DSA WITHIN MILITARY NETWORKING WAVEFORMS

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DSA

Dynamic Spectral Allocation is a Cognitive Radio Technology whereby a radio or a network of radios sense their operating environment and adapt their spectral usage in response to the sensed environment.

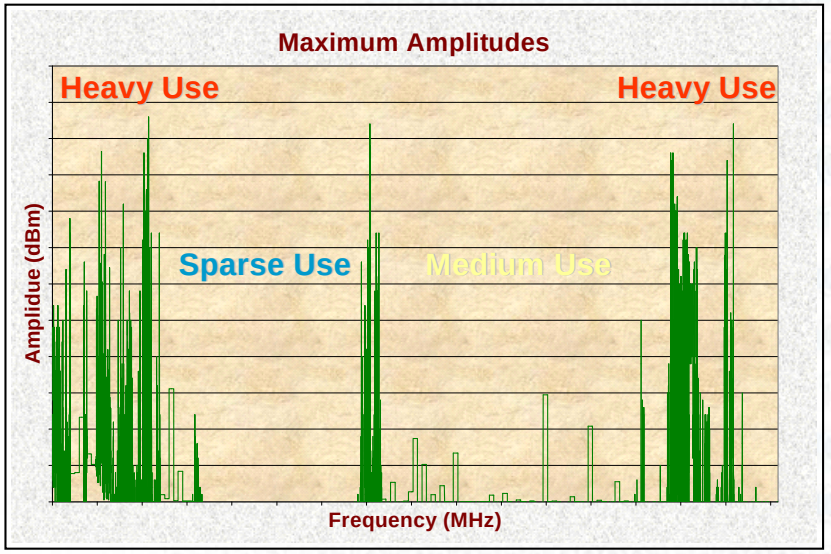
Radios Should

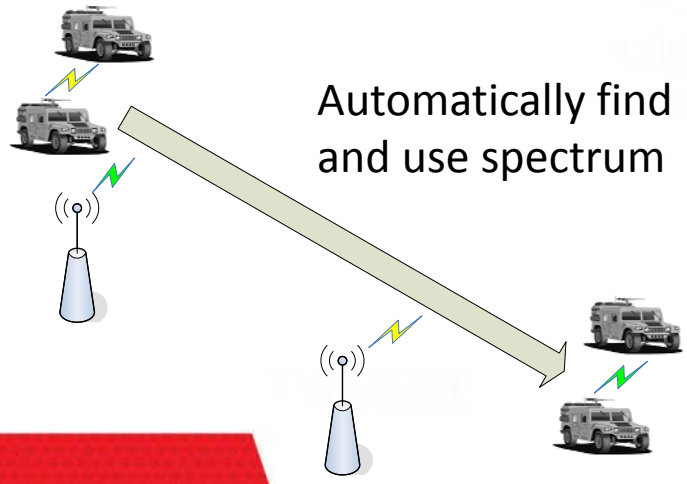
- Transmit only on allowed frequencies
- Cease transmitting when using secondary frequency when interference detected by self or when informed by others
- Co-operate with other cognitive radios in use of primary and secondary frequencies

DSA Promise

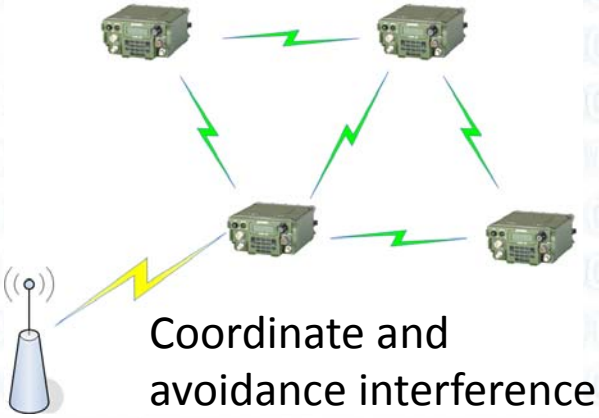
DSA radios must …

- adaptively utilize the spectrum to improve performance, flexibility, and deployment time
- coordinate and select their own frequencies
- adapt to changes in the RF environment and sustain reliable network communication connections
- improve network performance





Automatically find and use spectrum



Coordinate and avoidance interference

Military Ad-hoc Networks

Ad-Hoc Networks

- Proactively maintain membership, establish routes, monitor call groups
- Other DSA enabled networks sharing the same set of primary and/or secondary frequencies
- Non DSA radios enabled networks
- Sharing of UHF, VHF and L-band frequencies

Military Networks – Primary or Secondary ?

- Primary – always available for use to the network
- Secondary – available on non-interfering basis

Reliance on external information (when it exists)

- Broadcast Environmental database
- Timing from GPS signals

Frequency recovery

Frequency or spectrum that has had interference in the past

No frequency recovery

- Intermittent interferences ‘chases’ radios away from available operating frequencies

Policies

- How long and what signal level
- Do all nodes in network need to agree
- Do rules changes when running out of frequencies

Approach - Single Frequency

Advantage – quick to rendezvous but …

Exclusion

- Group moves frequency due to local interference
- Interference prevents signaling to other radios
- Some terminals may be excluded

Abandonment

- Group is operating on a single frequency
- Interference is detected – must go to another frequency
- Policy states – interference is detected, radio must not transmit

Impairment of interference assessment

- In a busy network, time is dedicated to transmitting information
- Can easily miss intermittent sources.

Approach - Agile Frequency

Frequency Agile networks possible solve some of the fixed frequency problems but introduce new ones

Rendezvous

- Potentially a lot of frequencies that network or group is using. Rendezvous is a difficult problem.
- Rendezvous time is O(N) where N is the number of possible operating frequencies

Hopping pattern synchronization

- When we have received first message in a hopping system, we can gain time sync,
- Frequency pattern is chosen dynamically, so remainder of pattern needs to be determined.

Harris DSA

Harris DSA is a slow, synchronous-hop-based blind-rendezvous approach

- Networked radios coordinate & select their own frequencies
- They dynamically adapt to changes in RF environment
- High-sensitivity multiple-waveform sensing detects signals below noise floor
- Epoch synchronized to GPS time supports fast late-net-entry & group merge
- Also support non-GPS time synchronization
- Better bandwidth utilization means more radios without performance drop
- Can use TV whitespace, unlicensed spectrum, & share assigned frequencies
- Can use secondary frequencies when primary frequencies are degraded

Information Sharing

Quick Dissemination

- Notification of NEW occupied frequency
- Just 14 bits each beacon period

Slow

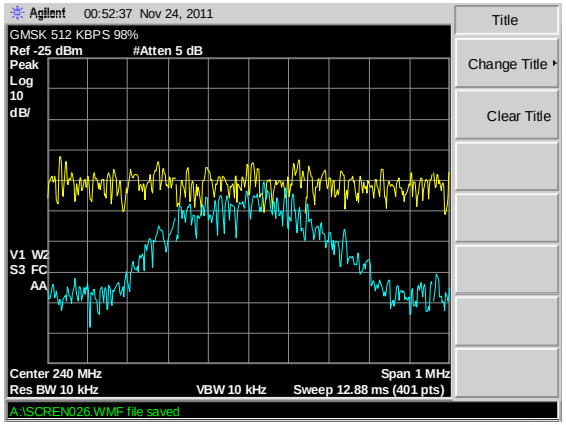
- Full occupied state information

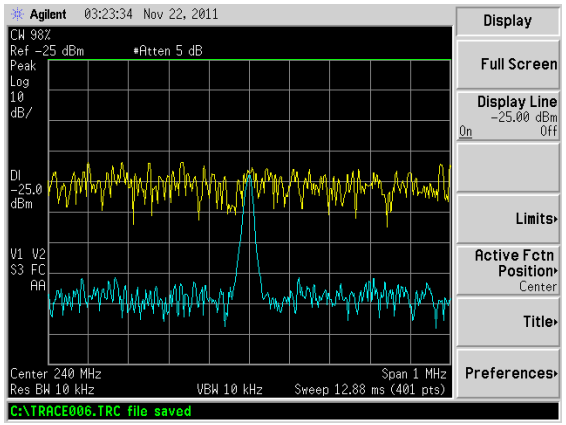
Coordinated messaging

- All nodes in the network act at the same time
  - Frequency Recovery

Detect

Multiple-waveform sensor detects signals below noise In signal band





Adapt

Adaptive frequency agility (Hopping) maintains links during interference mitigation actions

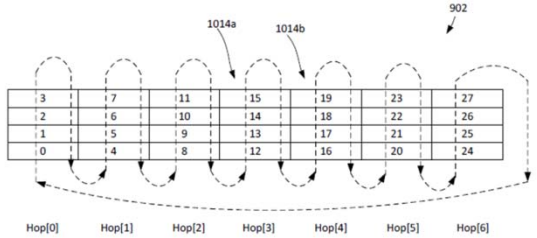


FIG. 10

Harris DSA networks …

- Detect wideband and narrow band signals
- Automatically coordinate frequency agility set across network
- Maintain user traffic flows during frequency changes

Demonstrated with ANW2 waveform on AN-PRC 117G

- Real time sensing and adaptation with live streaming video

Front End Sharing

Opportunistic Sensing

- Waveform informs sensor when it does not need use of RF interface
- Sensor schedules and executes sensing
  - Multiple senses if there is enough time
- Front end use restored to waveform for next transmission or reception event
- Remaining time in receive window when preamble detect is not triggered

Software/Security

Policy/Configuration

- Specification of what frequencies are available to radio set
- Primary / Secondary
- Spectral Use policy
- Database interfaces

Frequency selection

- Frequency selection algorithms

Sensor Control

- Competes with radio for front-end control
- DSA competes with other RF sensing applications

Sensing Core

- Collects statistics from RF environment