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Spectrum Use and Policy:

Considerations regarding Cognitive Radio and TVWS applications in Canada

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THE RESEARCH BROAD BAND WIRELESS GROUP
www.crc.ca/coral

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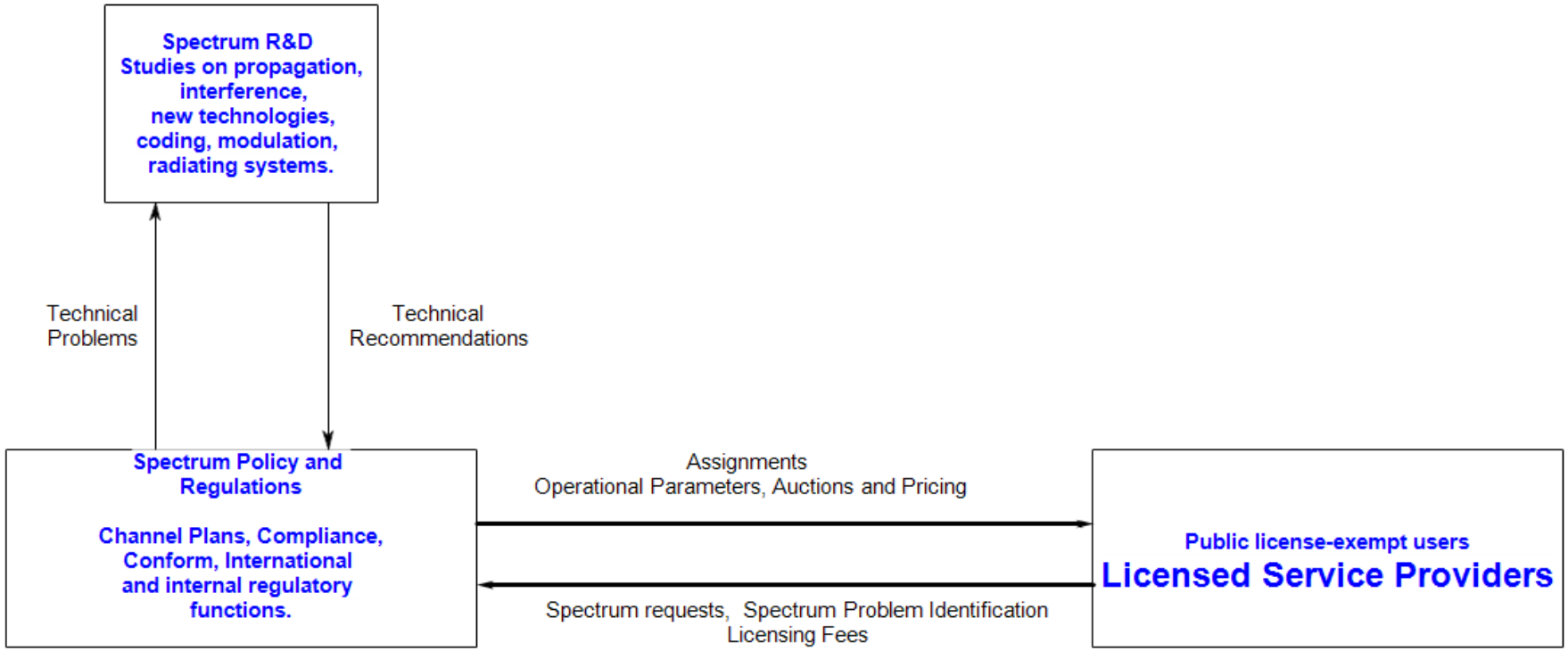
Overview of Talk.

1. Consolidation and reorganization within Industry Canada.
2. TVWS: new spectrum initiatives and a CR venue.
3. Cognitive Radio and Policy: the Mitola Radio Realized.
4. Data Base as a Cognitive Radio Component.
5. Guiding the evolution of the TVWS Data Base
6. Summary

Consolidation and Reorganization within Industry Canada

- **Federal Government of Canada is implementing a 5-10% reduction over 3 years.**
- **Research and Development in Telecommunications reduced by up to 35% : New emphasis on spectrum and radio resource management issues.**
- **Cognitive and Software Defined Radio R&D remains a high priority and has not seen reduction and may grow.**
- **Spectrum Policy, Regulations, and R&D resources are to be brought closer together to create a 'critical mass' support future spectrum management objectives.**

The Current Policy/User/R&D Paradigm



What CRC brings to the new order…

- An organization more focused on SDR and CR
- An organization with more focus on Policy and Spectrum Issues.
- A background of experimentation and evidence based recommendations.
- Background in ISM and TVWS studies (IEEE 802.22)
- Hands-on experience with SDR and CR.
- A network of national and international collaborators working on CR.

Background in ISM band studies and Cognitive Radio Development

See: www.crc.ca/coral

700 MHz "super-WiFi" Experiments

Site #2 – Range 6

with

2.4GHz Hotspot

Site #1 – CRC

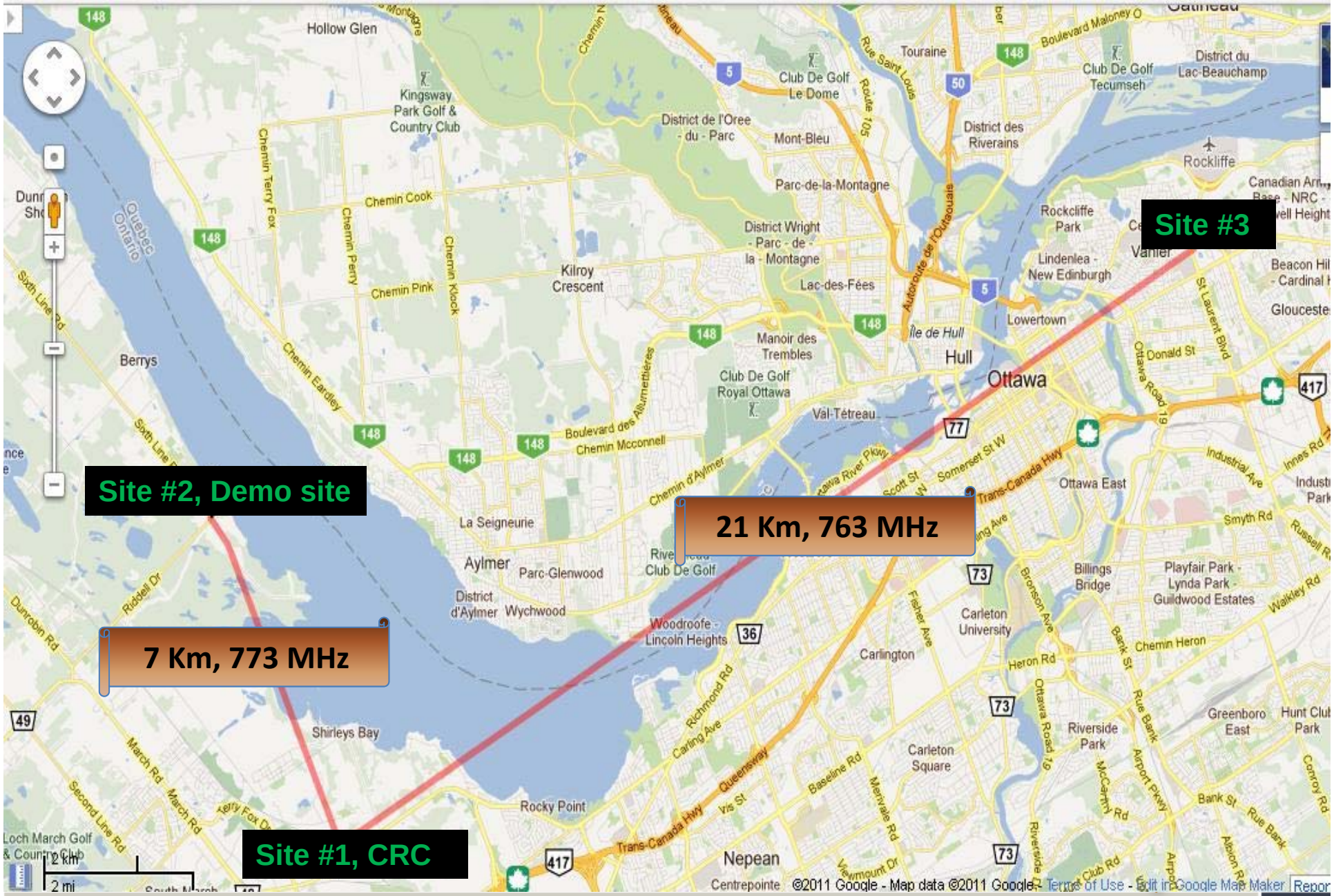
with

Relay

Site #3 – East End

with

Network Camera


Site #3
Site #2, Demo site
21 Km, 763 MHz
7 Km, 773 MHz
Site #1, CRC
Hollow Glen
Kingsway Park Golf & Country Club
Chemin Cook
Chemin Pink
Chemin Terry Fox
Chemin Perry
Chemin Klock
Kilroy Crescent
Berrys
Chemin Eardley
Quebec
Ontario
Sixth Line Rd
Riddell Dr
Dunrobin Rd
Shirleys Bay
March Rd
Second Line Rd
Loch March Golf & Country Club
Rocky Point
Nepean
Centrepointe
Aylmer
La Seigneurie
Parc-Glenwood
District d'Aylmer
Wychwood
Woodroofe - Lincoln Heights
Carlington
Carleton University
Carleton Square
Riverside Park
Billings Bridge
Ottawa East
Ottawa
Hull
Île de Hull
Val-Tétreau
Lac-des-Fées
Manoir des Trembles
Club De Golf Royal Ottawa
District Wright - Parc - de - la - Montagne
Parc-de-la-Montagne
Mont-Bleu
District de l'Oree - du - Parc
Club De Golf Le Dome
Touraine
District des Riverains
Rockliffe
Rockcliffe Park
Lindenlea - New Edinburgh
Lowertown
Vanier
Club De Golf Tecumseh
District du Lac-Beauchamp
Boulevard Maloney O
Boulevard des Allumettières
Chemin Mcconnell
Chemin d'Aylmer
Trans-Canada Hwy
Somerset St W
Scott St
Bronson Ave
Fisher Ave
Richmond Rd
Carling Ave
Queensway
Baseline Rd
Merivale Rd
Riverside
Ottawa Road 19
Donald St
St Laurent Blvd
Industrial Ave
Smyth Rd
Heron Rd
Chemin Heron
Bank St
Rue Bank
Airport Pkwy
Greenboro East
Hunt Club Park
Conroy Rd
Walkley Rd
Russell Rd
Innes Rd
Beacon Hill - Cardinal
Gloucester
Canadian Arm Base - NRC - Powell Heights
Playfair Park - Lynda Park - Guildwood Estates
Rue Saint Louis
Route 105
Autoroute de l'Outaouais
148
5
50
73
77
36
49
417
2 km
2 mi
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Report

Policy: An operational attribute of Cognitive Radio

- **Recognize that Policy is a defining technical characteristic of CR.**
- **EG: Emission requirements, priority of access, interference limits.**
- **Policy can be embedded within the CR, within a data base.**
- **EG: the Darpa XG radios; The FCC TVWS data base**

The Cognition Cycle as proposed by Mitola…

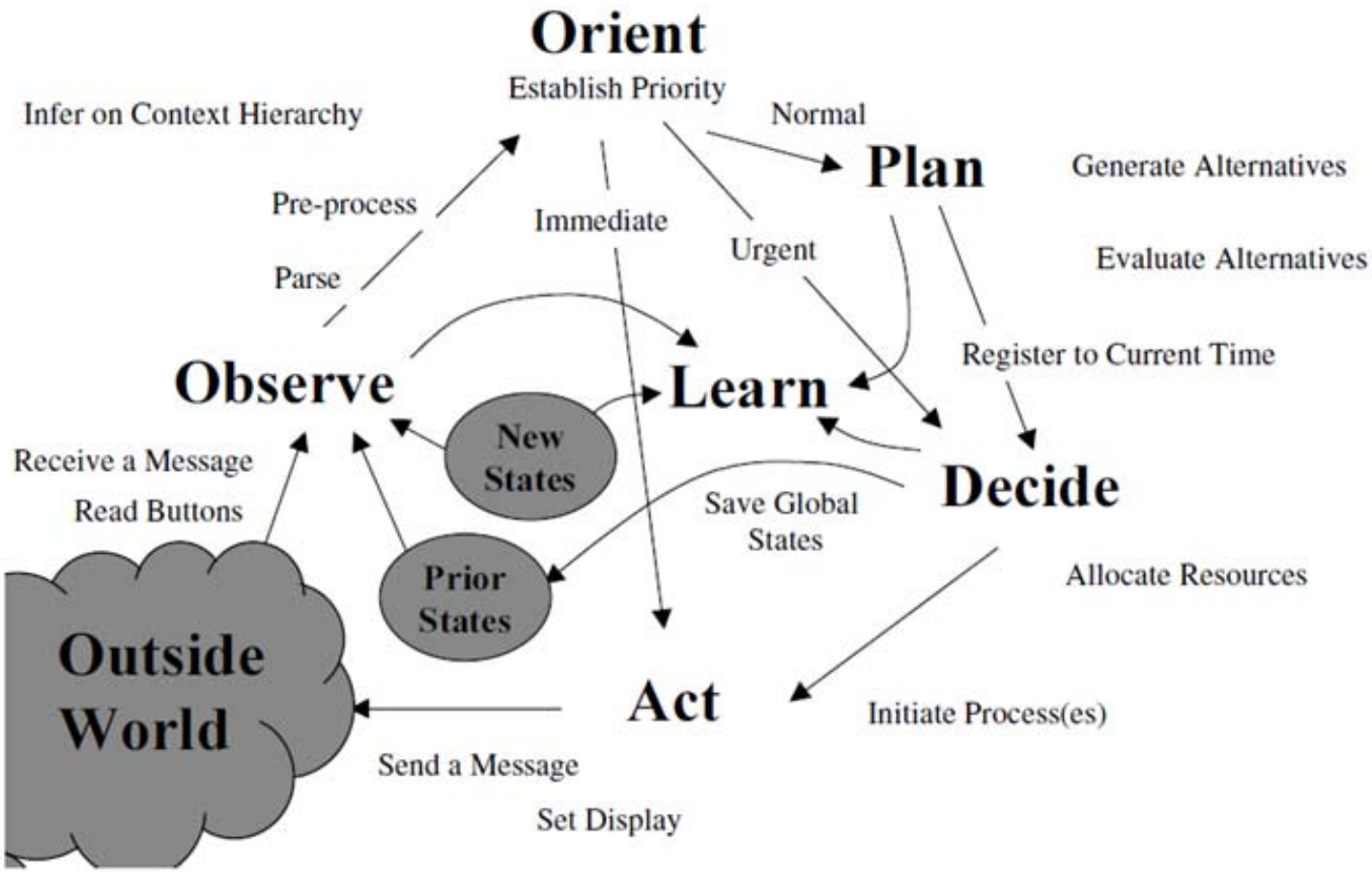


Figure 4-2 Simplified Cognition Cycle

Has attributes that can be defined as Policy.

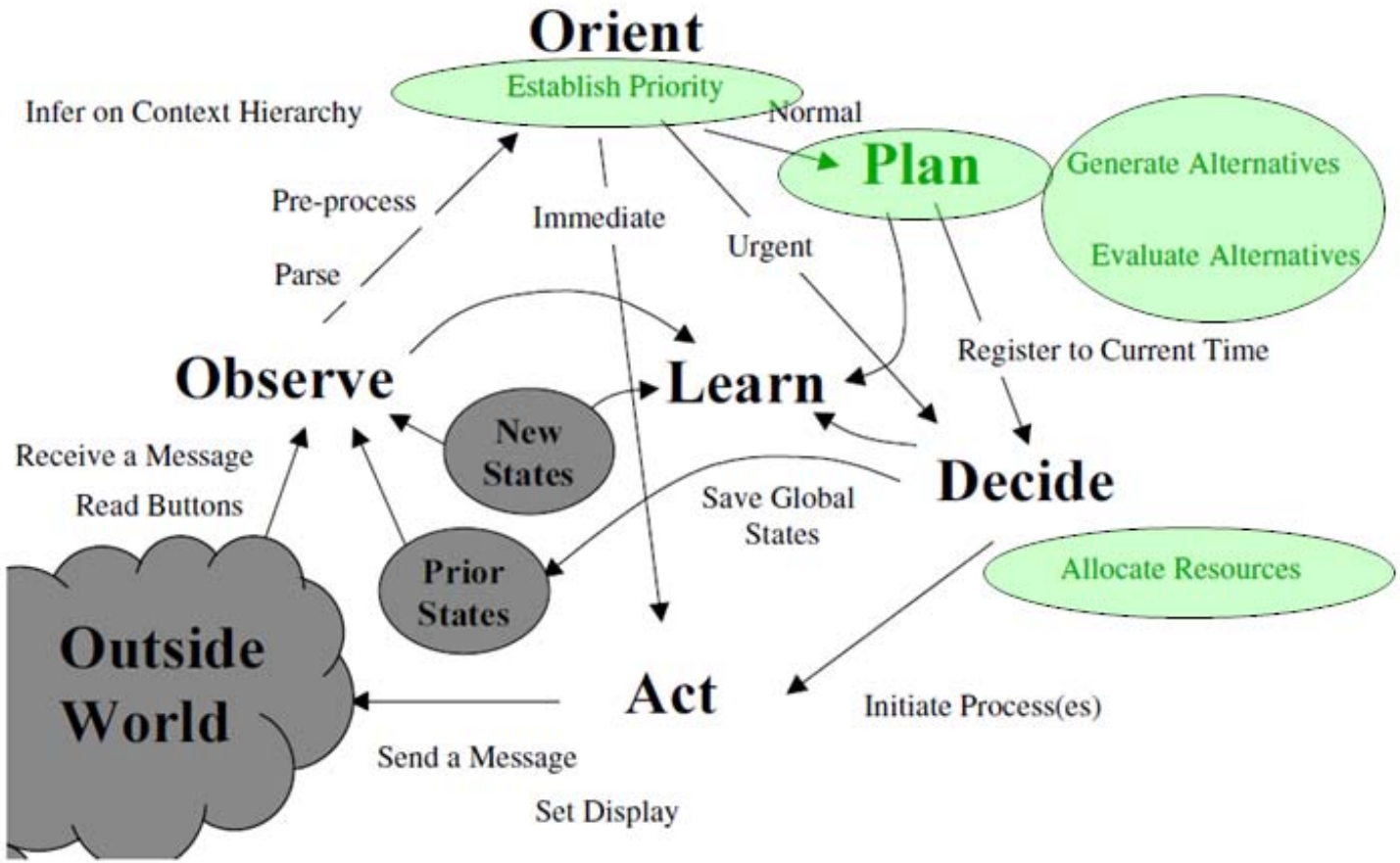


Figure 4-2 Simplified Cognition Cycle

TVWS: Canada`s Approach, getting ready for new models.

- Consultation ended last fall
- General Policy to be in place by Summer 2012.
- Questions asked of potential users: Which Model US or UK?
- Data Base and Sensing.
- Regulations and equipment compatibility: RABC input
- Users: Cellular extension; Public Safety; License-Exempt
- Uniquely Canadian Issues: Large land mass, need for low cost WISPs
- Embedding Policy within TVWS Cognitive Radio.

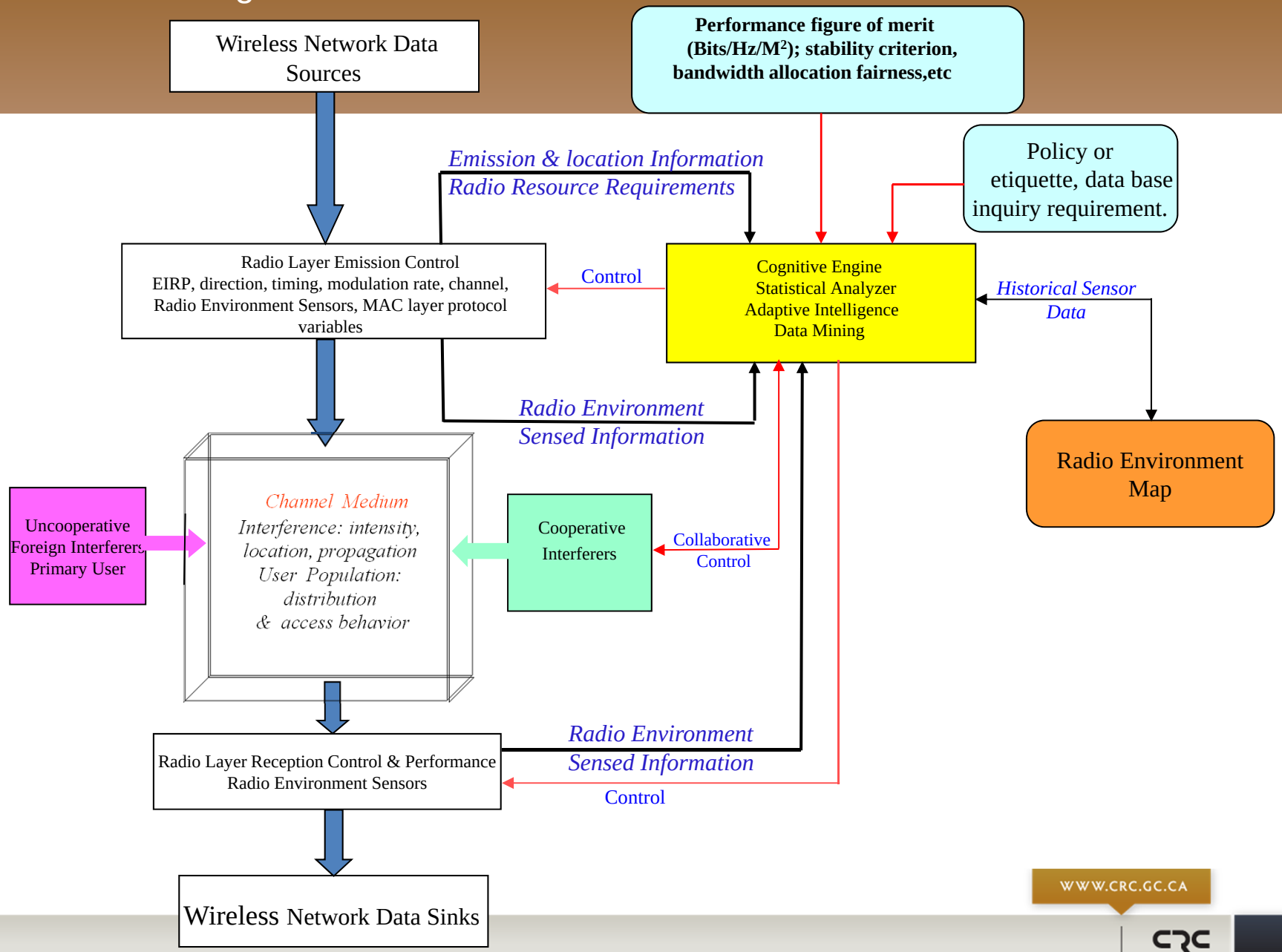
Policy, CR, and License-Exempt access to TVWS

- **TVWS is the de facto playground for CR.**
- **Initially, this CR will be founded on the use of a Data Base.**
- **Many competing technologies will share spectrum: IEEE 802.11af, 802.22, LTE, Super-WiFi, etc.**
- **Protecting incumbent TVWS users is only one problem.**
- **More pressing policy issues: Interference control, coexistence, collaboration, fairness.**
- **Don't want to repeat the ISM band.**

Data Bases: The Radio Environment Memory of a CR

- Acts as a repository for Policy
- Can act as a Radio Environment Memory
- IP addressable.
- No need to be centralized, can be shared.
- Support for a variety of CR topologies

❑ Formative Cognitive Radio Architecture



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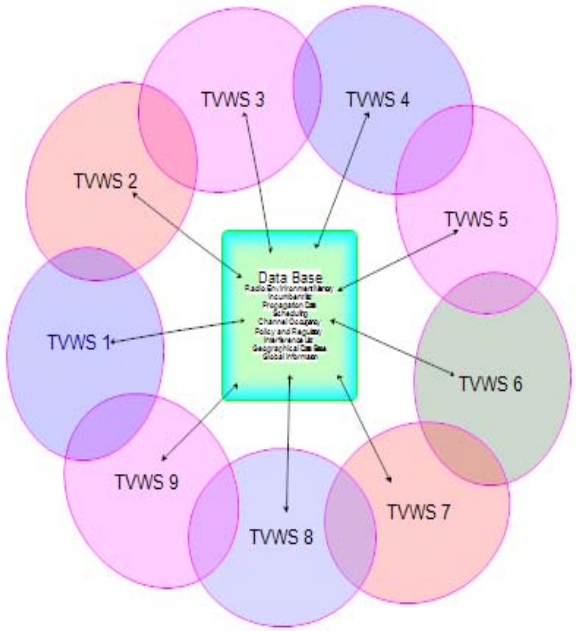
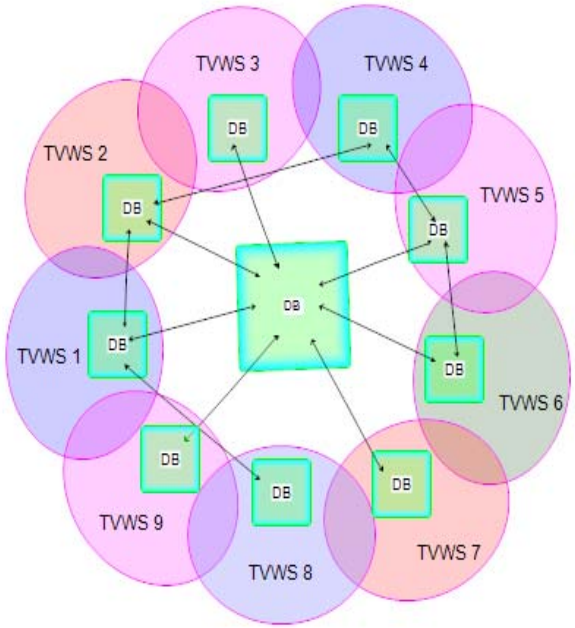
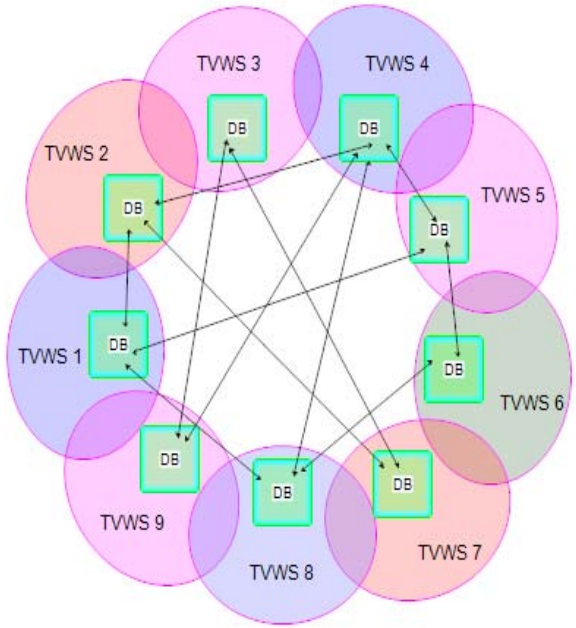
Data Base Constructs



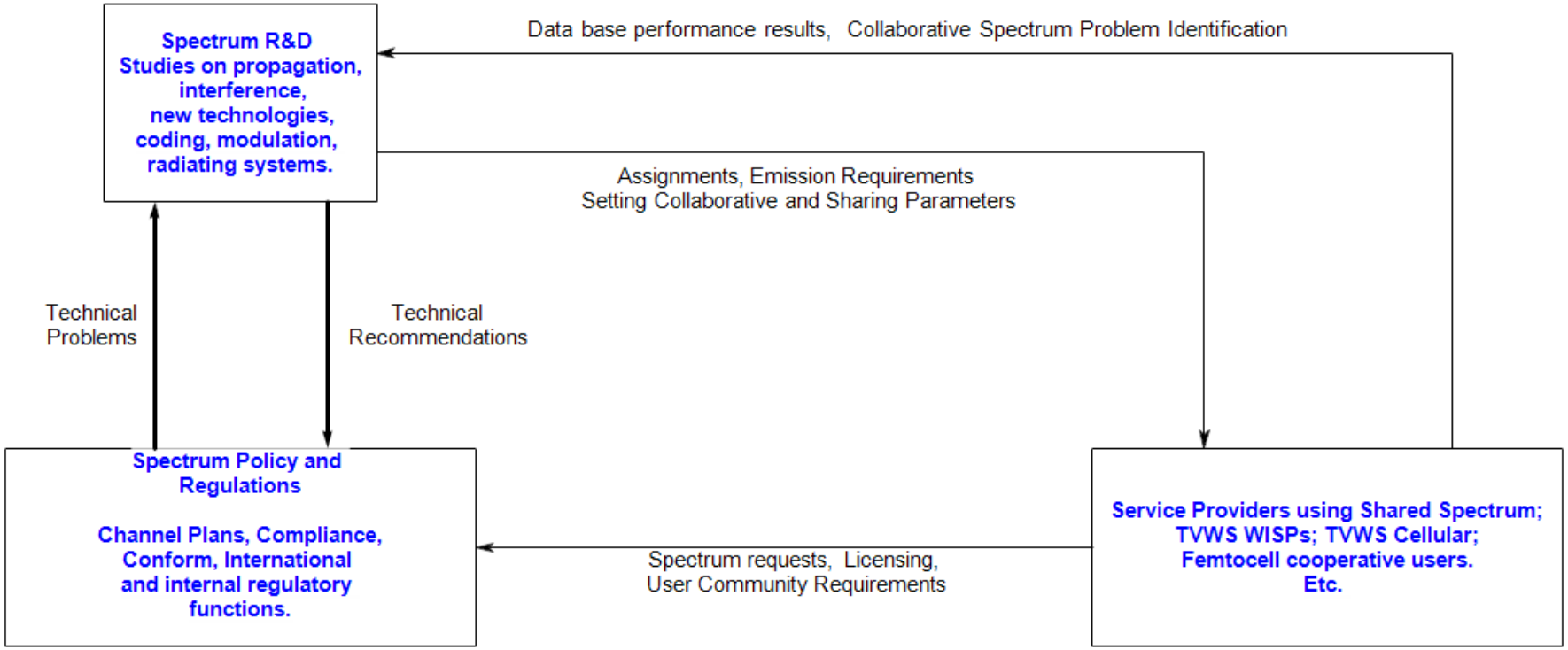




TVWS Data Base: Venue for Advancing CR

- Canadian implementation of Data Base for WISP
- Telco interest in shared spectrum: femtocells
- Solicit Industry input on the construct of the DB.
- CRC interest in overseeing implementation.
- Performance metrics: spectrum efficiency fairness.
- Move toward etiquettes?

Implementing DB for LE/TVWS: melding policy & technology



What the future may bring..

- Implementation of another kind of 'cognitive cycle' where data base knowledge and operation is modified by subtle Policy change; where spectrum efficiency and fairness of allocation become the CR performance metrics.
- The challenge of supporting different TVWS PHYs on co-channel basis.
- A multiplicity of CR architectures.
- Migration of ideas to new types of CR ISM band applications

Summary

- **Bond between regulatory, policy, and R&D processes at Industry Canada to become stronger.**
- **TVWS process and timelines in place within Industry Canada.**
- **Unique Canadian requirements, especially with Rural and WISP will need to new approaches in developing and using TVWS data bases.**
- **Data Bases: Will meld Policy and Radio Resource Management.**
- **Foreseen Process: Private Sector DB development; Industry Canada (SITT and CRC) overview and monitoring of implementation and experimentation.**
- **Policy and DB design will influence CR evolution.**