An Encapsulation for Reasoning, Learning, Knowledge Representation, & Reconfiguration Cognitive Radio Elements

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Introduction

- What we mean by the term ‘cognitive radio’.
- What is required to implement a practical system (from our perspective).
- CTVR’s approach.
- Where the main challenges lie.
- Conclusions and questions.

Setting the Scene

- A global unified view of what is meant by ‘cognitive radio’ does not yet exist.
- However, the majority of the ongoing discussions focus on one or all of these three features/abilities:
  - Observation and awareness
    - Device state, radio resources, contextual information.
  - Decision-making and learning
    - What action is required, what happened previously, what should be done next.
  - Implement, and respond to change
    - Application, structural and parameter changes.
    - Ability to vary, and ‘switch off’ cognition abilities

CTVR Cognitive Radio Design

- Store current & previous actions, observations and outcomes
- Make decisions, innovate, and develop conclusions
- Constraints
- External Constraints
CTVR Cognitive Radio Design

Highly reconfigurable software radio (IRIS) and comms stack.

Observations
Action Set
Decision-Making, Learning, Conclusions Formation
Variable Weighting
Knowledge Representation Delay-Line Memory
Tasks:Actions:Outcomes:Conclusions
0 1 2 3
N
Short Term Long Term

Variable Weighting
Etiquettes
System Constraints
Regulatory Policy
Constraints

Decision-making and learning using the knowledge store and constraints. Creates a series of reconfiguration actions (Action Set).

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Internal device and core (system constraints) and external constraints.

Reasoning Engine
Reconfigurable Core
Observations
Action Set
System Constraints
Etiquettes
Regulatory Policy
Constraints

CTVR Cognitive Radio Design

Short and long term store of actions, observations and conclusions.
Current Challenges

- Hardware – portable yet multi-band system with long operating lifetime.
- Deployment in Ireland under COMREG’s test and trial licence scheme.
- Cognitive Networks – distributed processes and intelligence, overlay and underlay (easement use) communications, learning from others.
- User authentication
  - "Trusted user has full access, a thief has none"
- Verification of cognitive radio ‘personality’
- Controlling rogue operation.

Conclusions

- CTVR design incorporates awareness, decision-making and learning, and reconfiguration.
  - The 3 key elements of most cognitive radio descriptions.
  - There’s currently a tradeoff between performance and reconfigurability.
  - Reconfigurability is a key element of a cognitive radio and network however.
- Consumer mainly cares about “always connected anywhere, best performance, low cost” not about how that’s achieved.
  - Not developing cognitive radio for cognitive radio’s sake.
- Cognitive radio is more than just the more efficient use of spectrum.
  - But we have not yet explored many new potential applications.
Thank you.

Questions?

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