FFI Forsvarets forskningsinstitutt

Overview of EDA projects MODITIC and CENSIT

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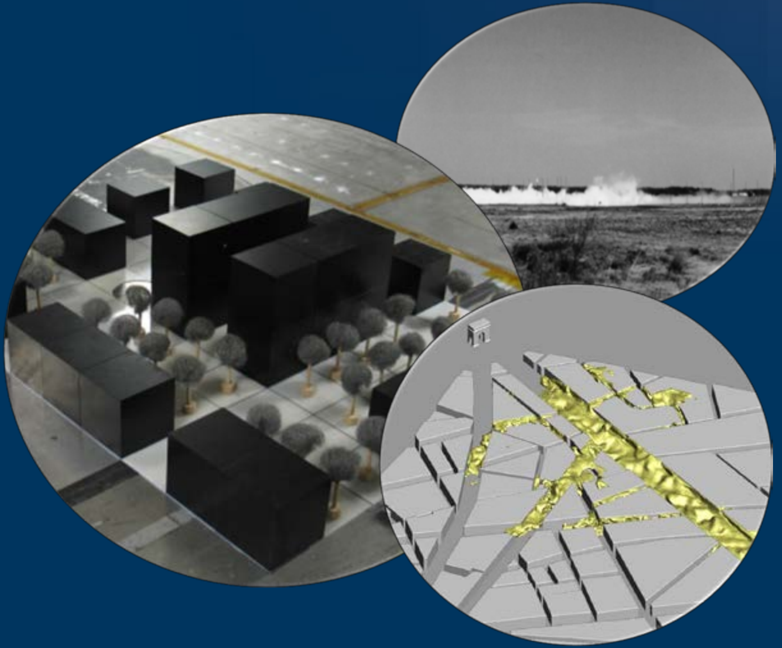
Norwegian Defence Research Establishment (FFI)

- Established 1946
- Major defence R&D organisation in Norway
  - Serving all Ministries and governmental bodies, as well as other Norwegian and European stakeholders
- Six divisions
- **Protection and Societal Protection Division** includes i.a.:
  - CBRN threat and consequence assessments
  - Preventive, protective and recovery measures
  - Flow physics
- **Air and Space Systems Division** includes i.a.:
  - Satellites and space
  - Multi- and hyperspectral imaging
  - IR detector technology

MODITIC - MOdelling the DIspersion of Toxic Industrial Chemicals in urban environments



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Norwegian Defence Research Establishment
FOI
DGA
INERIS
UNIVERSITY OF SURREY

MODITIC

MOdelling the **DI**spersion of **T**oxic **I**ndustrial **C**hemicals in Urban Environments

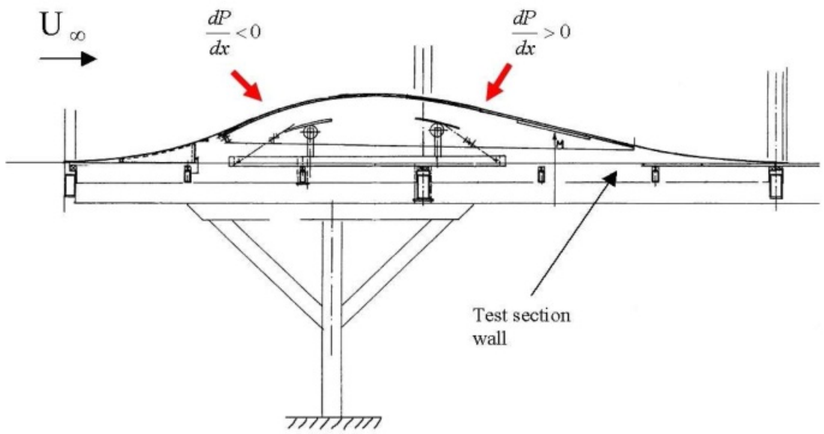
- European Defence Agency (EDA) category B project
- Lead by FFI
- Contributing member states (cMS):
  - Norway (FFI),
  - Sweden (FOI),
  - France (DGA NRBC Maitrise and INERIS)
- Subcontractor FFI: University of Surrey, UK
- Duration: 01.09.2012 – 01.03.2016

Objectives and project content

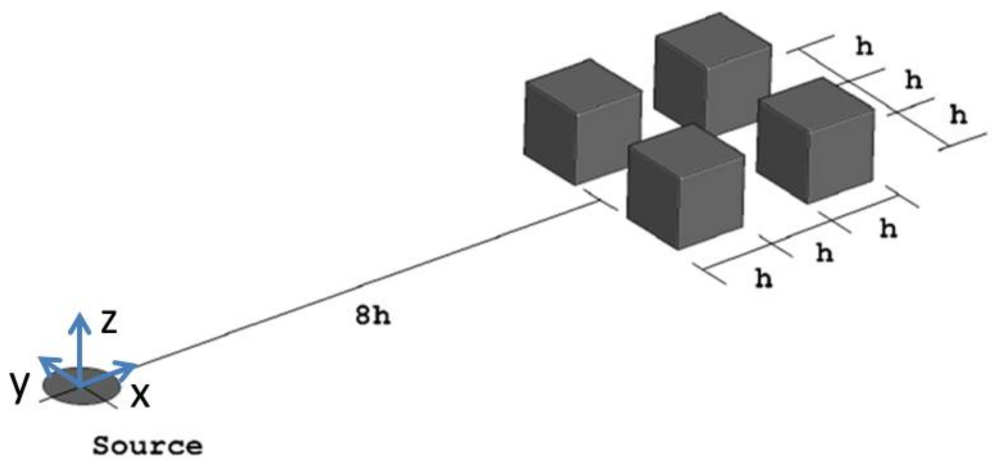
- Systematically study the release and transport of neutral and non-neutral chemicals in complex urban environments
- Enhance our understanding of the dominating physical processes involved
- Support improvements in modelling techniques

- Wind tunnel experiments
- Numerical simulations
- Field and source term experiments and computations
- Linear inverse modelling
- High-quality database

Geometries and release scenarios of increasing complexity

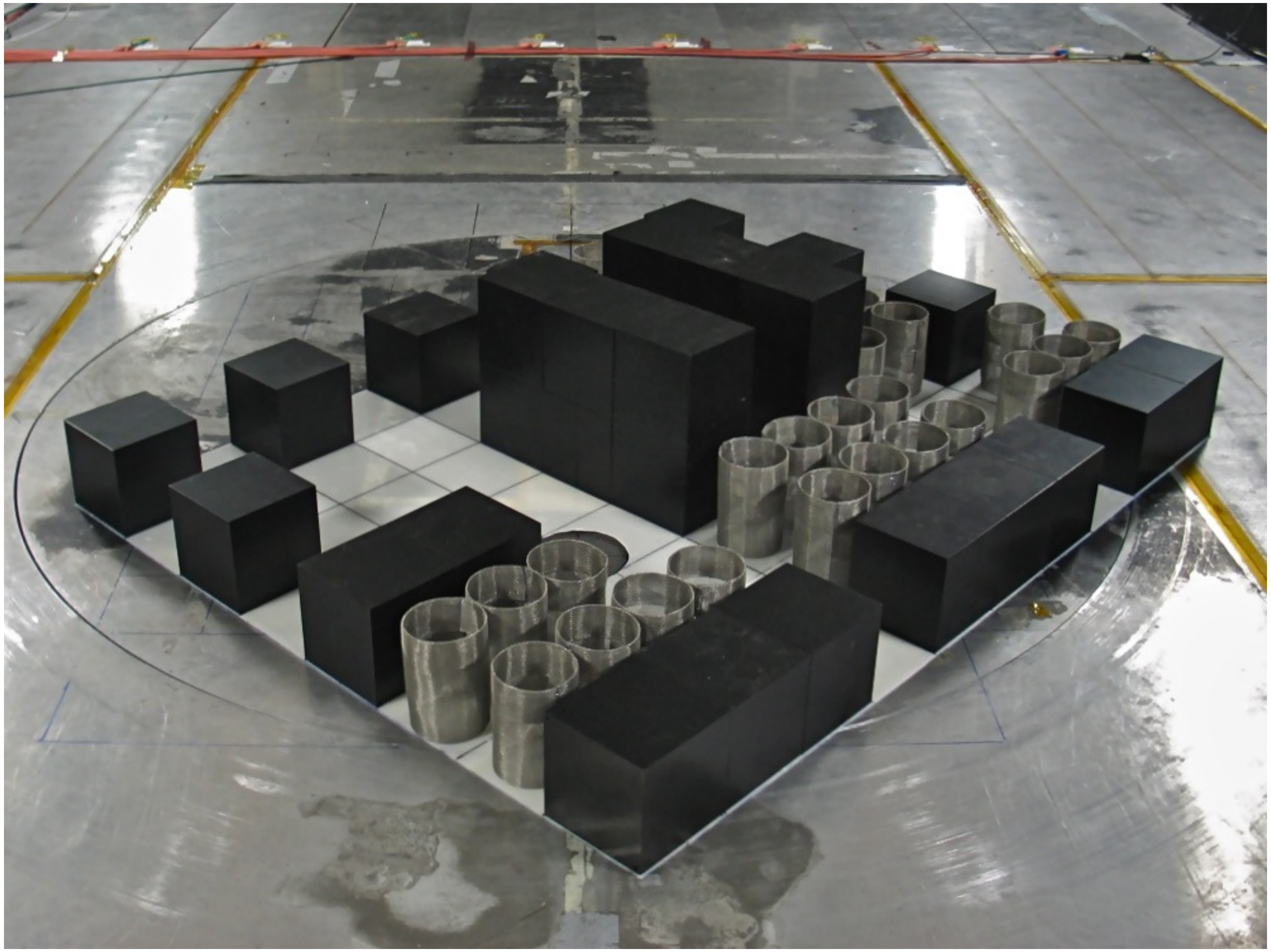


Flat surface
Two-dimensional hill
Two-dimensional back-step



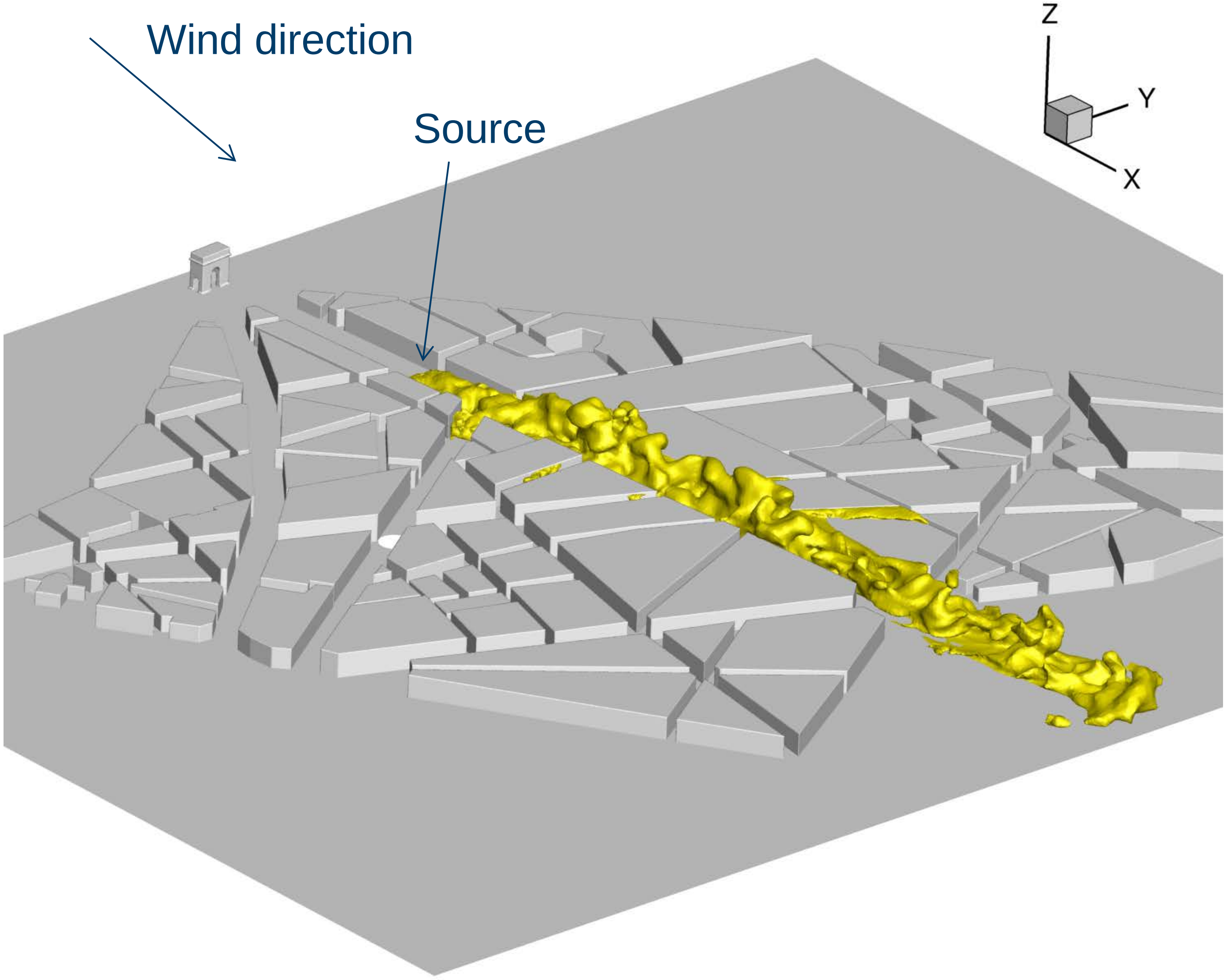
Simple array of obstacles

Complex array of obstacles

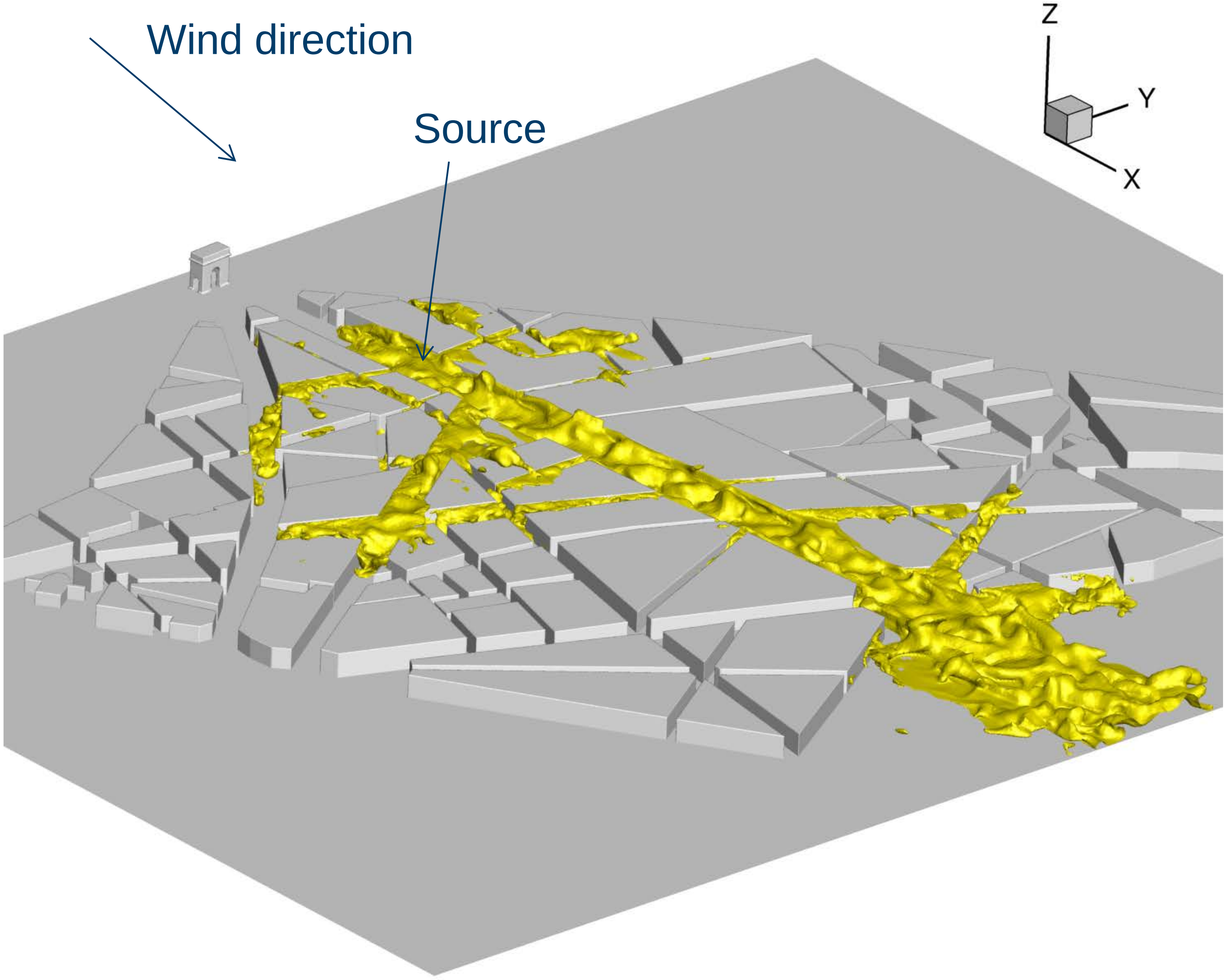


An urban area – central Paris

Paris, neutral gas release



Paris, dense gas release



Main results and conclusions (1)

- Large database
  - Experimental results for release and dispersion of neutral and dense gasses in complex geometries
  - Quality assurance is ongoing (feedback between experimentalist and modellers)
  - Subsequently it will be made available
- Operational models
  - Models are usually conservative and overestimate the concentration levels close to the source
  - Of the models tested, just one of the models was able to handle both obstacles and dense gas dispersion
- RANS simulations
  - Models used can capture the turbulent transport of neutral releases
  - Buoyant effects are only partially captured

Main results and conclusions (2)

- LES simulations
  - The LES methodology used is suitable to predict both dense and neutrally buoyant releases of gas within an urban environment
  - Care should be taken concerning the inflow conditions with regard to the spatial and temporal resolution of the incoming boundary layer
  - Care should be taken to resolve the source details
- Inverse dispersion modelling
  - Inverse methods work acceptably well in the urban setting with neutral releases
  - A greater challenge is the treatment of dense gas emissions

- MODITIC website: **www.ffi.no/moditic**
  - Reports and papers

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Fusion of CBRN sENSor Information in Tactical networks - CENSIT

Fusion of CBRN sENSor Information in Tactical networks - CENSIT

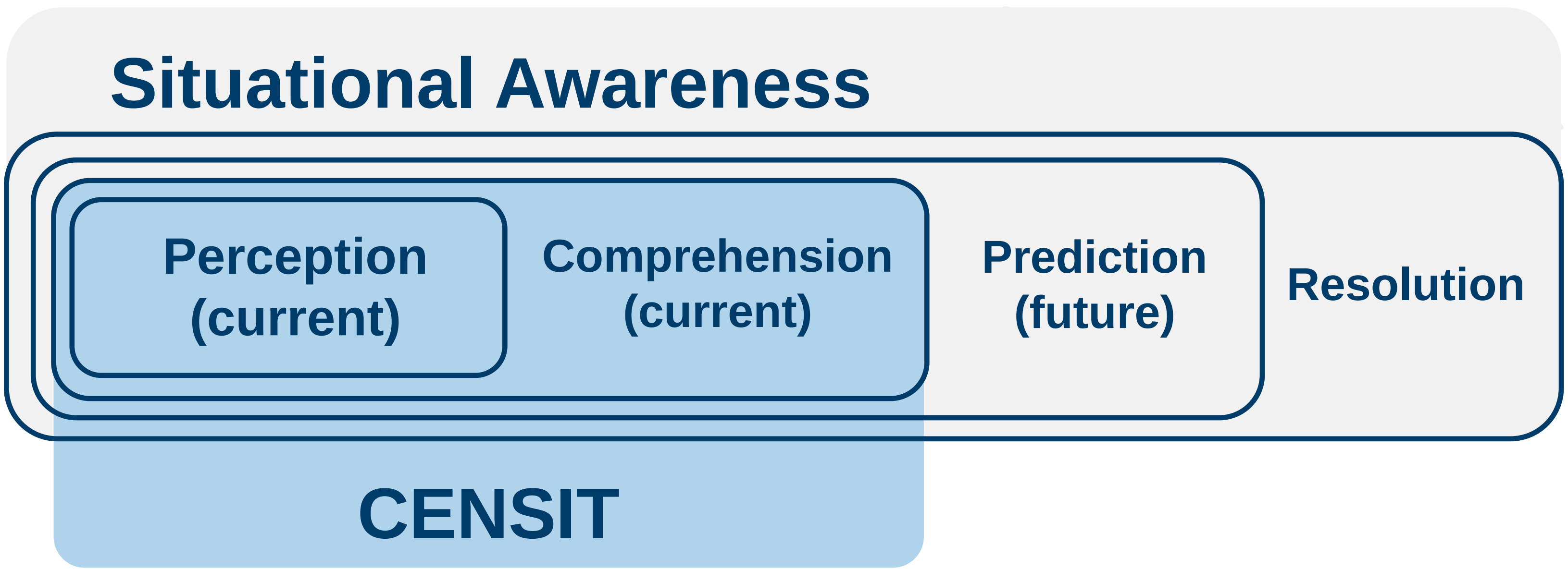
- Joint Investment Programme (JIP) CBRN protection
- Start: March 2015
- Duration: 30 months
- Finish: December 2017 (Extended with 3 months)
- Partners
  - FFI: Norwegian Defence Research Establishment (lead)
  - TNO: The Netherlands Organisation for Applied Scientific Research
  - ITTI Sp. z.o.o.: Poland (SME)
  - TMS: Technical Mathematische Studiengesellschaft, Germany (SME)

Background for CENSIT Project

- Early detection, warning, and reporting after a CBRN incident is paramount in order to safeguard the life and health of the personnel and to sustain operational capability
- This requires building robust situational awareness in near real-time
- It is generally believed that a robustly networked force improves information sharing, giving enhanced situational awareness. This, in turn, enhances sustainability and speed of command (net-centric warfare)
- Today's warning system for CBRN incidents is often based on voice messages. Lessons identified from exercises show that this often leads to poor situational awareness

Aim of CENSIT

Develop a conceptual network of sensors that improves the commander's situational awareness both in the threat phase and in the response phase of a CBRN incident



***Target goal: Earlier** and more **accurate** detection, warning, and reporting through **fusion** of CBRN sensor information in tactical networks*

CENSIT
Fusion of CBRN sENSor Information in Tactical networks

Acquiring Perception

The best decisions are made with the best and most accurate data

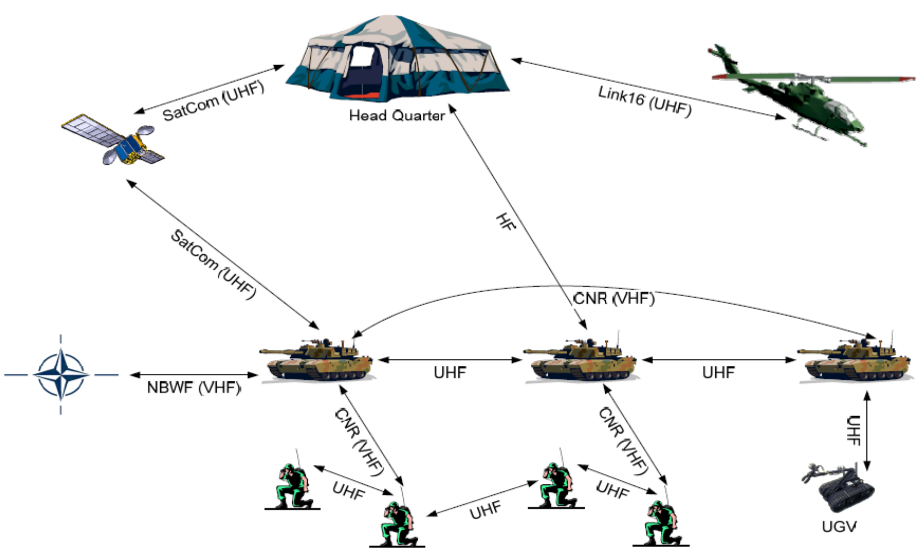
Data acquisition:

- What data do we need?
- How do we obtain the data?
- How do we know that we have all the available data?
- How do we know that the data are correct?
- How much data do we need?

Sensor information

Obtaining Comprehension

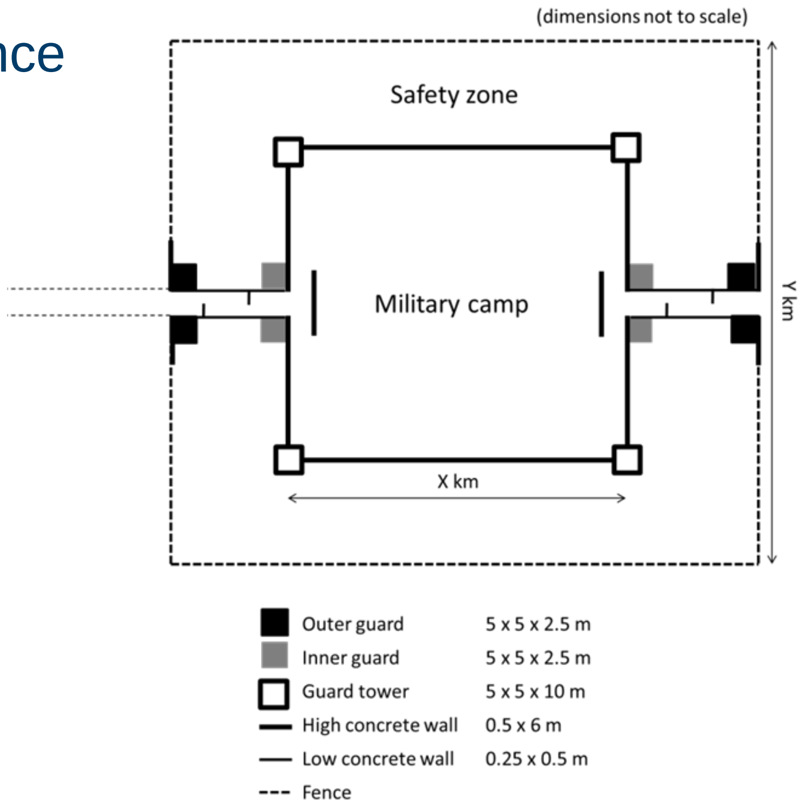
- Integration of sensors in C2IS environments allows for obtaining a huge repository of data and information about the environment
- Providing as much data and information as possible is not necessarily an adequate way to support the decision-maker
- Most of the data can, however, be seen as distracters and noise
- Sensors may give a large number of false positives
- It is hypothesized that **fusion** of CBRN sensor information will lead to **earlier** and more **accurate** detection, warning, and reporting



CENSIT Fusion of CBRN sENSor Information in Tactical networks

Concept for Deployment

- State-of-the-art strategies for sensor deployment around a military camp have been depicted and compared
- A genetic algorithm approach gives the best balance between performance and computational cost
- A software tool for optimizing the deployment of sensors has been developed in Censit



Concept for Sensor Data Fusion

- A Sensor & Background Model has been constructed
  - Sensor Response Model for selected sensors & agents
  - Sensor Response Distribution including „background only“ for defined scenarios
  - Time series of sensor response

- Clutter-learning
  - Deployed sensors could monitor clutter when no threat agent is present and use this to learn the clutter characteristics
  - This is used to reduce the false alarm rate



Situational Awareness

- This work-package is still ongoing.
- It is hypothesized that **fusion** of CBRN sensor information will lead to better situational awareness
- The added value of networked sensors compared to stand-alone sensors will be demonstrated.
- The situational awareness could also be enhanced by clutter learning when no threat agent is present
- The challenge is the small number of sensors that will be affected by a chemical release
- Space-based sensors might be used to complement point-sensors on the ground

Overview

Overall objectives:

- Explore what improved operational performance is possible to achieve by fusion of sensor information in tactical networks in order to enhance the CBRN situational awareness
- Explore how networks of sensors can be constructed by development of concepts for sensor data fusion and development of concepts for deployment of sensors

Outcome:

- Demonstration of a prototype system of a simulated network of sensors at the desktop level
- The added value will be evaluated and compared to a system of equal, but not-networked sensors