

Coordinated Dynamic Spectrum Management in Legacy Military Communication Systems

Marek Suchanski ¹, Piotr Gajewski ², Jerzy Lopatka ²,
Pawel Kaniewski ¹, Robert Matyszek ¹, Mateusz Kustra ¹

¹ Military Communication Institute, Zegrze, Poland

² Military University of Technology, Warsaw, Poland

Main goal

Practical verification of Coordinated Dynamic Spectrum Management feasibility in radio communication system of Polish Armed Forces, according to the roadmap proposed by “Cognitive Radio in NATO II” Research Task Group.

Content

- Properties of military radio communication system
- Frequency management overview
- NATO IST104/RTG-050 roadmap
- An attempt to implement "baby steps"
- A frequency broker concept
- Coordinated dynamic spectrum management in CNR nets – experiment
- Results
- Conclusions

Properties of military radio communication system

- Pre-planned hierarchical architecture
- Organised nets, radio links and relays
- Simplex (half duplex) communication
- Pre-planned frequencies
- FF or FH modes
- Static frequency assignment

OTAR capable radios

- R-450C - V/UHF



Thales, France
Radmor, Poland



Transbit, Poland

- PR4G F@stnet - VHF



Harris, USA

- RF-5800H (AN/PRC-150C) - HF

OTAR capabilities

● R-450C - V/UHF

- The **data is sent by air** from the radio connected to the frequency broker to other radios in the network.
- Advanced Manager Interface (AMI) remote control protocol is used.

● PR4G F@stnet – VHF

- The **data is sent by air** from the radio connected to the frequency broker to other radios in the network in unicast or broadcast mode.
- PPS remote control protocol is used.

● RF-5800H (AN/PRC-150C) - HF

- On rekeying the **radio data is not sent by air**, but the proper set is chosen.
- Radio Programming Application for preparing and uploading text files containing all radio data.

Frequency management overview

- Static spectrum management – frequency assignments
- Spectrum deficiency – partly due to static assignments
- DSA concept – CDSA and OSA
- Safety/security over flexibility/capacity

NATO IST104/RTG-050 roadmap

An evolutionary plan of introducing more effective ways of spectrum use in NATO countries:

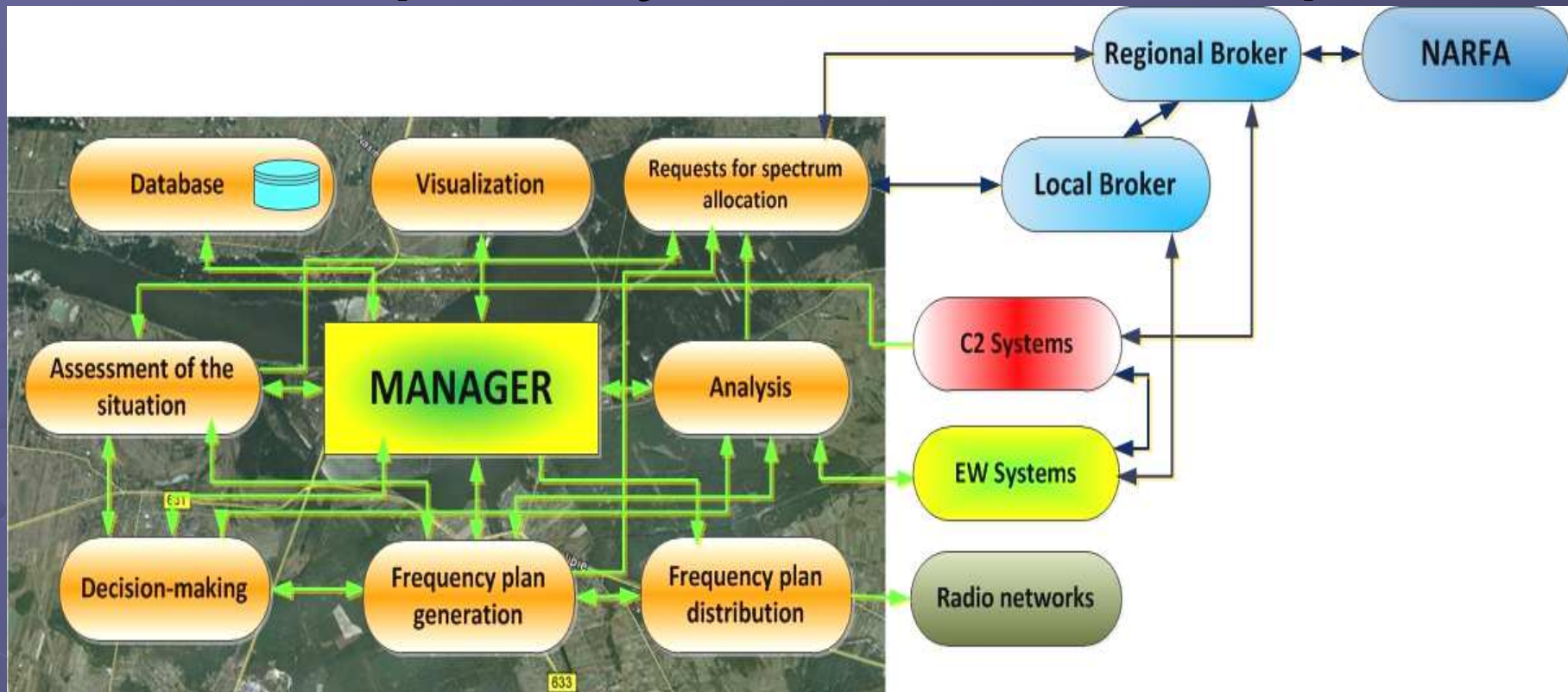
- Phase I – "baby steps" (BS):
 1. reduce time delay for frequency assignments;
 2. reduce minimum assignment duration;
 3. from assignment to generic allotment allowing optimisation of frequency usage within a given system;
 4. spectrum awareness based on sensing;
 5. more efficient spectrum management tools.
- Phase II – future directions:
 1. open access in dedicated bands;
 2. hierarchical access (PU & SU);
 3. flexible policy-managed access.

CDSA to implement "baby steps"

An evolutionary plan of introducing more effective ways of spectrum use in NATO countries:

- Phase I – "baby steps":
 1. reduce time delay for frequency assignments;
 2. reduce minimum assignment duration;
 3. from assignment to generic allotment allowing optimisation of frequency usage within a given system;
 4. spectrum awareness based on sensing;
 5. more efficient spectrum management tools.
- Phase II – future directions:
 1. open access in dedicated bands;
 2. hierarchical access (PU & SU);
 3. flexible policy-managed access.

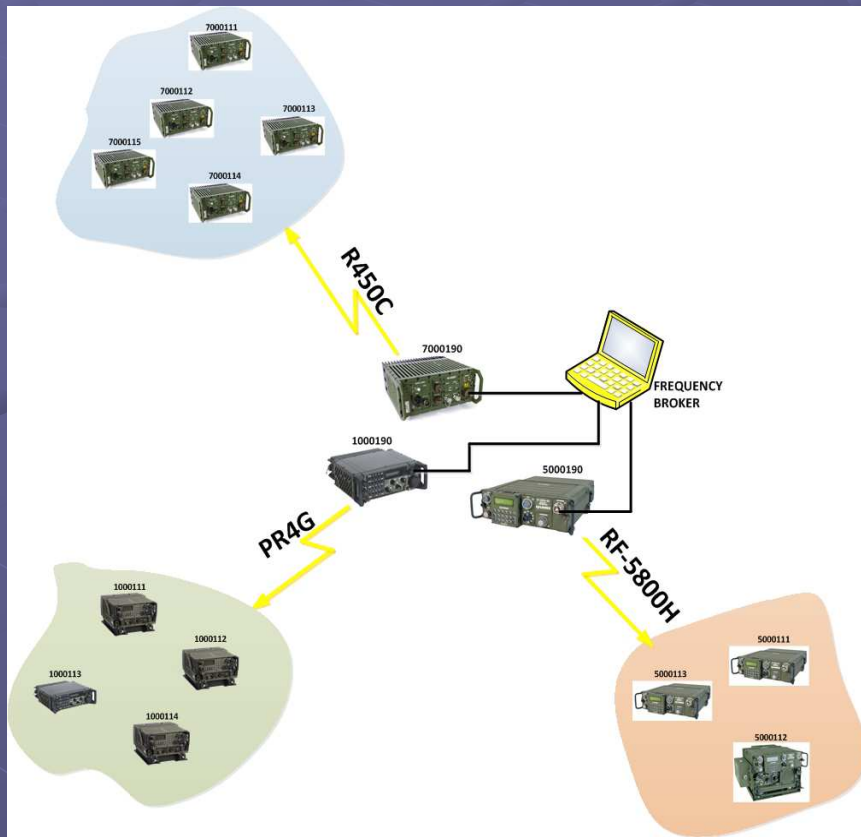
Frequency broker concept



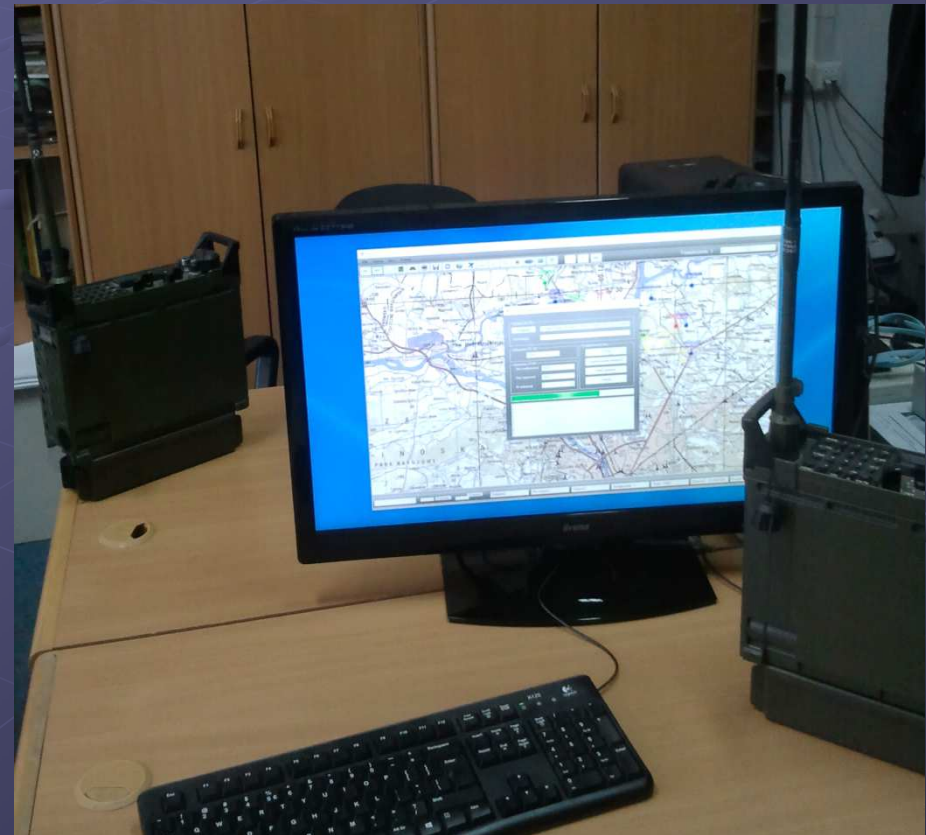
- The broker has two functions:
 - preparing radio plan at the planning stage
 - dynamic spectrum management during the operation

Experiment

Aim: practical verification of OTAR feasibility for the radios commonly used in Polish Armed Forces.



CDSM in experimental radio communication system



PR4G test set

Results

R-450C network reconfiguration time
(unicast, with confirmation)

No. of trials	Av. time [sec.]	Std dev. [sec.]	Min. [sec.]	Max. [sec.]
10	0.81	0.05	0.17	2.7

For **RF-5800H** radio
activation process
of a selected radio
communication plan
lasts not longer
than 5 seconds.
The plan is not sent,
but must be loaded
in advance.

F@stNet network reconfiguration time

Mode of PR4G radio	No. of trials	Av. time [sec.]	Std dev. [sec.]	Min. [sec.]	Max. [sec.]
unicast	10	57	2	54	61
broadcast	10	72	2	69	77

Conclusions

- The experiment was done to check if the roadmap proposed by “Cognitive Radio in NATO II” research task group (IST-104/RTG-050) is feasible, but not all “baby steps” (BS) were implemented.
- Some organisational activities (e.g. **reduce minimum assignment duration** – BS no 1) depend on decision-makers as NARFAs.
- Radio Environment Maps development is necessary to enable BS no 4 - **spectrum awareness based on sensing**.
- Development of procedures enabling efficient use of multi-range radios as well as principles of spectrum sharing with other systems need further regulations and research.

Conclusions

- OTAR feasibility was practically verified for the radios commonly used in Polish Armed Forces. OTAR procedure execution duration for 3 types of radios was measured.
- Usability of dynamic frequency change is acceptable for new V/UHF radios, but may be insufficient for older VHF ones.
- Proposed solution of CDSM is a significant step towards spectrum-efficient radio networks (Phase II – future directions).