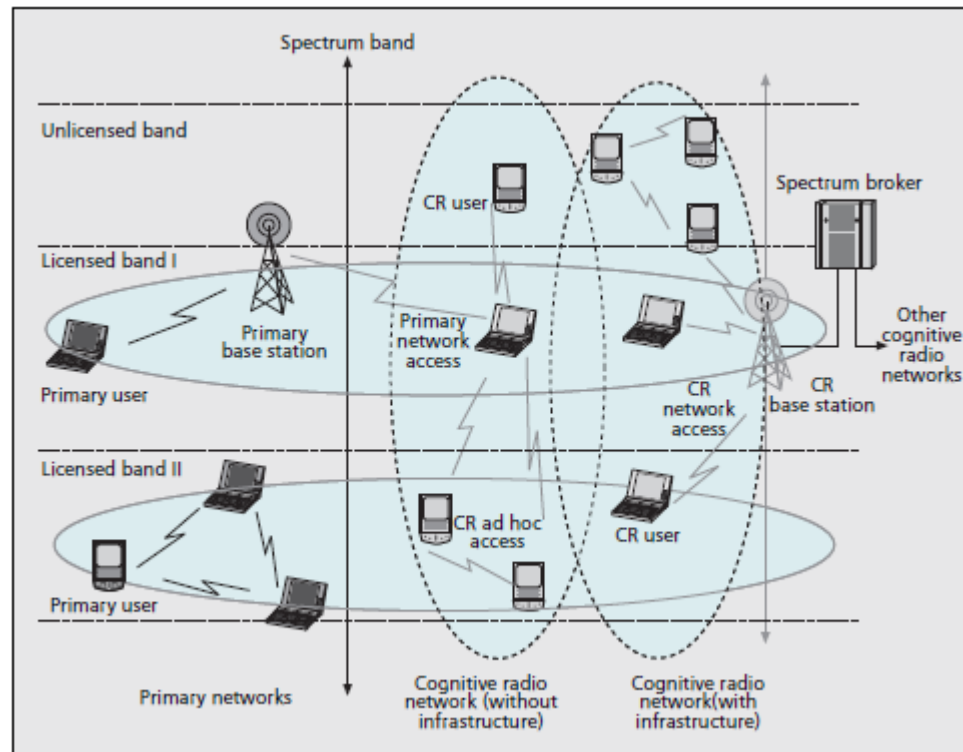# NATO IST-140 RTG-065
Cognitive Radio Networks - Efficient Solutions for Routing, Topology Control, Data Transport, and Network Management

Motivation

- **Individual Cognitive Radio Network aspects have been studied**

  ➢ A holistic picture is still missing

  ➢ Global networking goals should be achieved

- **Cognitive Radio Network will now optimize end-to-end connectivity**

- **WE GO BEYOND COGNITIVE RADIO**

Overview

- **What is IST-140?**
- **Our expectations**
- **What are Cognitive Radio Networks?**
- **Objectives**
- **Context of IST-140**
- **Topics**
- **Status of our work**
- **Summary**

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What is IST-140? (1/2)

- **NATO**
  - ➢ North Atlantic Treaty Organization
  - ➢ Intergovernmental military alliance
  - ➢ Collective / mutual defence
- **Science and Technology Organization (STO)**
  - ➢ Aim: meet the collective needs of
    - ▪ NATO
    - ▪ NATO Nations and
    - ▪ partner Nations
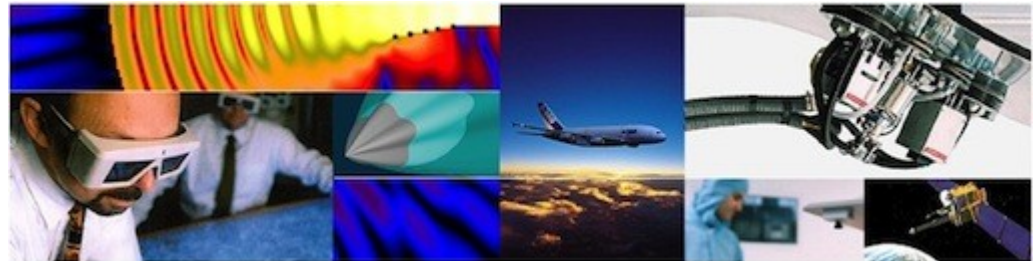 - ➢ in the fields of Science and Technology

What is IST-140? (2/2)

- **Information Systems Technology (IST) Panel**
  - ➢ advance and exchange appropriate technologies to provide
    - ▪ timely,
    - ▪ affordable,
    - ▪ dependable,
    - ▪ secure and
    - ▪ relevant information
  - ➢ and to improve C3I systems
  - ➢ including special focus on Interoperability and Cyber Security
- **IST-140**
  - ➢ Research task group below IST panel
  - ➢ Researchers from different nations
  - ➢ Solve a particular research and technology problem
  - ➢ ⬡ Cognitive Radio Networks

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How does the group work?

- **TTL: Jan. 2015 to Dec. 2017**

- **3 to 4 meetings per year**

- **Participating nations:**

- **Build upon the results of other groups (e.g. IST-104 CR in NATO II)**

- **Investigate**
    - ➤ challenges and solutions
    - ➤ for Cognitive Radio Networks
    - ➤ in a military context

- **Main output is a report with recommendations**

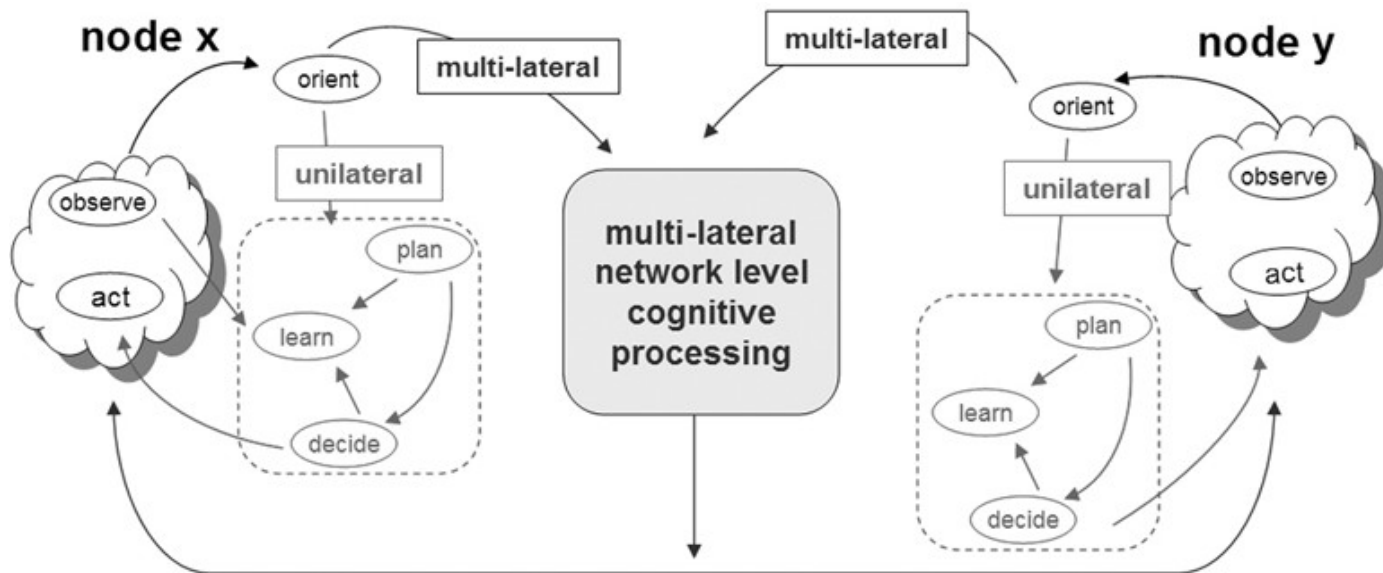# Our expectations

- **Get known to the public**

- **Raise interest in the topic**

- **Get**
  - Comments
  - Inputs

- **And perhaps welcome new members**

What are Cognitive Radio Networks?

- **Cognitive Radio: dynamic spectrum access**
- **Networks of Cognitive Radios: legacy network of CR devices**
- **Cognitive Radio Networks: end-to end optimization**

Objectives

- **Identify**
  - ➢ military requirements for CRN usage in joint and combined operations
  - ➢ potential capabilities of military CRN as compared to legacy networking
  - ➢ networking challenges in CR operation in infrastructure-based and ad-hoc military networks
- **Explore**
  - ➢ networking solutions for infrastructure-based and ad-hoc CRN
  - ➢ solutions to exchange control information taking into account military requirements
  - ➢ technologies for further enhancements
  - ➢ system architectures for CRN
- **Propose recommendations for specifications, implementations and/or further researches**

Context of IST-140
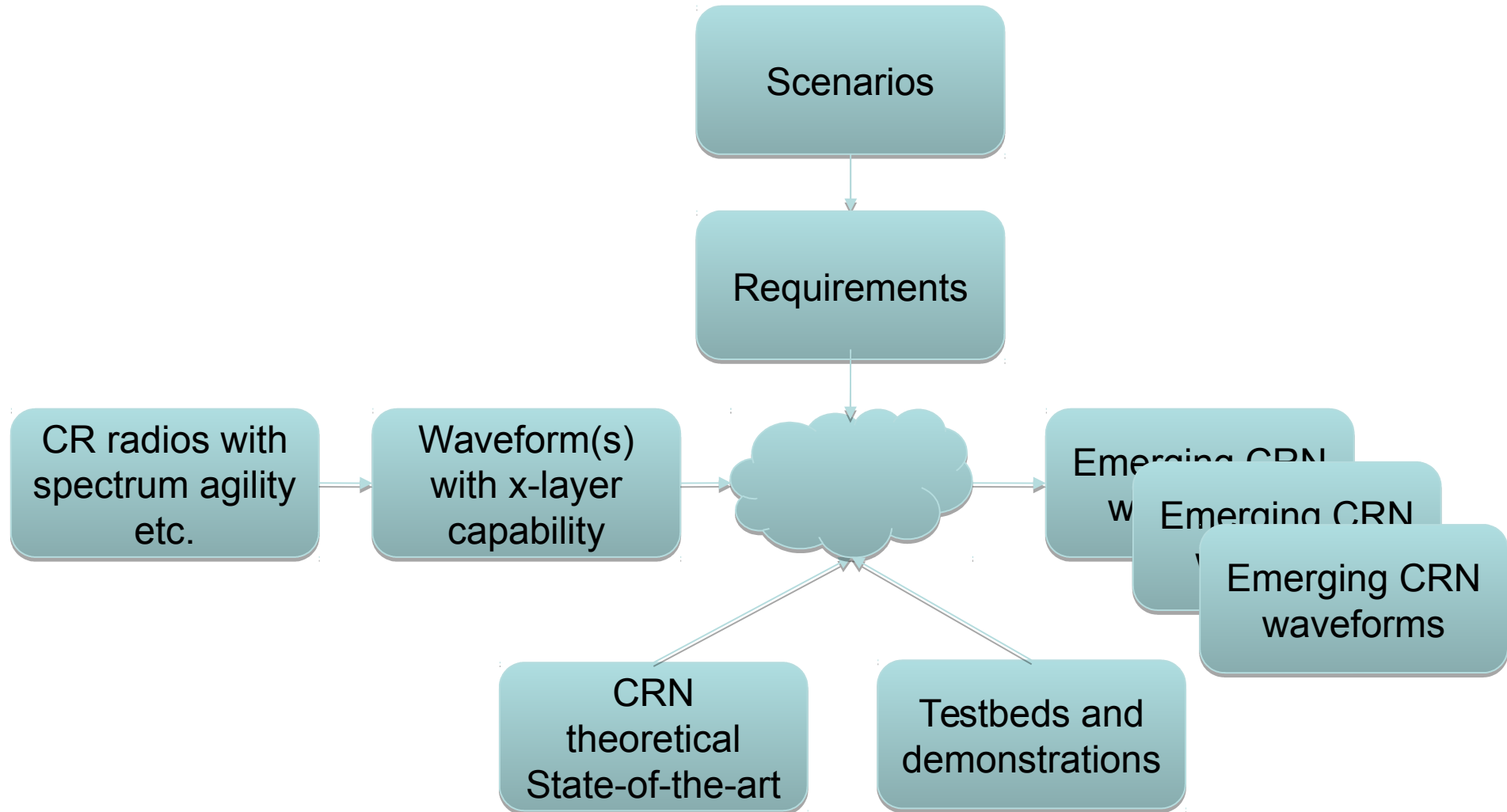
Topics

- **Technologies studied in the context of CRN**
  - ➤ Routing: Take into account metrics from CR entities
  - ➤ Topology Control: Take into account frequency information
  - ➤ Data Transport: TCP and UDP not designed for wireless networks
  - ➤ Clustering: part of DLL, but closely related to networking
  - ➤ Management: trade-off human control 🔔 automatization
  - ➤ Reliable exchange of control information: Information from both networking and CR
  - ➤ Trust Management: analyse neighbour trustworthiness
- **CRN System Architecture**

Status of our work

- **Scenarios have been selected**
- **State of the art has been described**
- **Challenges are being identified**
- **Still a long way to go...**

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Summary

- **Go beyond Cognitive Radio**
  - ➢ Cognitive Radio has a local perspective
  - ➢ End-to-end networking perspective is added
- **Two nested cognition cycles**
- **We focus on adapting networking techniques**

Thank you!

Any questions?