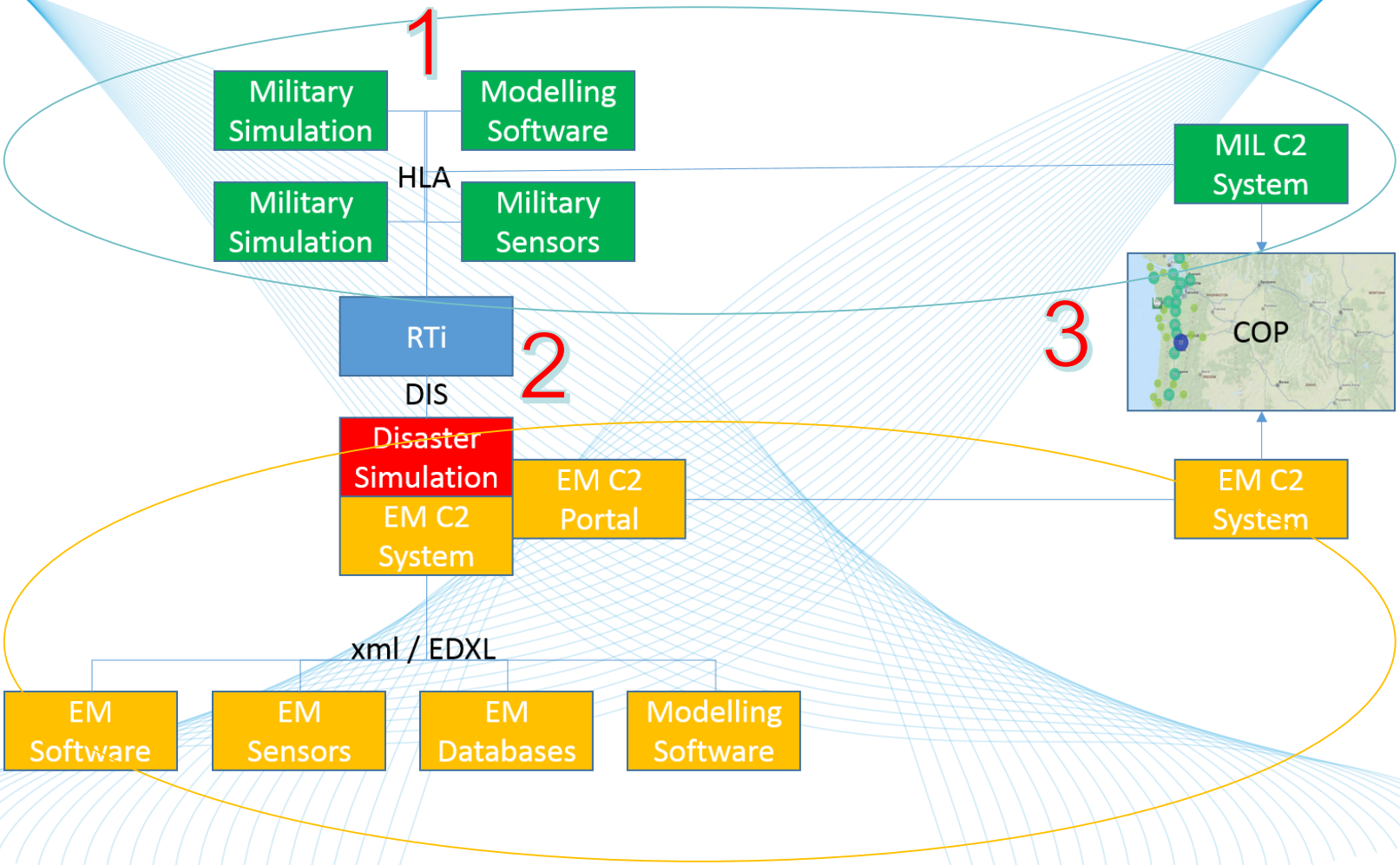
Aim of the Project

The aim of the project is to develop a proposal technical platform capable of supporting and conducting crisis management and disaster response exercises, analysis and preparatory training.
The intended result is to support military (NATO) decision making on the basis of prediction, analysis and visualization of effects in order to foster Courses of Action (CoA) in the light of a disaster.



CONCEPTUAL MODEL

Defined GAPs

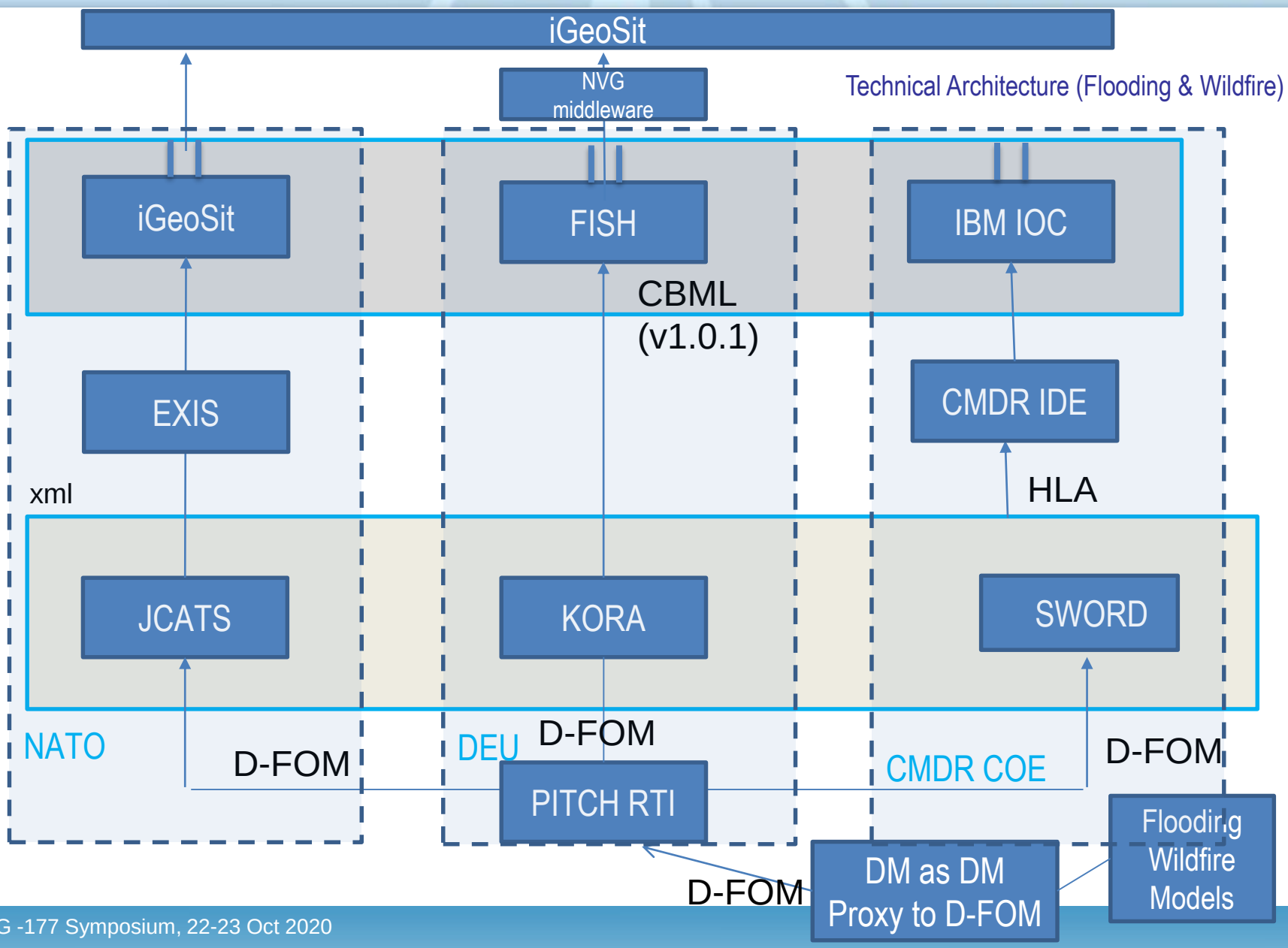


LOEs Details

Dates:

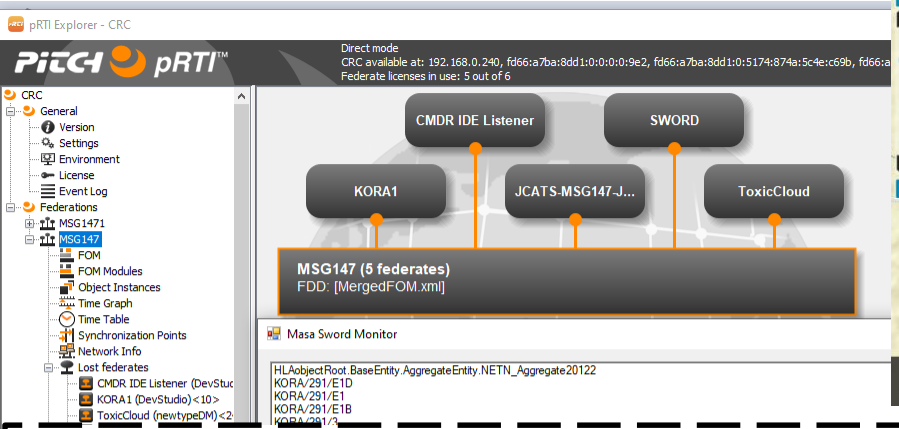
- LOE 1 20 – 24 March 2017 – CMDR CoE, Sofia Bulgaria
- LOE 1a 16 – 20 October 2017 – JFTC, Bydgoszcz, Poland
- LOE 2 15 – 19 October 2018 – CMDR CoE, Sofia BGR
- LOE 3 pre-test 07 – 11 October 2019 – JFTC, Bydgoszcz, Poland
- LOE 3 20 – 24 January 2020 – CMDR CoE, Sofia BGR

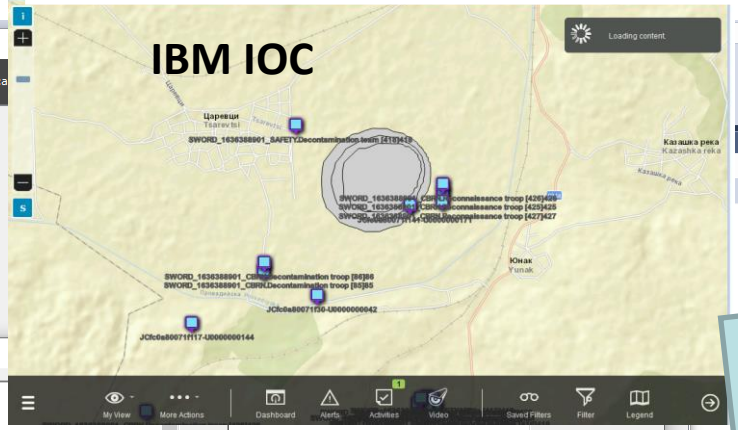
Scenario Terrain and ORBAT:	Bulgaria, CIV and MIL units in Coy size
Test Cases:	CBRN, Wildfire and Flooding
Simulation Systems:	JCATS, KORA, SWORD, CMDR IDE
C2 Systems:	IBM-IOC, IGeoSit, FIS H, SitaWare
Predictive Tools:	CBRN → HPAC, Flooding, Wildfire → CMDR IDE, KORA (exp only)
Architecture & **Test Cases**	Proof of concept


iGeoSit
NVG middleware
Technical Architecture (Flooding & Wildfire)
iGeoSit
FISH
IBM IOC
CBML (v1.0.1)
EXIS
CMDR IDE
xml
HLA
JCATS
KORA
SWORD
NATO
D-FOM
DEU
D-FOM
CMDR COE
D-FOM
PITCH RTI
Flooding Wildfire Models
D-FOM
DM as DM Proxy to D-FOM

Simulation systems in federation

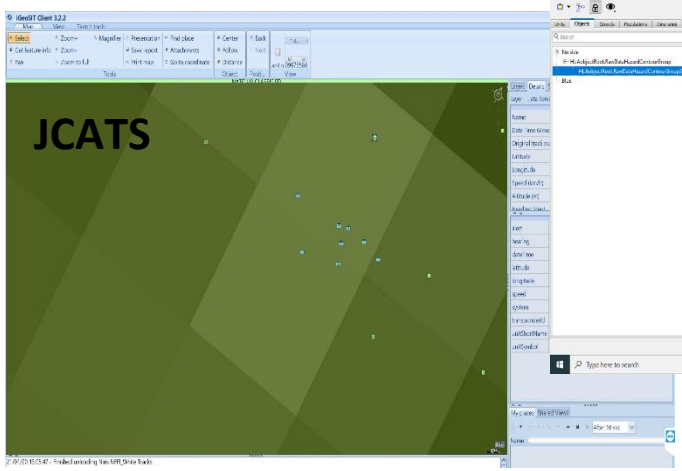
Units and plum transfer to C2 system

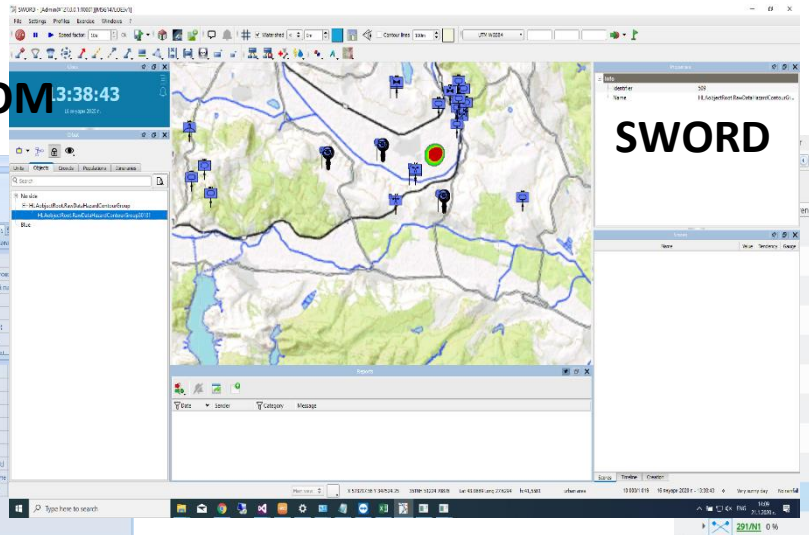


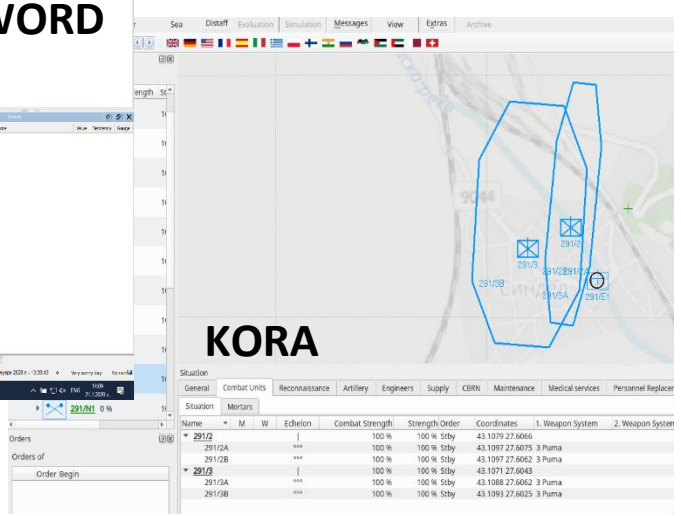


IDE (LISTENER)

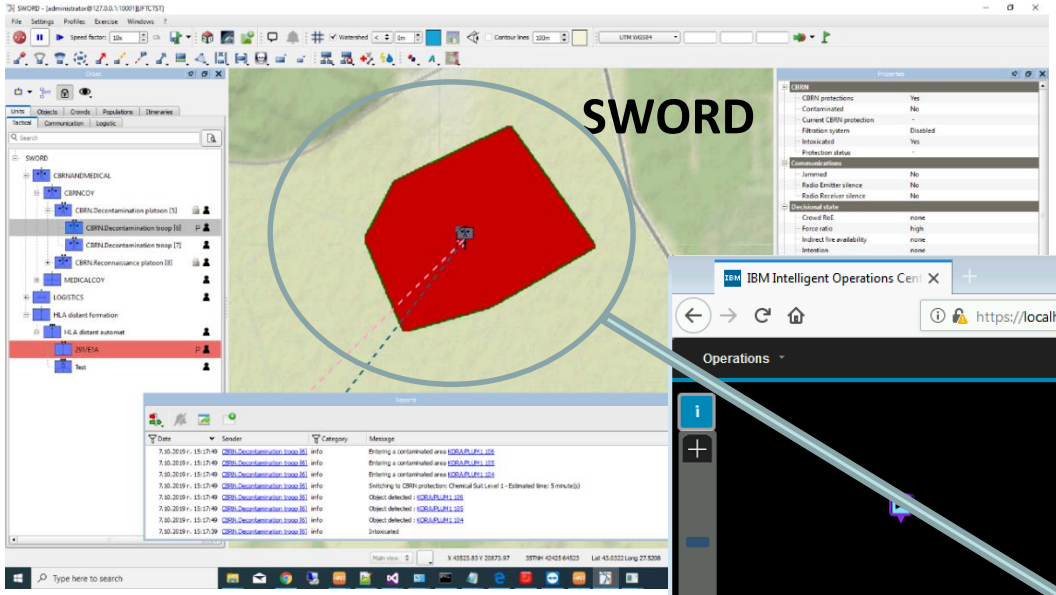
HLA FEDERATION
NETN FOM2 + DISASTER FOM

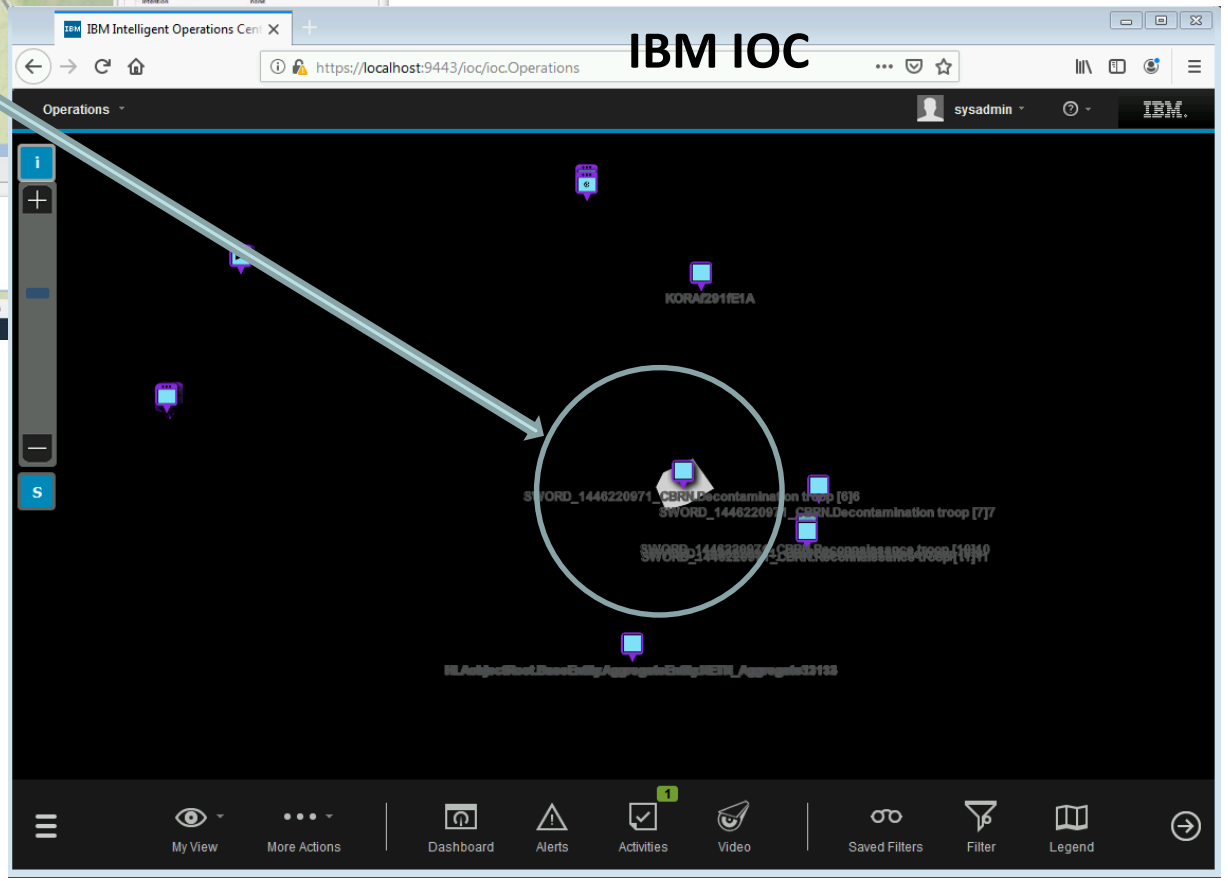






Pictures from the LOEs

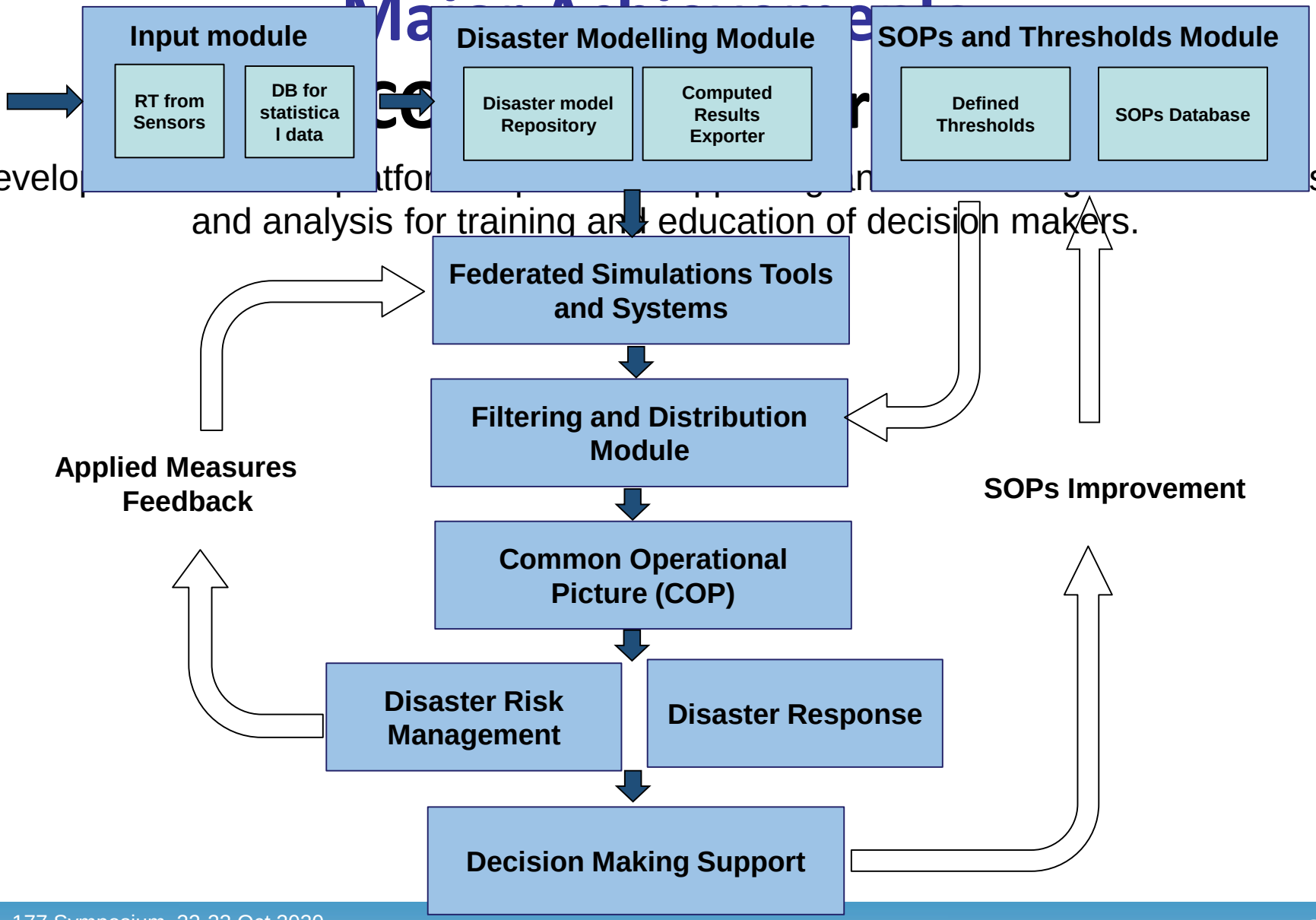


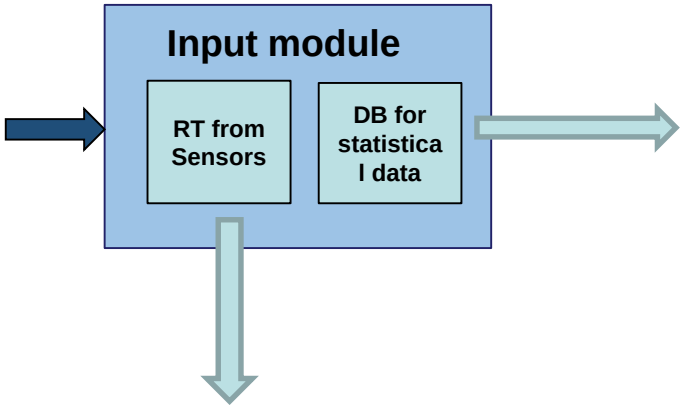


Units in the affected area (wildfire) in SWORD are visible in the affected area in IBM IOC.

Major Achievement

Develo… atfor… n… ses and analysis for training and education of decision makers.

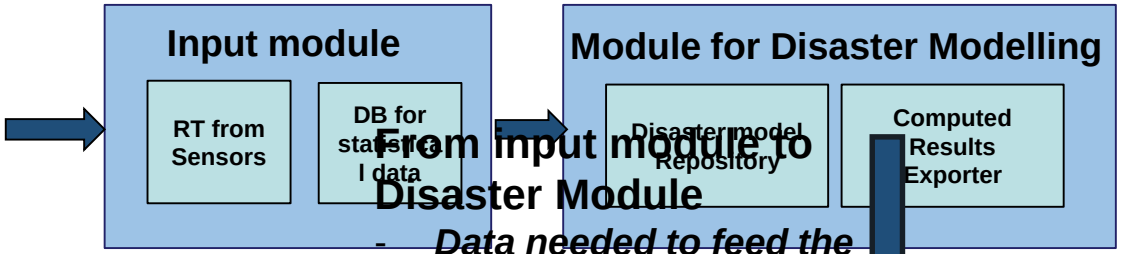




- **Open Sources** plus specific information

- **Automatic Sensors** – weather stations, river level, etc.

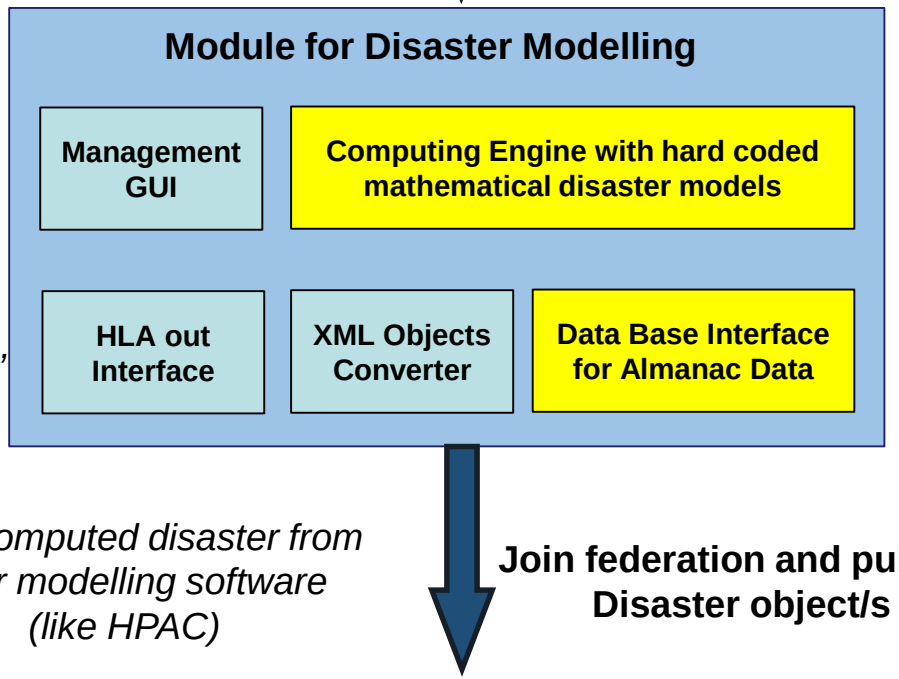
CMDR COE has agreements with organizations for access of such real-time data: MoI, BAS, Military Academy, Bulgarian Armed Forces, Insurance companies, etc



From input module to Disaster Module

- ***Data needed to feed the Mathematical model***

First developed module.
Used to generate precise and objective vivid HLA object, representing disaster.



The Operator choose the Model, set the parameters, refresh the rate, set the network

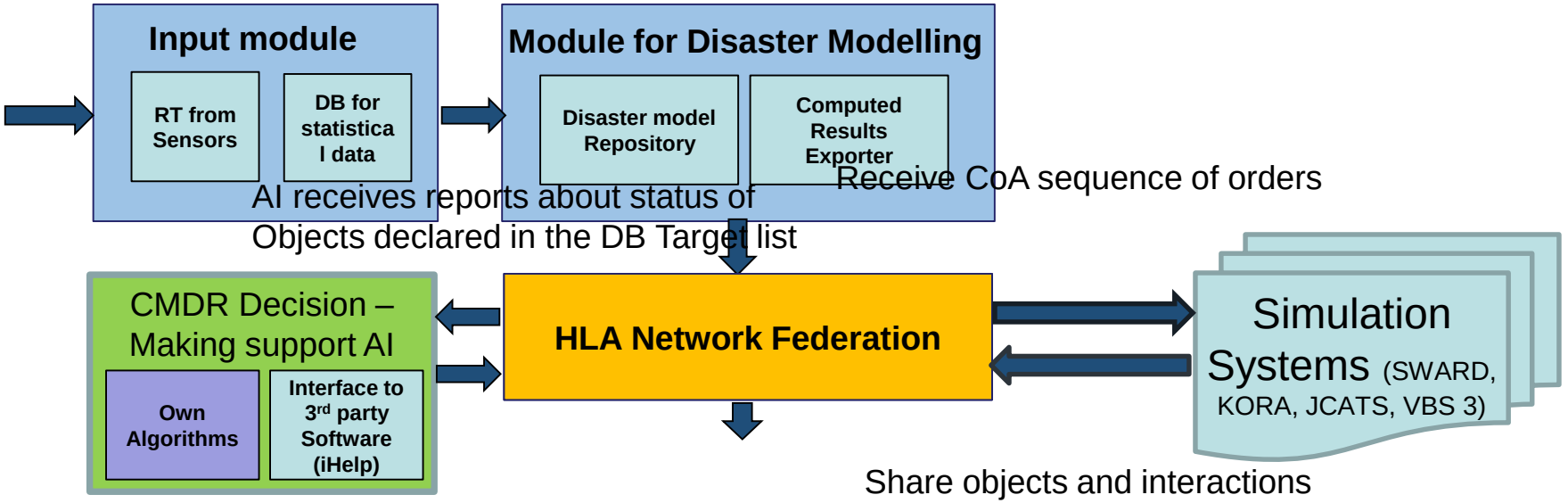
Wrap the computed disaster as HLA object, join federation, Publish the object

Embedded Mathematical models with open equations and coefficients

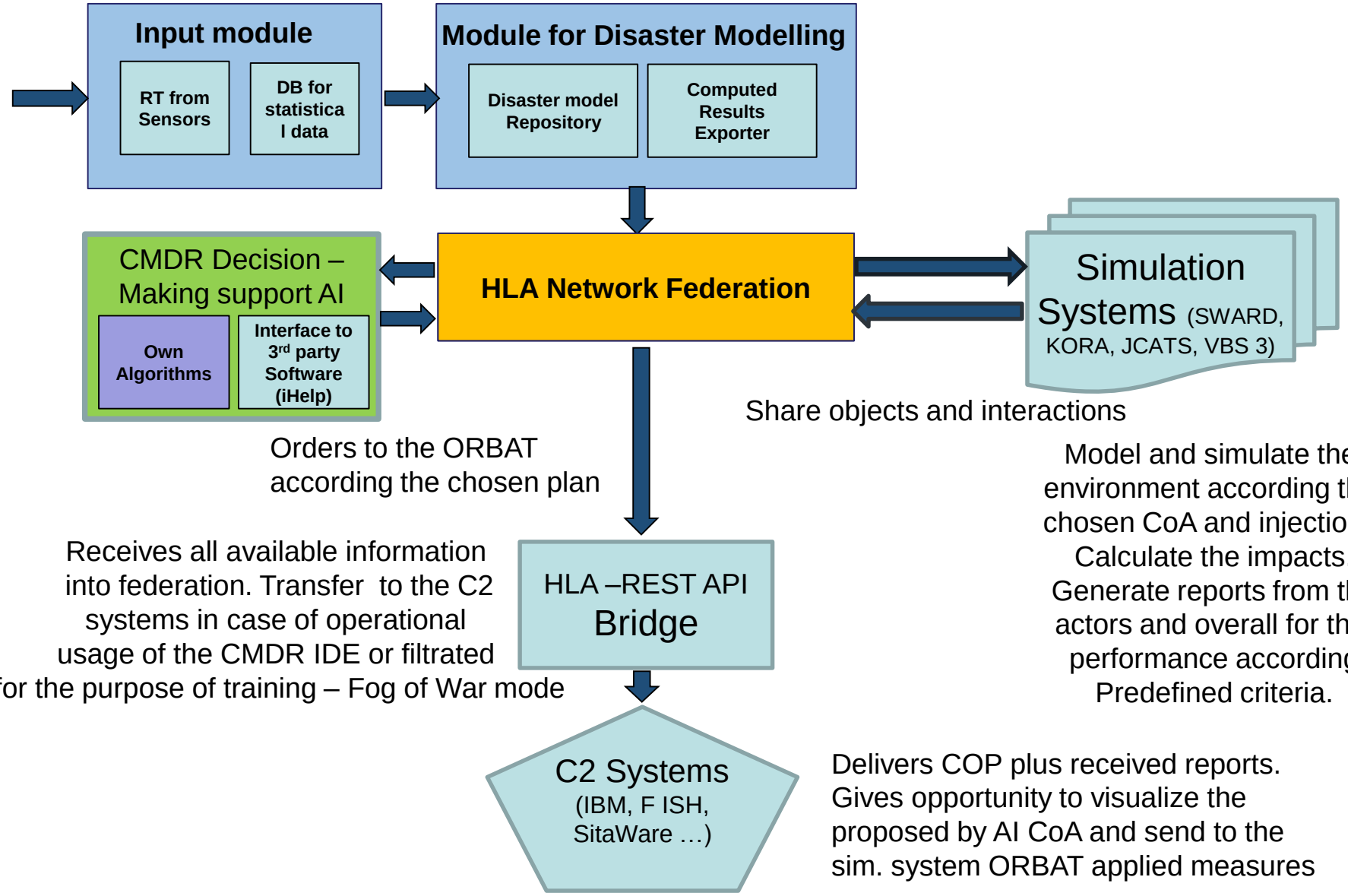
Mostly constants and physical values

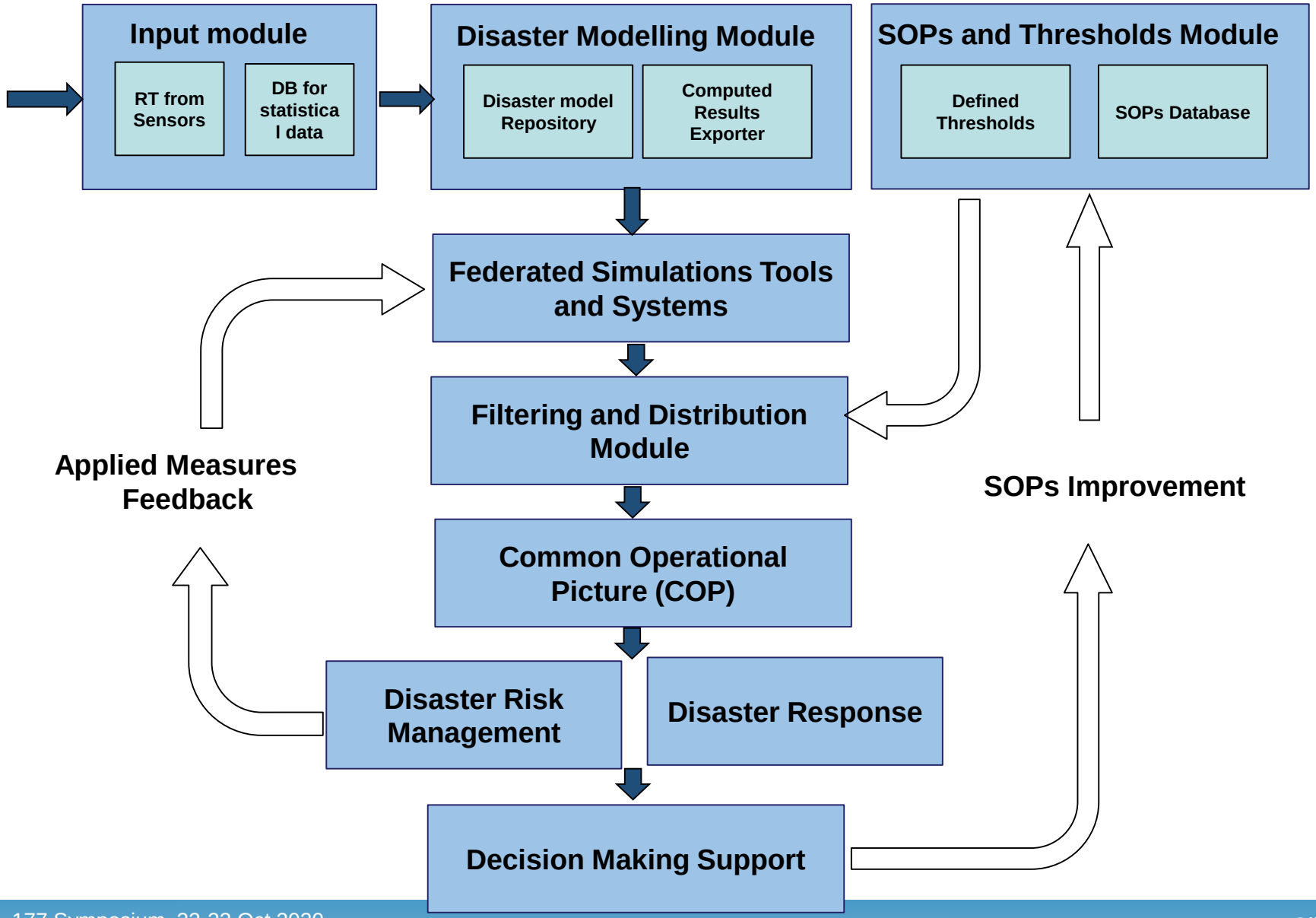
Gets computed disaster from other modelling software (like HPAC)

Join federation and publish Disaster object/s



Filtrates relevant response measures from the SOP DB according to the received data about impacted object from the Target List beyond the threshold. Sends proposal for CoA to the decision-maker. Receives confirmed measures and transfers them to orders.


Input module
RT from Sensors
DB for statistical data
Module for Disaster Modelling
Disaster model Repository
Computed Results Exporter
CMDR Decision – Making support AI
Own Algorithms
Interface to 3rd party Software (iHelp)
HLA Network Federation
Simulation Systems (SWARD, KORA, JCATS, VBS 3)
Share objects and interactions
Orders to the ORBAT according the chosen plan
Model and simulate the environment according the chosen CoA and injections. Calculate the impacts. Generate reports from the actors and overall for the performance according Predefined criteria.
Receives all available information into federation. Transfer to the C2 systems in case of operational usage of the CMDR IDE or filtrated for the purpose of training – Fog of War mode
HLA –REST API Bridge
C2 Systems (IBM, F ISH, SitaWare …)
Delivers COP plus received reports. Gives opportunity to visualize the proposed by AI CoA and send to the sim. system ORBAT applied measures

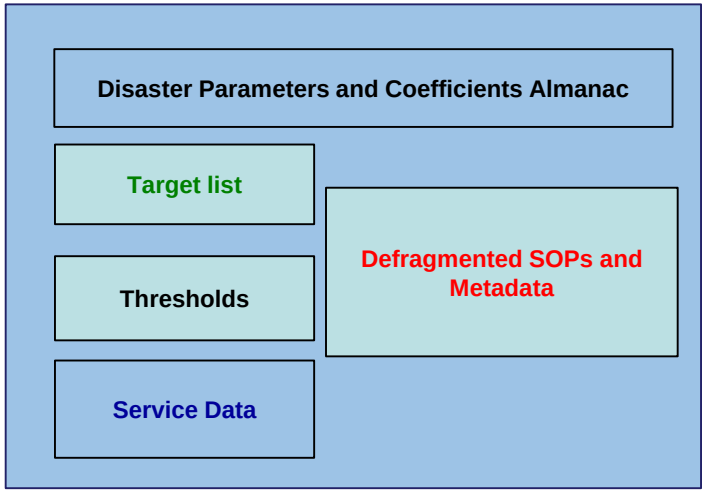

Input module
RT from Sensors
DB for statistical data
Disaster Modelling Module
Disaster model Repository
Computed Results Exporter
SOPs and Thresholds Module
Defined Thresholds
SOPs Database
Federated Simulations Tools and Systems
Filtering and Distribution Module
Applied Measures Feedback
SOPs Improvement
Common Operational Picture (COP)
Disaster Risk Management
Disaster Response
Decision Making Support

SOPs and Thresholds Module

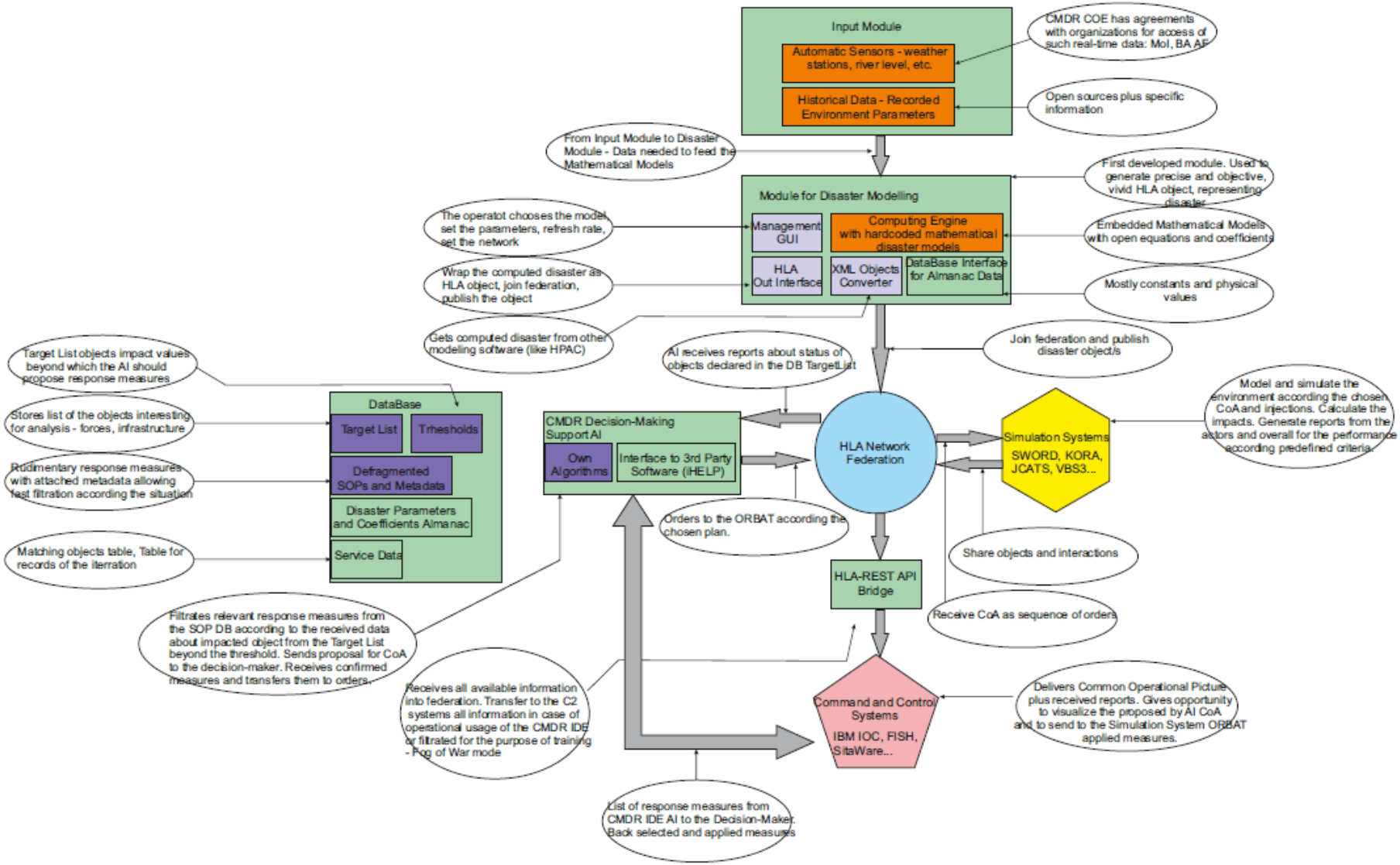
Stores list of the objects interesting for analysis - forces, infrastructure

Target List objects impact values beyond which the AI should propose response measures

Matching objects table, Table for records of the iteration



Rudimentary response measures with attached metadata allowing fast filtration according the situation

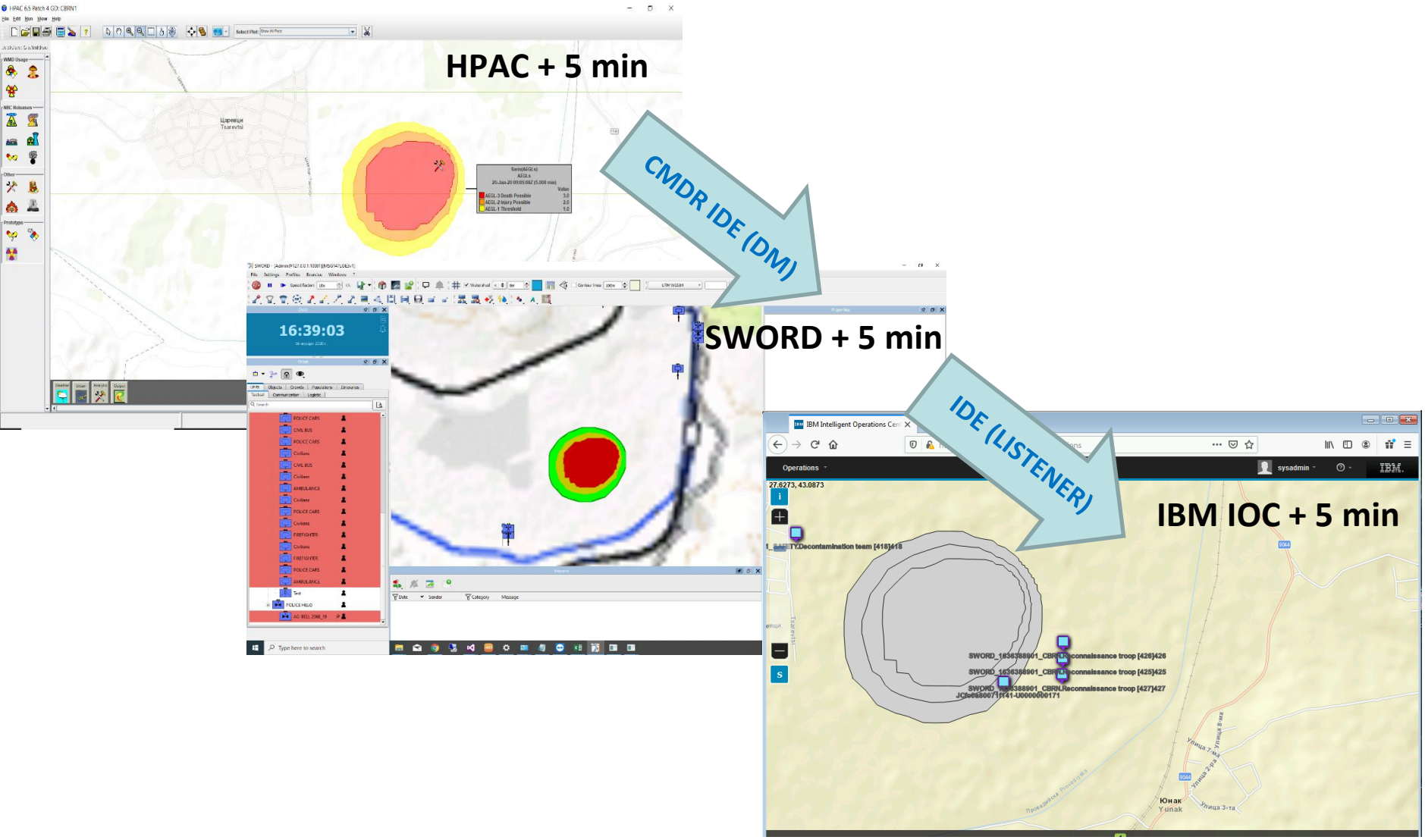

Input Module
Automatic Sensors - weather stations, river level, etc.
Historical Data - Recorded Environment Parameters
CMDR COE has agreements with organizations for access of such real-time data: MoI, BAAF
Open sources plus specific information
From Input Module to Disaster Module - Data needed to feed the Mathematical Models
Module for Disaster Modelling
Management GUI
Computing Engine with hardcoded mathematical disaster models
HLA Out Interface
XML Objects Converter
DataBase Interface for Almanac Data
First developed module. Used to generate precise and objective, vivid HLA object, representing disaster
Embedded Mathematical Models with open equations and coefficients
Mostly constants and physical values
The operator chooses the model, set the parameters, refresh rate, set the network
Wrap the computed disaster as HLA object, join federation, publish the object
Gets computed disaster from other modeling software (like HPAC)
Join federation and publish disaster object/s
AI receives reports about status of objects declared in the DB TargetList
Target List objects impact values beyond which the AI should propose response measures
DataBase
Target List
Trhesholds
Defragmented SOPs and Metadata
Disaster Parameters and Coefficients Almanac
Service Data
Stores list of the objects interesting for analysis - forces, infrastructure
Rudimentary response measures with attached metadata allowing fast filtration according the situation
Matching objects table, Table for records of the iterration
CMDR Decision-Making Support AI
Own Algorithms
Interface to 3rd Party Software (iHELP)
HLA Network Federation
Simulation Systems
SWORD, KORA, JCATS, VBS3...
Model and simulate the environment according the chosen CoA and injections. Calculate the impacts. Generate reports from the actors and overall for the performance according predefined criteria.
Orders to the ORBAT according the chosen plan.
Share objects and interactions
HLA-REST API Bridge
Receive CoA as sequence of orders
Filtrates relevant response measures from the SOP DB according to the received data about impacted object from the Target List beyond the threshold. Sends proposal for CoA to the decision-maker. Receives confirmed measures and transfers them to orders.
Receives all available information into federation. Transfer to the C2 systems all information in case of operational usage of the CMDR IDE or filtrated for the purpose of training - Fog of War mode
Command and Control Systems
IBM IOC, FISH, SitaWare...
Delivers Common Operational Picture plus received reports. Gives opportunity to visualize the proposed by AI CoA and to send to the Simulation System ORBAT applied measures.
List of response measures from CMDR IDE AI to the Decision-Maker. Back selected and applied measures

Major Achievements:

CMDR COE IDE

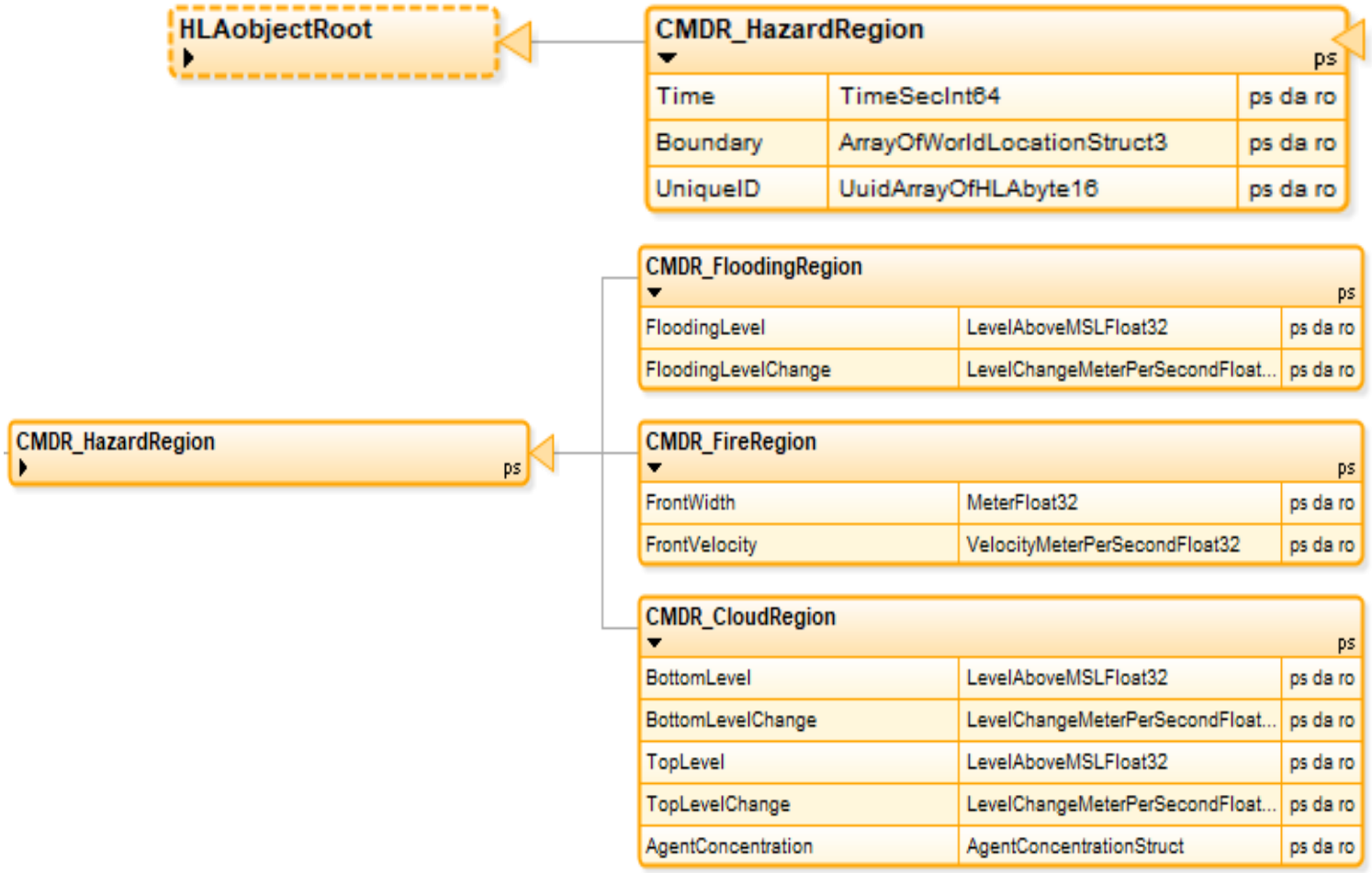
- Developed CMDR Integrated Distributed Environment (IDE) software including:
  - Disaster module for implementing results from disasters models,
  - HLA Listener transferring data to C2 system,
  - Flooding, CBRN and Wildfire models
  - HLA Commander – transferring orders back to the HLA federated simulation system (under development)

Plume transfer to IBM IOC



Major Achievements:

Flooding and Wildfire FOMs



FINAL STATUS

Major Achievements:

- Defined GAPs for the ACT M&S GAP Analysis report – disasters FOMs, Civ/Mil common COP for interactions
- Developed a technical platform capable of supporting and conducting CMDR exercises and analysis for training and education of decision makers.
- Developed Disaster FOMs:
  - Flooding
  - Wildfire
- Developed CMDR Integrated Distributed Environment (IDE) software including:
  - Disaster module for implementing results from disasters models,
  - HLA Listener transferring data to C2 system,
  - Flooding, CBRN and Wildfire models
  - HLA Commander – transferring orders back to the HLA federated simulation system (under development)
- Capabilities for NATO and National disasters training both for military and civilians.
- Initial Operational Capability for In-Theatre support, Reach Back and In-house analysis.
- Concept for CMDR COE (M&S Decision Making Support for CDMP and CCI) in accordance with NATO CD&E Methodology.
- 16 papers and presentations published and presented at various conferences

Outlook for further research and development

- Application of the technical platform in context of CAX, decision-making support and training
- Selection of SOP by artificial intelligence
- Extension of CMDR IDE interoperability to accommodate more models
- Extension of the disaster module in CMDR IDE to deal with further disaster types
- Extension of the established disaster database
- Enhancement of C2-Systems capability to deal with dynamic disaster information
- Support of decision making capability by the use of drones as sensors and computer vision technology to augment in crisis data collection and situational awareness
- Augmentation of training by VR-training scenarios and/or gamification
- Establishment of a resilience assessment model for potential affected areas → Simulate resilience level of affected areas → Consult decision-makers based on estimated resilience levels of affected areas to recommend different courses of action during disasters
- Development of HLA Commander, transferring orders back to the HLA federated simulation system. The IABG not only developed FOM which standardized the transfer of information about disaster objects but also to handle and depict the disaster management (disaster related orders and reports).
- Development of a concept for CMDR COE (Disaster and Climate Change Implications on military activities) in accordance with NATO CD&E Methodology.

NATO OTAN

NORTH ATLANTIC TREATY ORGANIZATION
SCIENCE AND TECHNOLOGY ORGANIZATION

S&T organization

CRISIS MANAGEMENT AND DISASTER RESPONSE CENTRE OF EXCELLENCE

NMSG-147 Conducting Limited Object Experiment 3
20-24 January 2020, Sofia