Reachback:
A Crucial Cross-cutting Element of Nuclear Security Detection Architecture

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European Reference Network for Critical Infrastructure Protection (ERNCIP)

Thematic Group on
Radiological and Nuclear Threats to Critical Infrastructure

Solutions are needed to detect nuclear threats to critical infrastructure and to mitigate consequences

Topics being analysed by this network of experts are:

1) List-mode data acquisition based on digital electronics
2) Robotics - radiation detection with unmanned systems
3) Reachback - expert support to field teams.

https://erncip-project.jrc.ec.europa.eu/

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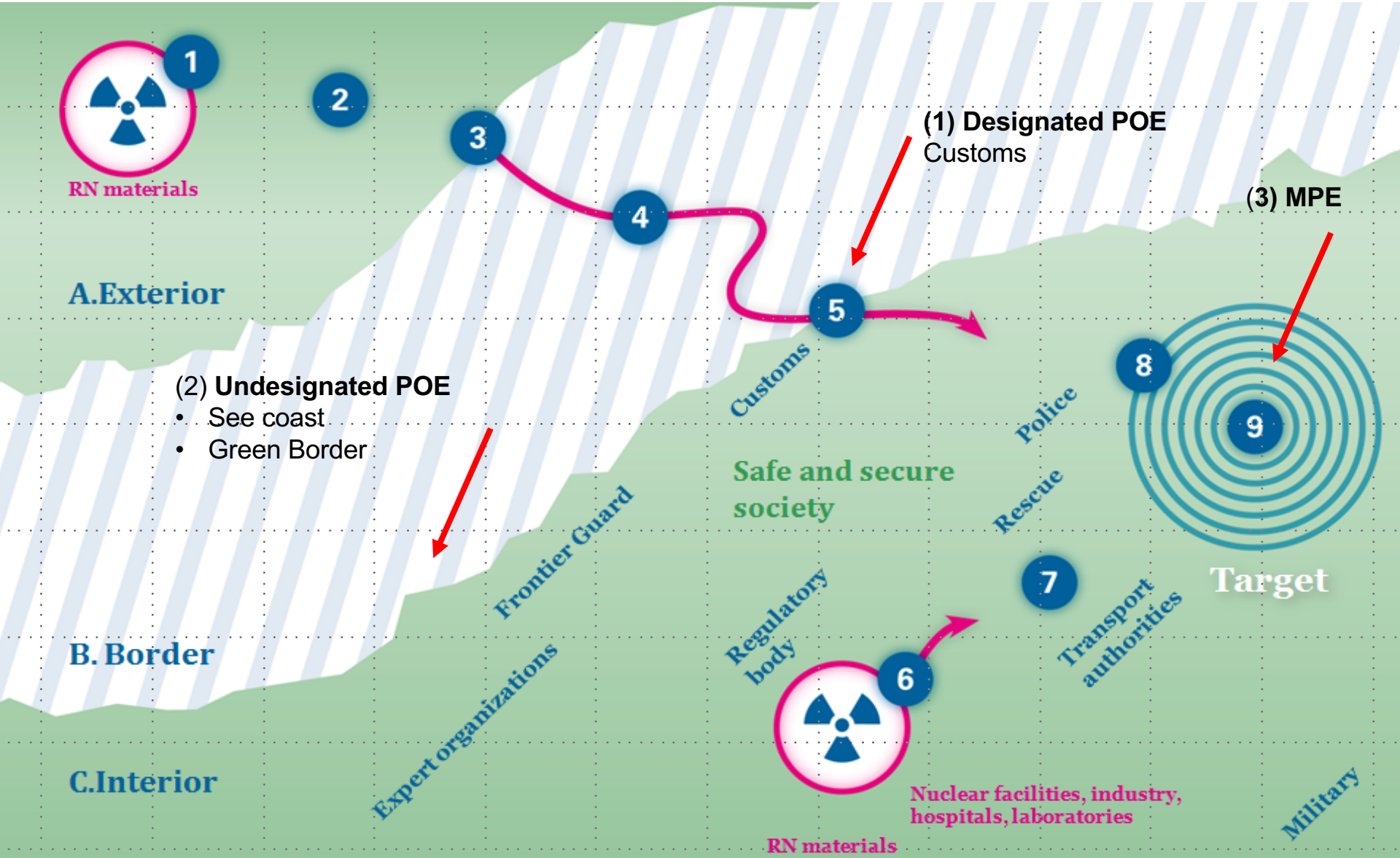
Nuclear Security Activities

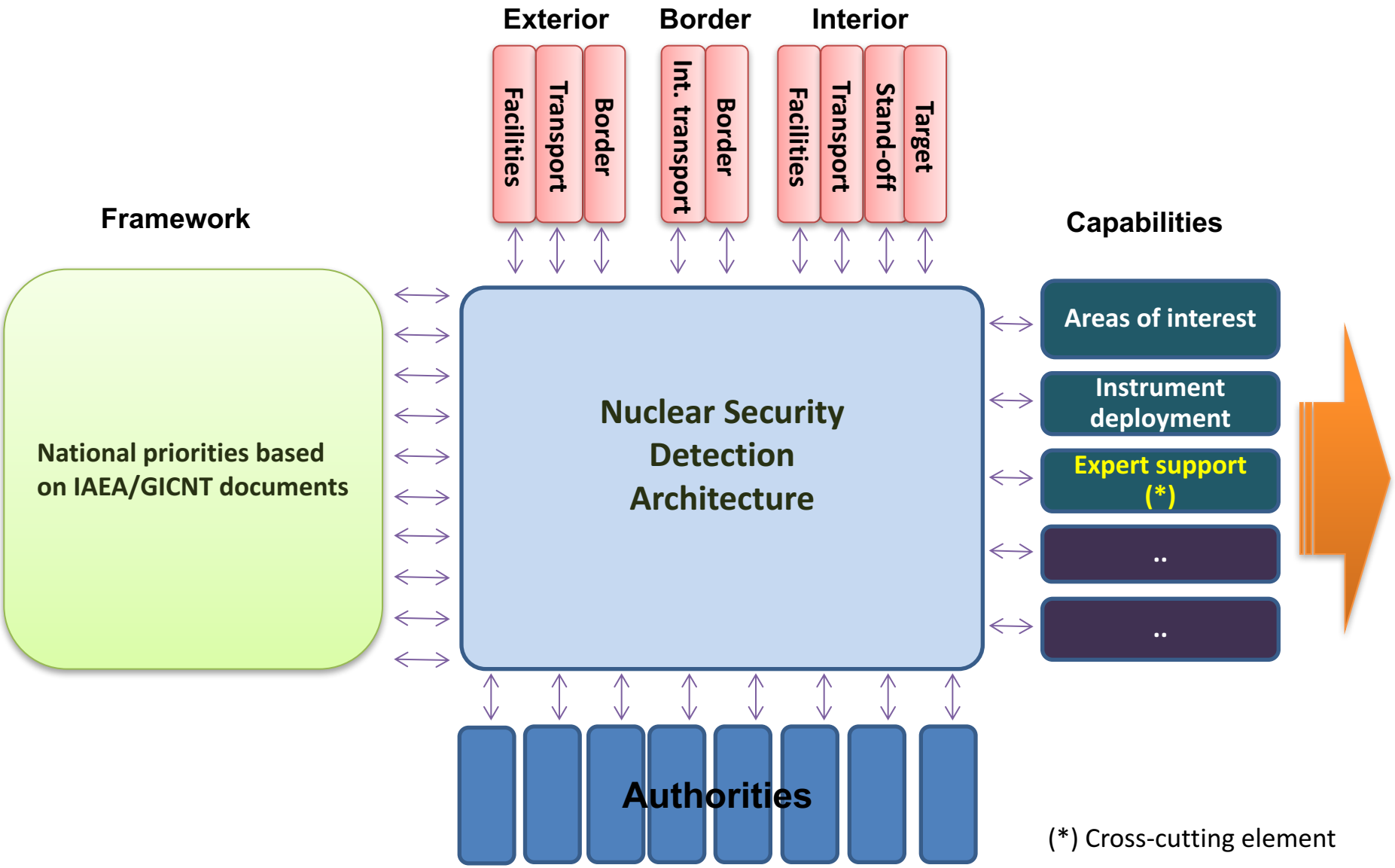
- Detection architecture includes:
  - Threat assessment
  - Detection
  - Assessment of the alarms and alerts

Nuclear experts have a crucial role on many areas of nuclear security, such as planning of the architecture, and detection and analysis measures.

Geographic Layers of NSDA
Global View to Pathways



Detection of MORC
Material Out of Regulatory Control



(*) Cross-cutting element

Expert Support

- Expert support is a process that brings remote resources to the field teams (law enforcement, customs, ..)
- The support is of vital importance for the assessment of the in-field measurements and adjudication of alarms.
- A well-designed programme of expert support separates the measurement and analysis processes.

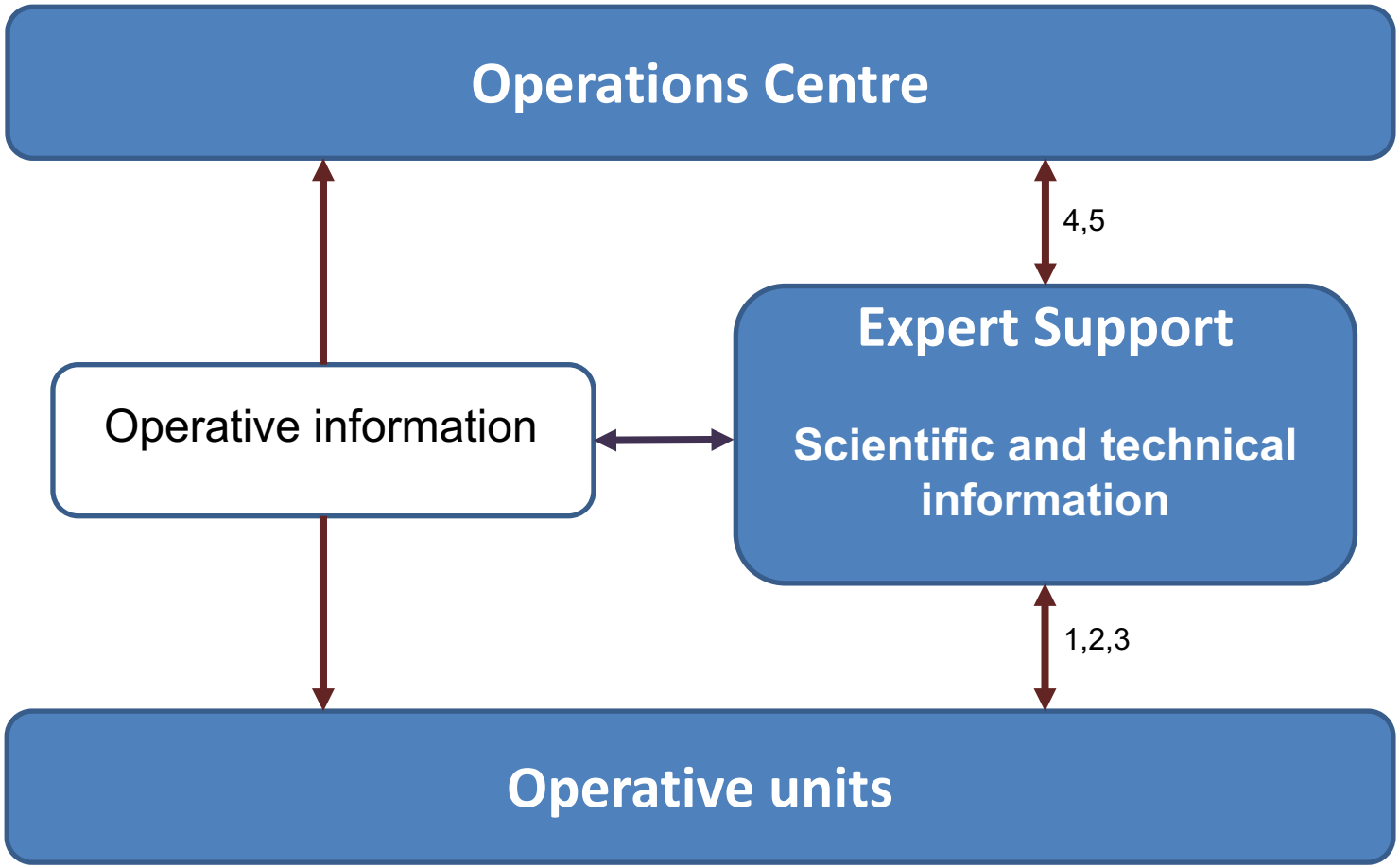
Expert support can be provided by

1. Specialist team arriving to the site
2. Remotely (information sharing, analysis, advice)

Reachback = Expert Support

- In a radiological emergency, **data analysis** plays a key role in providing a factual basis for deciding on the counter measures.
- Reachback technology must be knowledge-driven: i.e. must produce knowledge and wisdom ("**what to do next**") for the operative units, rather than data and unverified analysis results.
- A State may allocate this task to an agency, such as the Radiation Safety Authority. The operational unit is called as **Reachback Centre**.

Command and Control (CC)



Expert Support
Different Reachback Services

Level	Organization	Functionality - Role
A Assessment	**Subject Matter Experts (SME)**	POC - Point of Contact Call Centre Advice to Law Enforcement
AA Alarm Adjudication	**Expert Support Centre** (Reachback Centre)	*As above* **Technical Support** • Detection systems: implement, maintain, sustain, QC • Training, exercises • Mobile teams with basic capability **Scientific Support** Analysis support on request Alarm assessment and support to adjudication
AAA Advanced Alarm Adjudication	**Advanced Expert Support Centre** (Advanced Reachback Centre)	*As above* **Operational Support** • Integrated to operative units • CBRNE teams, Render safe, Crime scene management,.. **Advanced Technical and Scientific Support** • Operation of large real-time detection networks • Advanced analysis support 24/7 • Material characterization • Alarm adjudication

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Role of Information in the Detection Architecture

Technical and non-technical information
is generated from many sources:

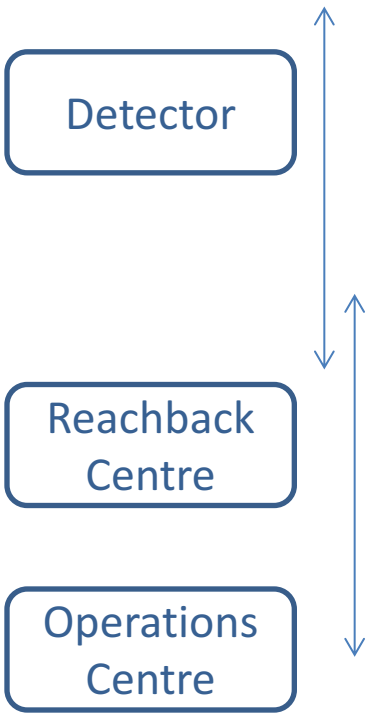
- Identification of suspicious activities
- Detection, identification and localization (MORC)
- Characterization of material
- Evaluation of effectiveness of the detection systems
- Production of situational awareness

Types of Information

Threat and Alarm or Alert Information	Configuration Information	Status Information
Potential or actual nuclear security event Requires timely delivery to users	**Setup and organization of detection assets** Assists operation managers and technical support	**State of health** Enables a rapid and effective response

Type of information varies and different competent authorities have different needs.

Categorization of Terms for RN Measurements and Related Information Products

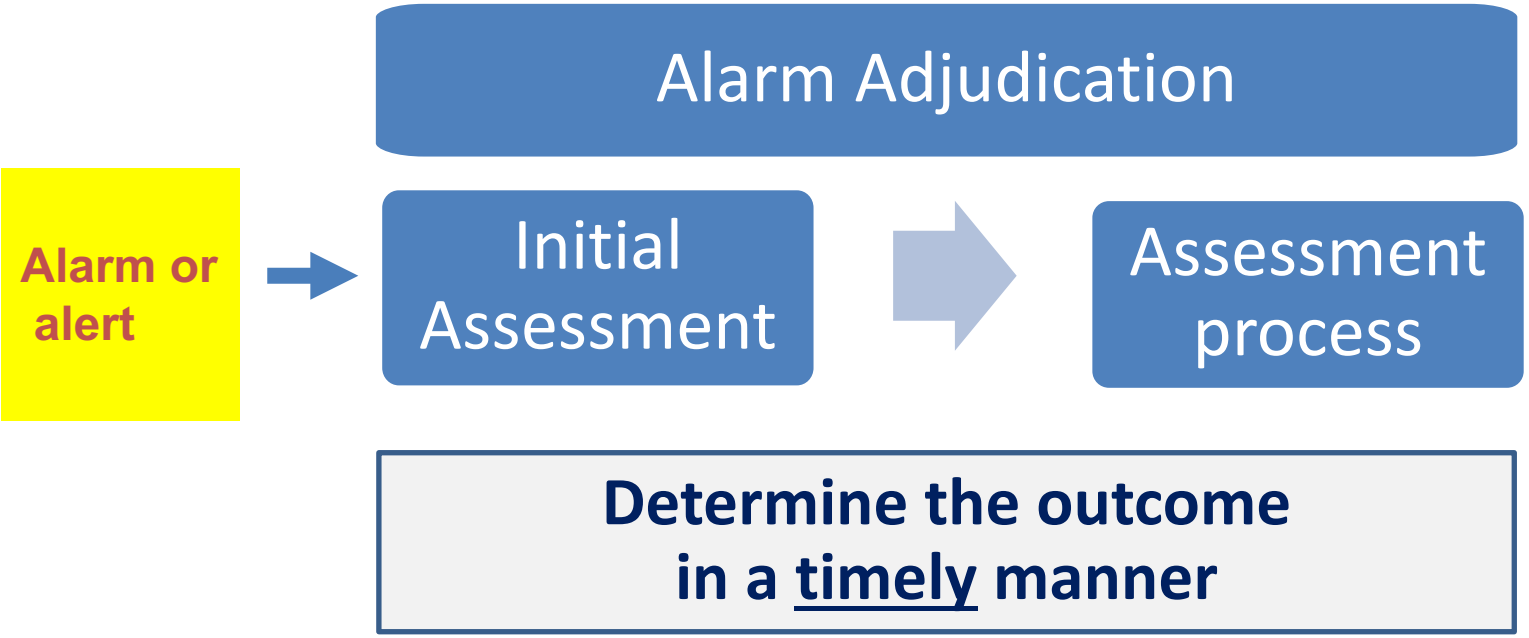


1	**Raw data**	Time-stamped events detected by instruments
2	**Data**	Spectra generated from raw data at certain intervals
3	**Information**	Messages in compact format (metadata, data, raw data, initial analysis results)
4	**Knowledge**	Verified information consisting of nuclide identification, activity estimation, …
5	**Wisdom**	Appropriate decision-making based on the attained knowledge. A message which is useful for the frontline officers to interdict.

Alarm Adjudication

Cooperation between Competent Authorities

Procedures and protocols must be in place for a prompt determination of potential threat



Competent Authorities for Prevention, Detection, and Response

Information sharing challenge

How a competent authority knows what is relevant information for another organization?

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Law Enforcement Needs for Expert Services

Cooperation between Competent Authorities

1. Experts support 24/7 field operations (planning, analysis, advice, safety,…)

2. Experts give operational support to Command and Control in a Nuclear Security Event (NSE) or potential NSE

3. Experts are part of the field operations (advanced measurements, advice, safety,..)

4. Regulatory body is the primary operator; law enforcement supports (render safe, transport,..)

Operations Centre

- Has the leadership in response actions
- Maintains situational awareness
- Contributes to the adjudication of alarms and alerts
- Directs resources and assets in response to alarms and alerts
- Facilitates coordination and communication among local, national, and international entities

Nuclear Experts for Security

RN scientists or inspectors have relevant expertise on

- Nuclear and other radioactive materials
- Implementation of detection systems
- Laboratory measurements and analyses
- Analysis of data from detection instruments
- Reachback resources
- Scenarios, consequences (risk-informed approach)

Where the subject matter experts come from

- Nuclear Regulatory Authority
- National Laboratories
- Academic Organizations
- Technical Support Organizations
- Industry

Tasks for Expert Support

Operational

Advice to law enforcement
Advanced measurements
Initiation of response protocol (together with CC)
Threat object neutralization - render safe, source recovery
Safety assessment – consequence analysis

Scientific

Analysis of measurement data
Alarm adjudication - nuclear security event?
Material characterisation - nuclear forensics

Technical

Instrument deployment
Quality control of data
State-of-health of detection systems
Network management
Education
Training and exercises

Tasks for RN Field Operations

Item	Challenges
Detection	**Spectrum acquisition** • optimum time frame
Identification	**False/Innocent/True Alarm** • Automated • Interactive
Localization	**Human knowledge** • Choke point monitoring • Search operations
Source characterisation • Activity • Shield properties	**Scientific expertise** • Difficult in unknown geometry • Not performed by FLO
Risk estimation • Threat reduction • Mitigation, resilience	**Safety and Security** • Simple safety rules • Countermeasures?

Tasks for RN field measurements

Item	Way forward
Detection	**List-mode; Robotics; Reachback** • CBRNE Sensor arrays • Time frame is an analysis issue
Identification	**Analysis improvements** • Embedded in local system • Cloud services (reachback)
Localization	**Novel technologies** • Operative use very soon • Different technologies
Source characterisation • Activity • Shield properties	**Novel analysis methods** • Possible when source localization issue is solved
Risk estimation • Threat reduction • Mitigation, resilience	**Well-justified response** • Source characteristics available

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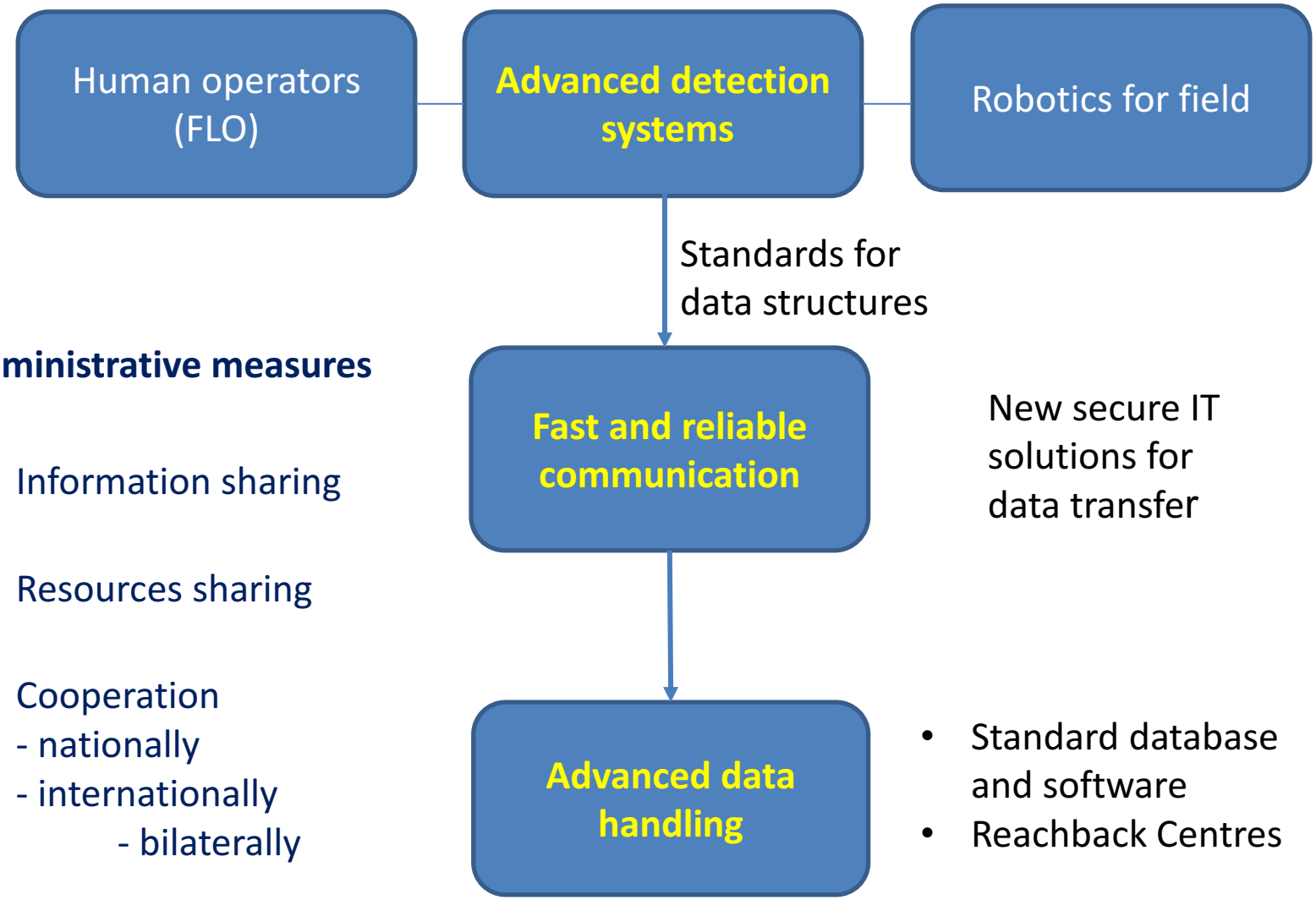
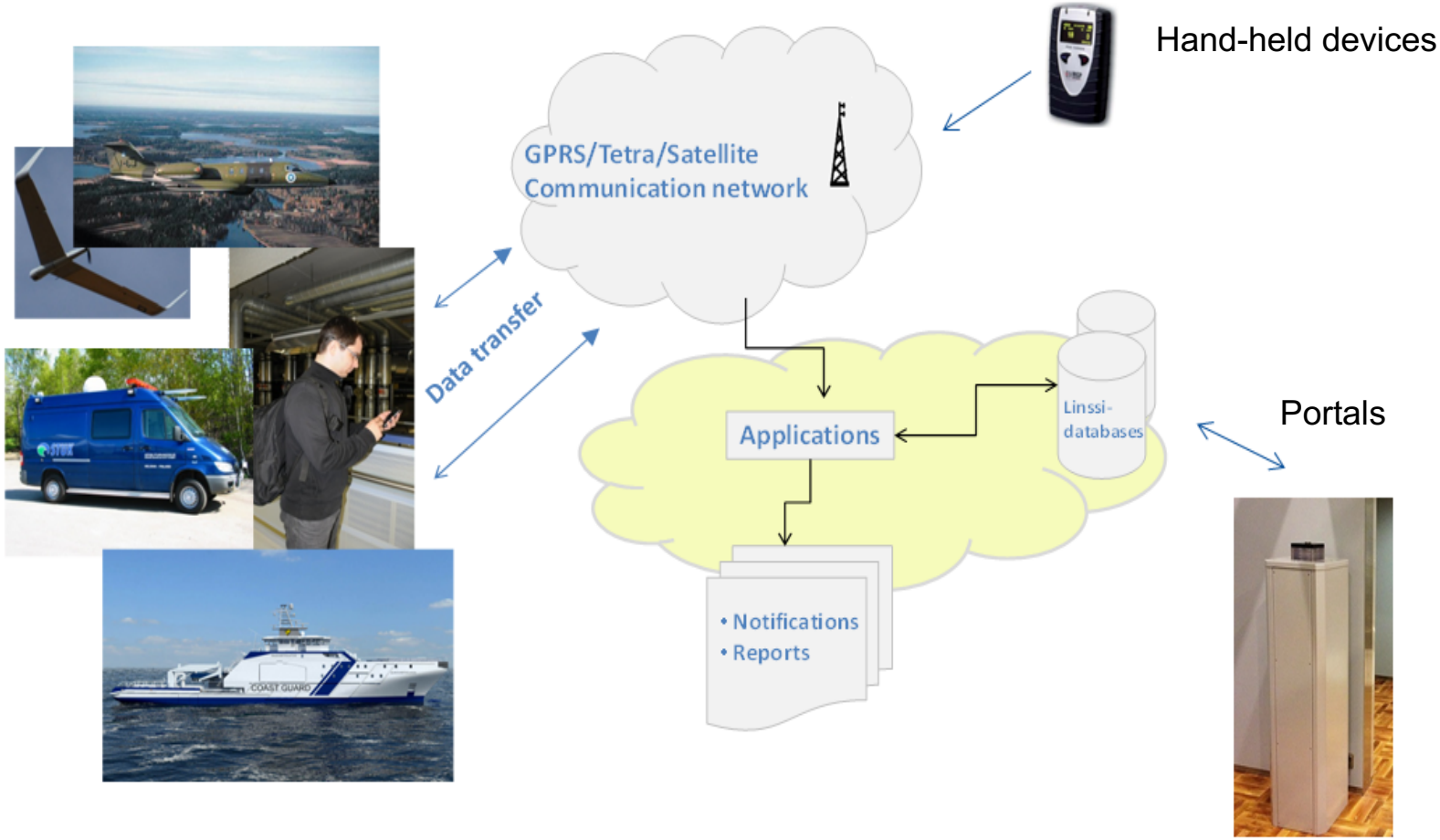
From Detectors to Reachback



Administrative measures

- Information sharing
- Resources sharing
- Cooperation
  - nationally
  - internationally
    - bilaterally

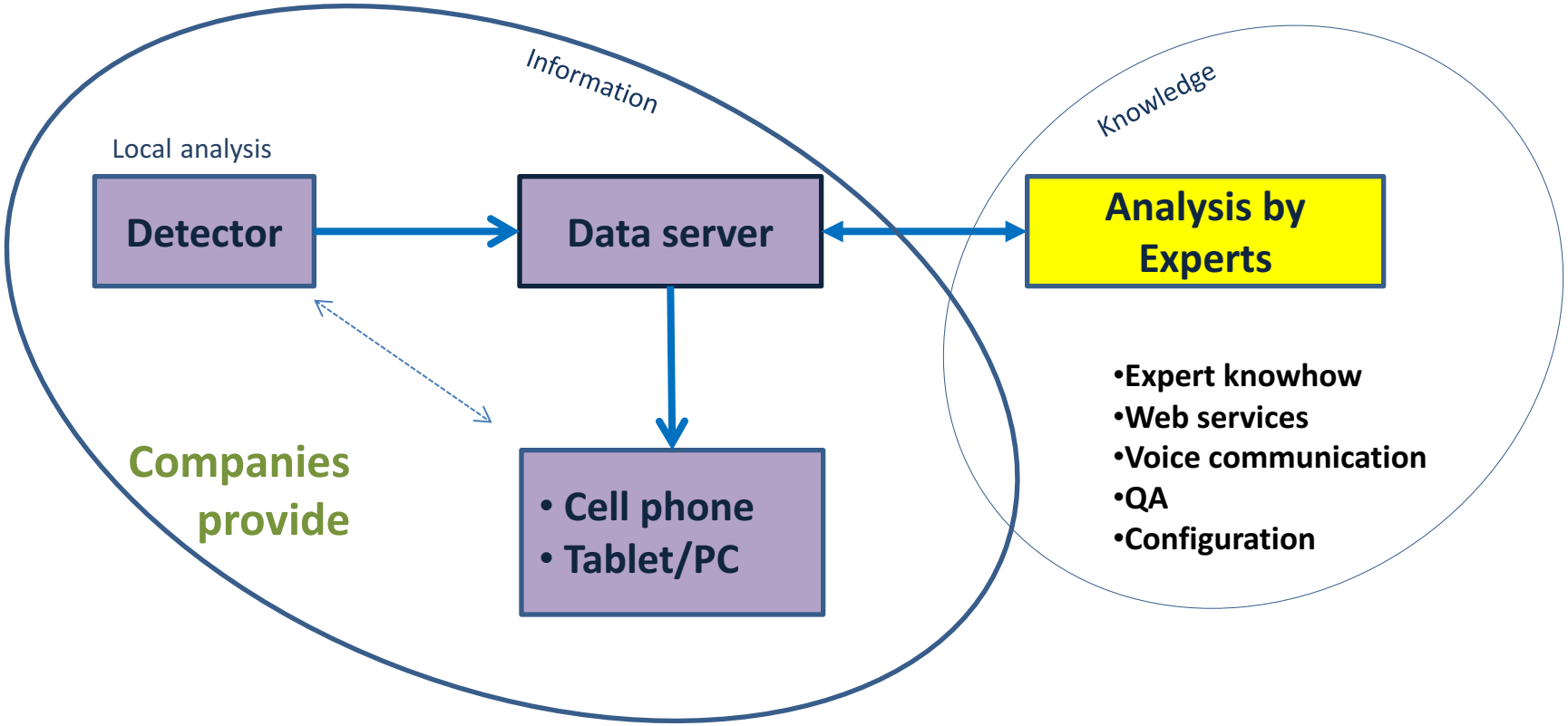
Network of Detection Assets



Spectra and other data are transferred to a remote data server for reachback
→ **situational awareness**

Nuclear Security Detection Architecture

Finnish REPO Concept



Fast and robust data transfer:

1. Prioritization of alarms
2. Recovery from breaks (no data lost)
3. Large amount of data
   - Clever data transfer algorithm (adapt to bandwidth, zip)
4. Encryption

Reachback Technology

Standard formats and protocols for information sharing

Finnish LINSSI

NATO MAJIIC

US NIEM

- **Use common interfaces for data exchange**
- **Upload data to a shared data server**
- **Give services to all relevant partners**

The users exchange data through the server, not directly with each other

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ERNCIP Recommendation

Contents

Need for Novel Technologies

- **Timeliness**
  - Authorities must counter the adversaries in a rapidly changing environment
  - Detect, analyze, communicate and act
- **Detection sensitivity**
  - New type of sensors and data acquisition systems
  - Building detection arrays
- **Different needs by different users**
- **Cooperation**
  - National
  - International or bilateral
- **Massive data flow**
- **Lack of international standards**

Lack of Awareness of authorities is the main inhibitor to implement Reachback

- **Blindness to the risk**
  - It won't happen in my country!
  - Why doing it now?
  - We are a nuclear-free zone!
- **Where the responsibility lies**
  - Somebody else takes care of this!
- **Fear of the costs**
  - Other threats and risks are more important!
- **Need for reachback technology**
  - Not understanding the benefits
  - Not talking the same language (reachback terms to glossary, CEN/TC391 WG2 CBRNE)

Joint Protocols

States should develop joint data structures, databases and software for efficient cooperation in nuclear security.

See the ERNCIP web page for the published reports (*):

- **Remote expert support of field teams**
- **National reachback systems for nuclear security**
- **Information sharing in a nuclear security event**

(*) The Reports:
https://erncip-project.jrc.ec.europa.eu/downloads

Novel in-field technologies provide <u>timely knowledge through reachback</u> to detect nuclear threats and to implement a balanced response.

$$\int \boldsymbol{I(1,2,3) * RBdt = I(4,5)}$$

THE END

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