# ISART 12

# *Radar R&D Panel*

## *Cognition Technologies*

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**Dr. Joseph Mitola III, Fellow of the IEEE**

Distinguished Professor, School of Engineering and Science,

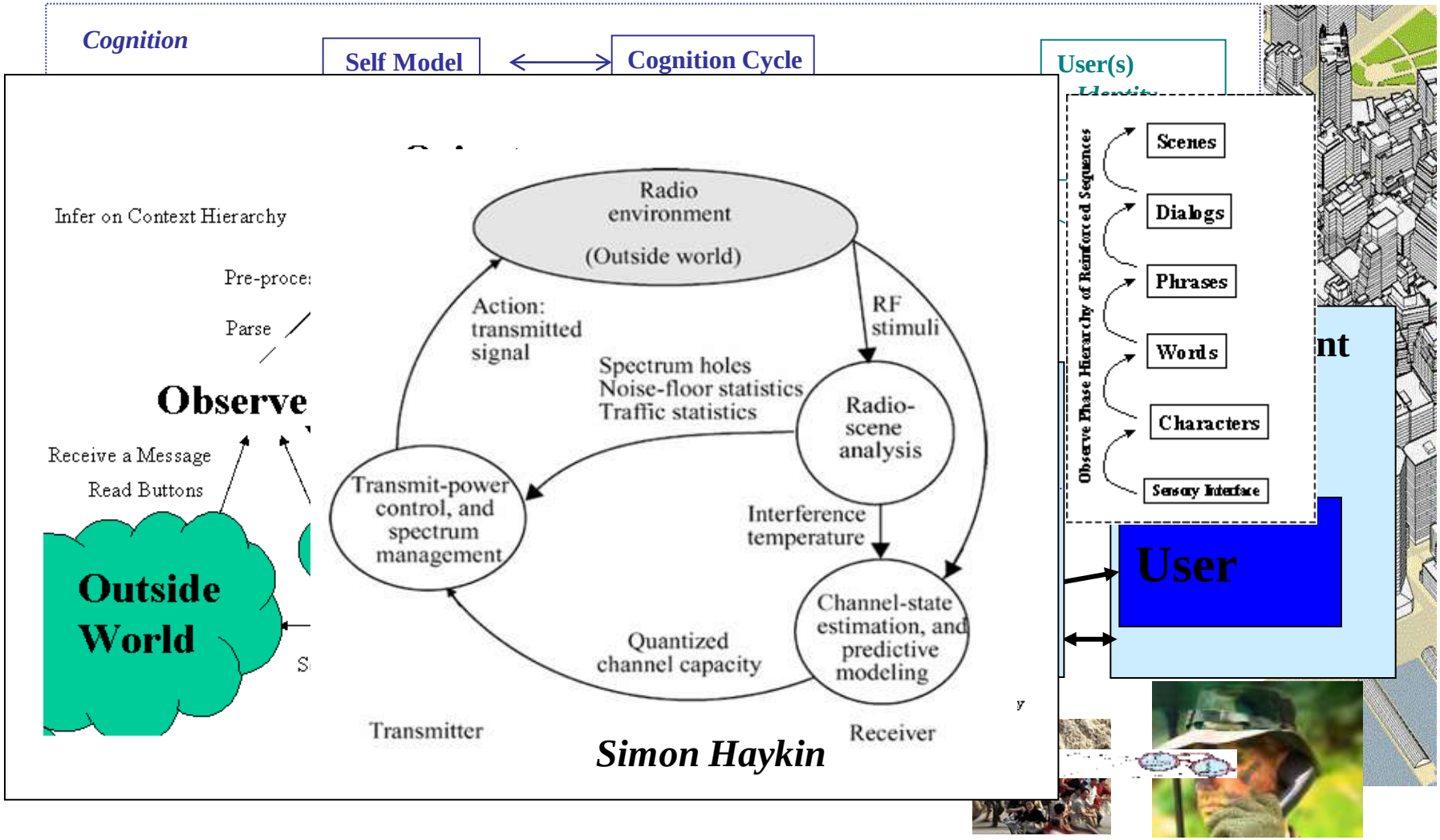
Director, Special Projects, US DoD Sytems Engineering Research Center (SERC)

Distinguished Professor, School of Systems and Enterprises, and

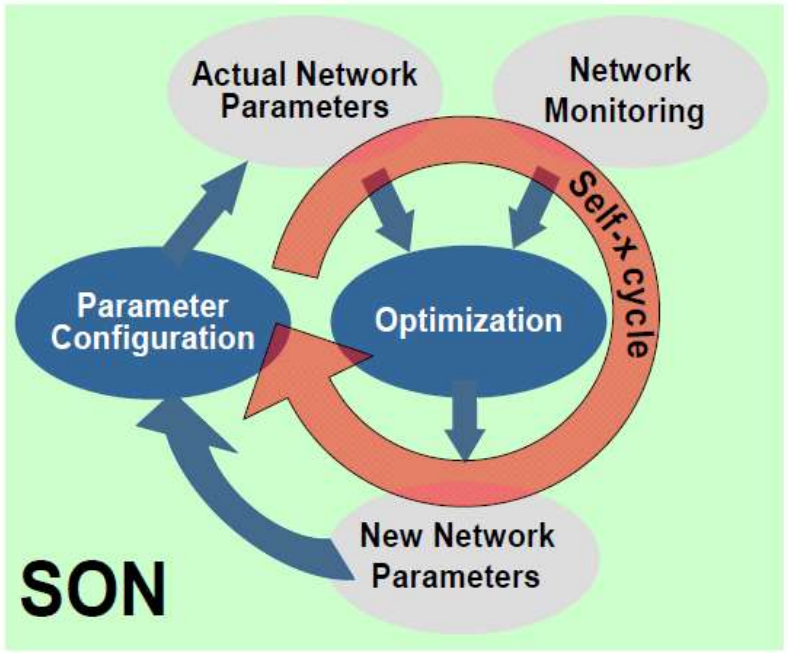
Vice President for the Research Enterprise

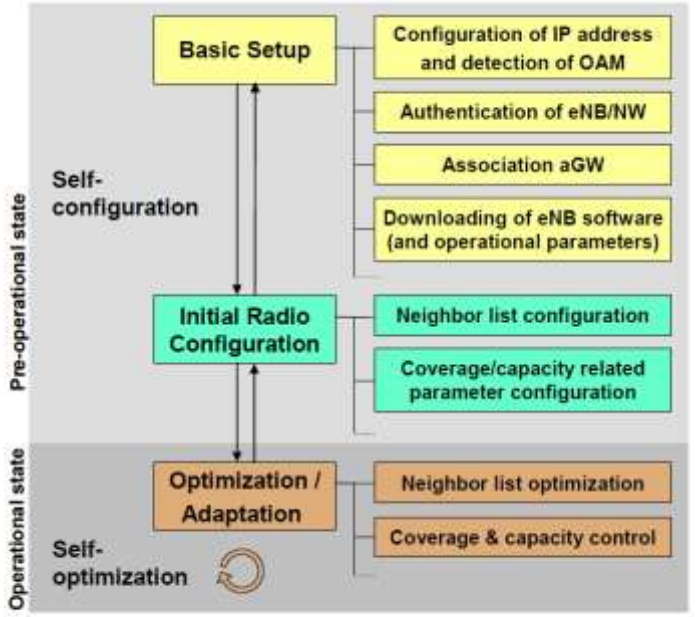
**Stevens Institute of Technology**

# Cognitive Radio and DSA

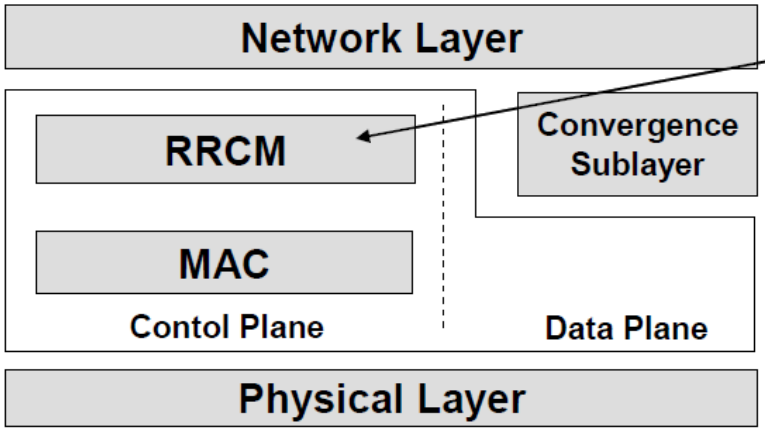


# Self Aware Networks




Ramifications of self-configuration/self-optimization functionality




**Self-organization**

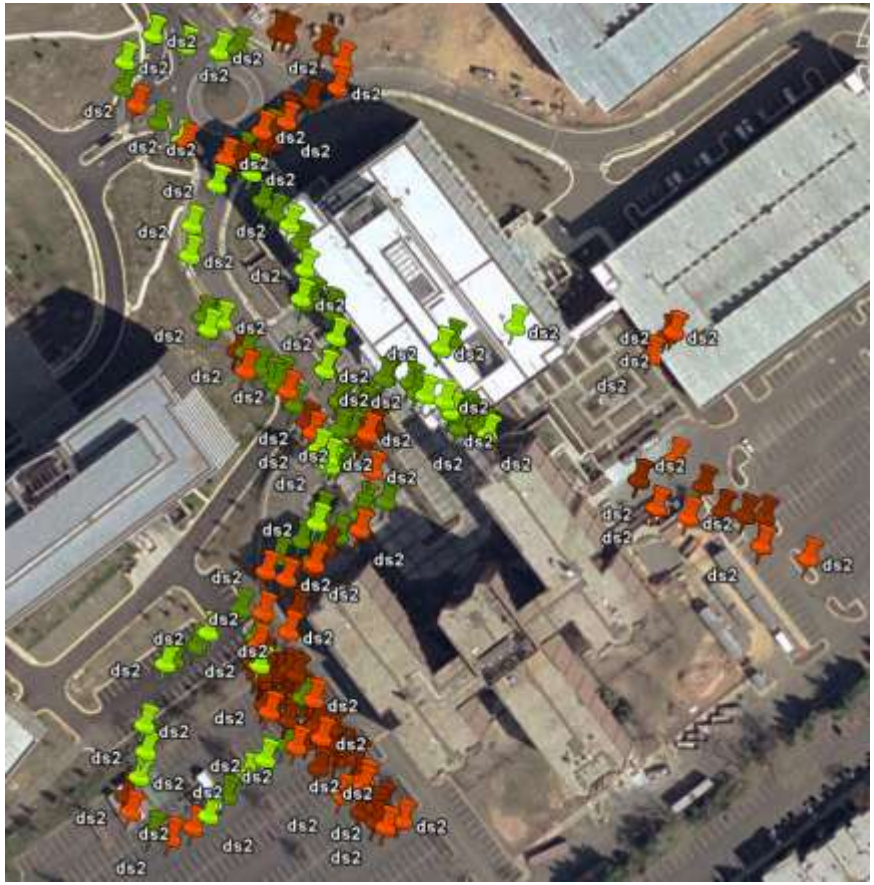
***IBM Autonomic Network Challenge 2001*** *(traffic, time, power, CPNs, …)*

MAC: Medium Access Control
RRCM: Radio Resource Control & Management

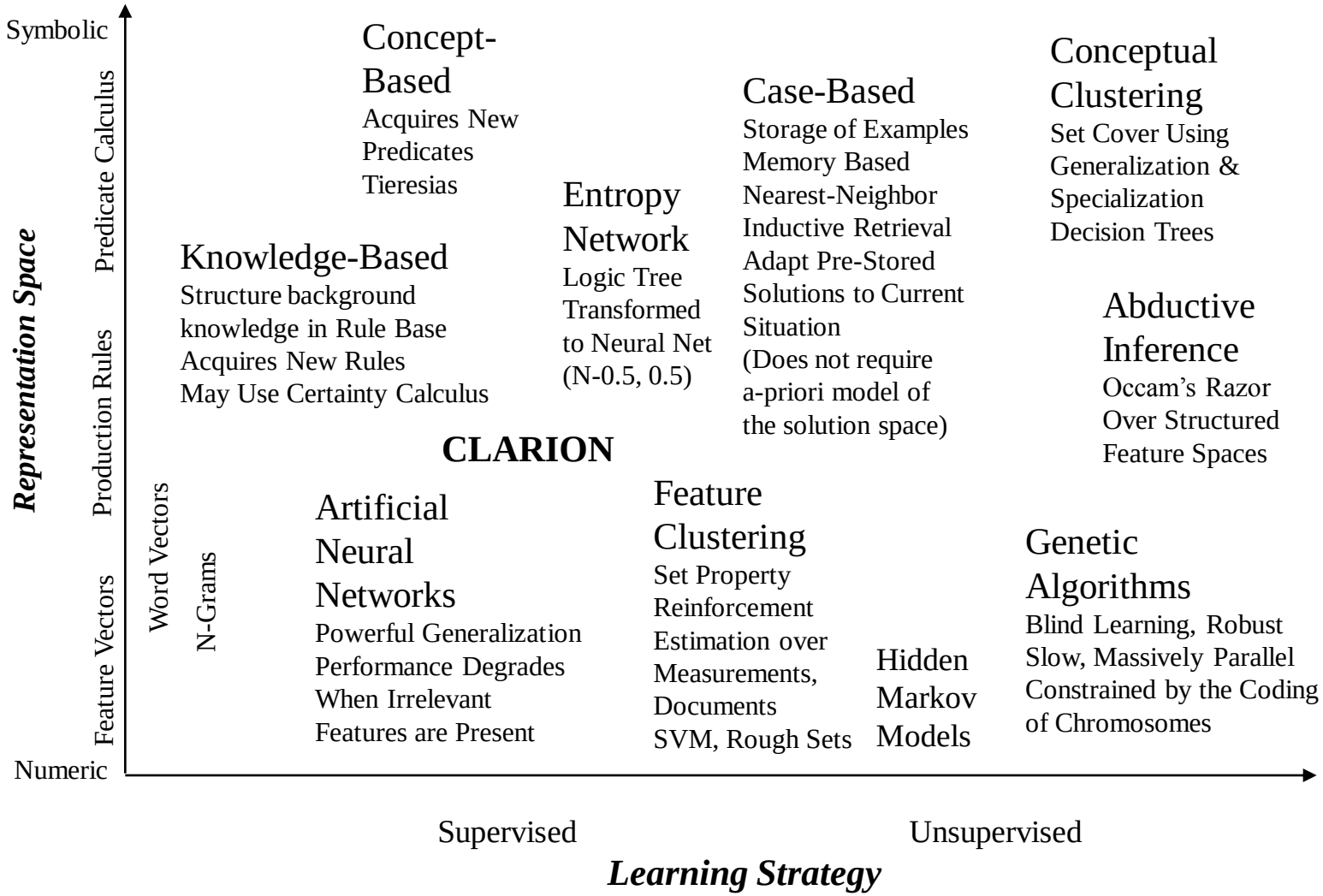
# Fine Structure Sensing and Control

**100 mW GSM GPRS (Blue)**
**25 kHz LMR Voice (1.2km Red)**

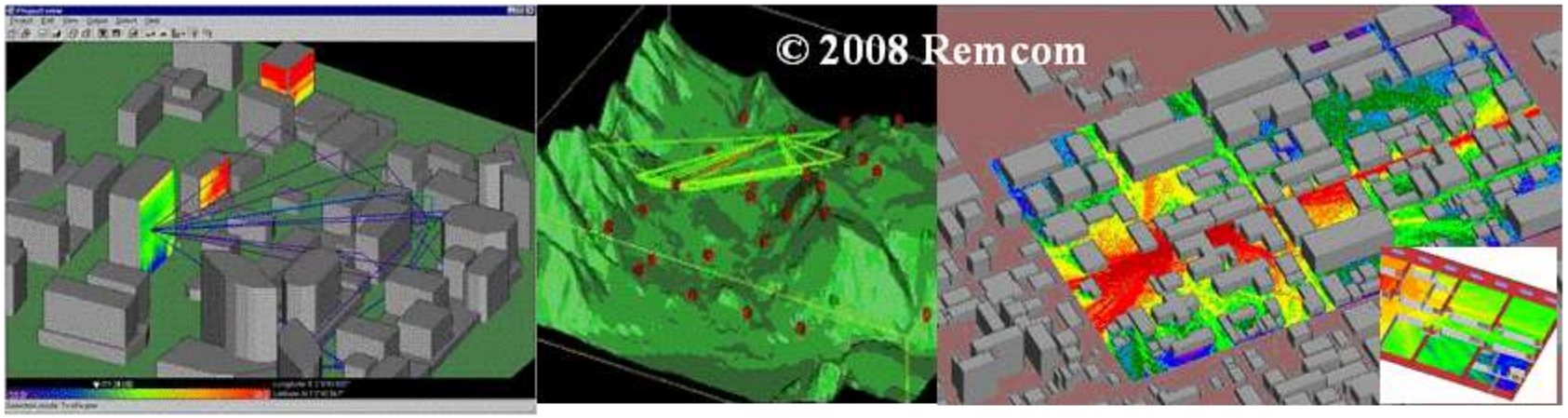
**WiFi 1 Mbps VoIP Coverage (Green)**



# Machine Learning



# Sensor-Validated RF Modeling

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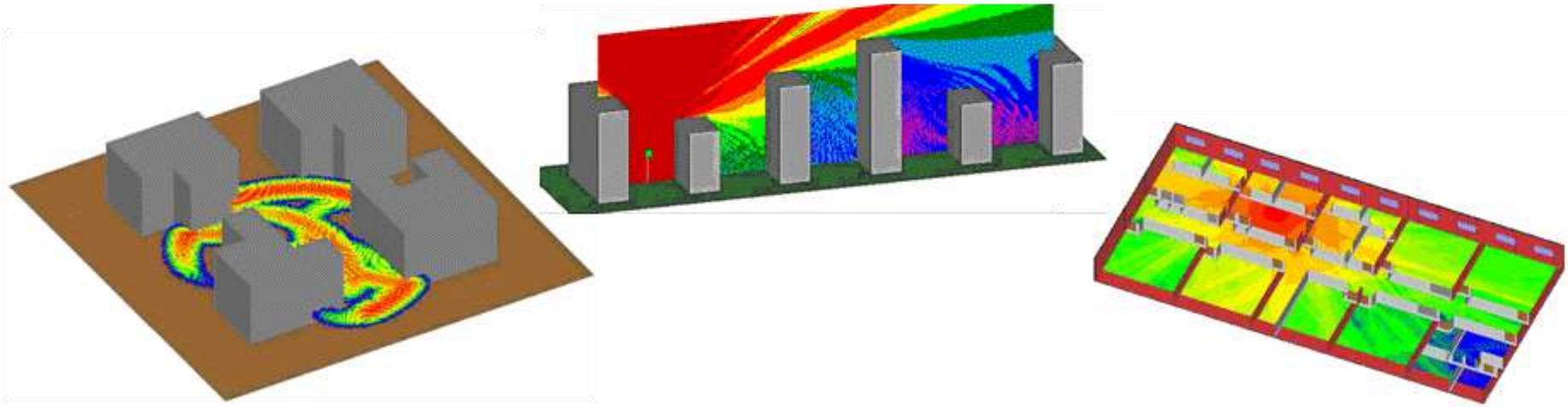
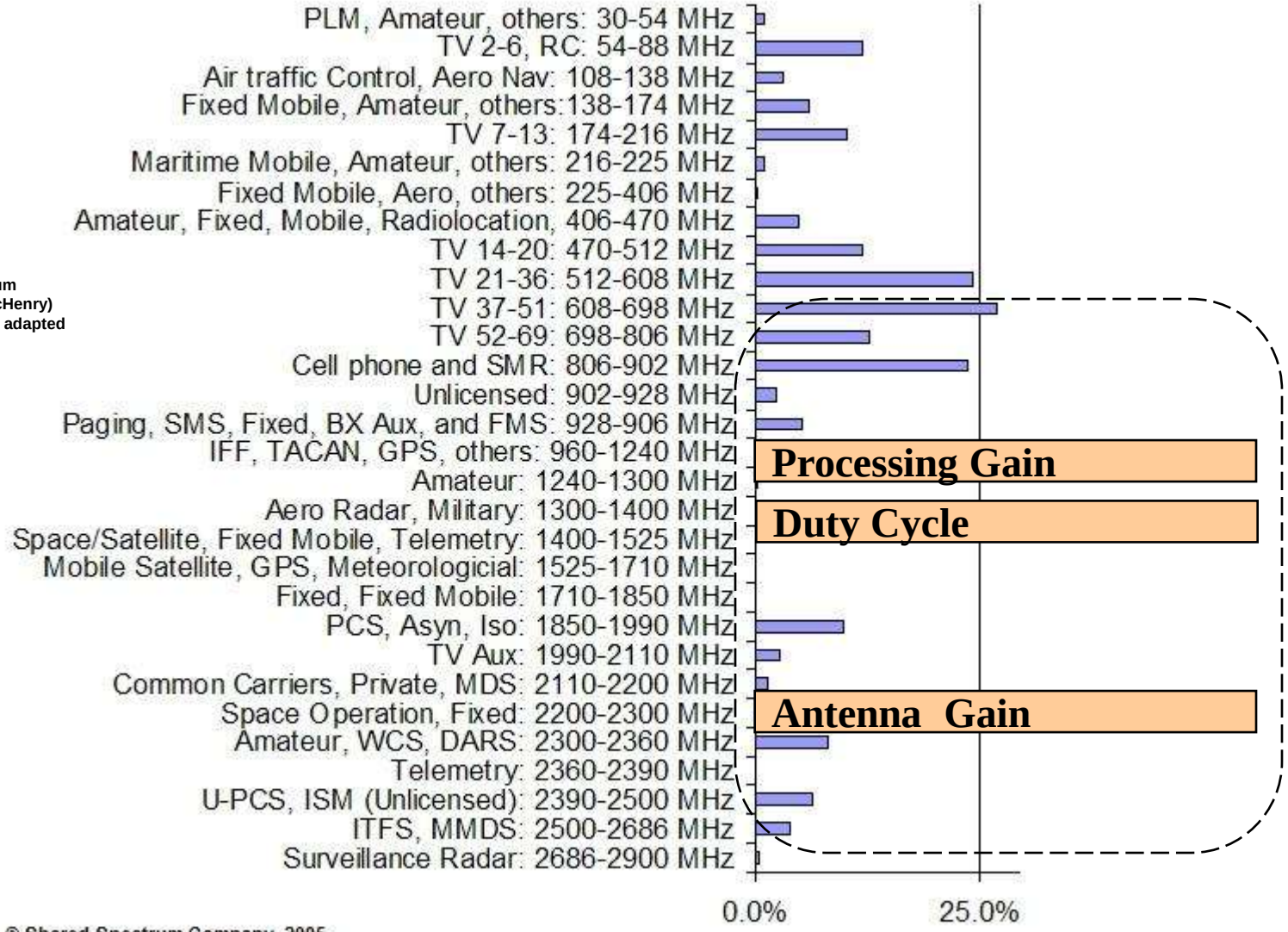
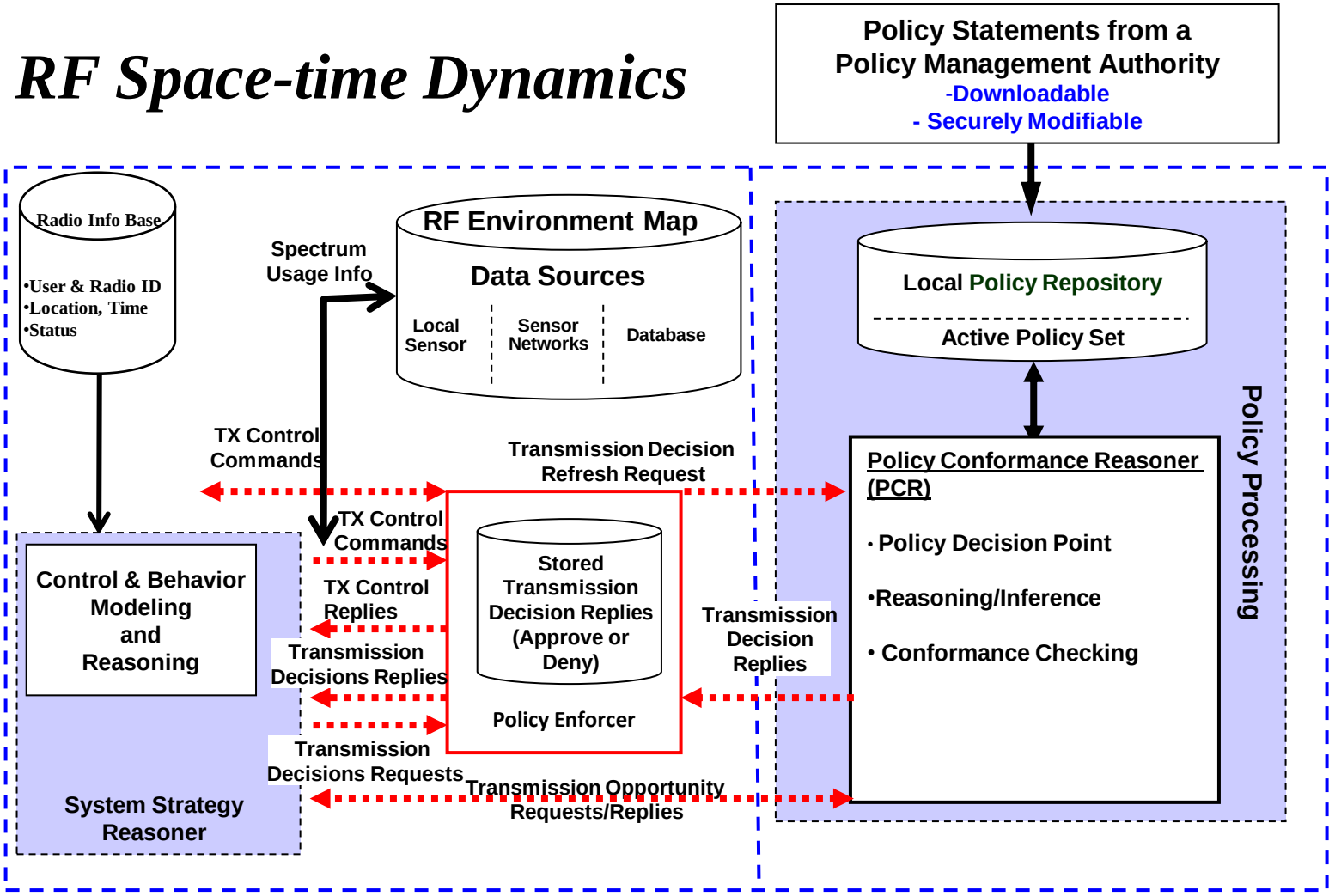


# Intelligence in the Network



# Policy Reasoning



# Semantic Signal Processing

| Source (Type or modify your source code here) | Abstraction & Representation | Semantic Representation (Type or modify your XML code here) | Inference Engine & Translation Service | Target (Generated C/C++ or Matlab code here) |
|---|---|---|---|---|
| Source Language: Matlab<br>Examples: A simple transmitter | | XML Example1 XML Example2 | | |

```
if (Signal_arrival==1)
 Signal_Mod=Transmitter(Signal_Bit);
end

function Signal_Mod=Transmitter(Signal_Bit)
 Signal_Code_Bit=Channel_Coding(Signal_Bit);
 Signal_Mod=Modulation(Signal_Code_Bit);
end
```

```
<Path name="main" >
<Cause name="Signal_arrival==1" >
<Path name=" f_Signal_arrivalE1" >
<Place name="Input">
<Thing>Signal_Bit</Thing>
<Action> input </Action>
</Place>

<Place name="Input">
<Thing>Signal_Bit</Thing>
<Action> input </Action>
</Place>

<Place name="Channel_Coding">
<Thing>Signal_Bit</Thing>
<Action> output </Action>
</Place>
<Place name="Input">
<Thing>Signal_Code_Bit</Thing>
<Action> input </Action>
</Place>
```

To Matlab

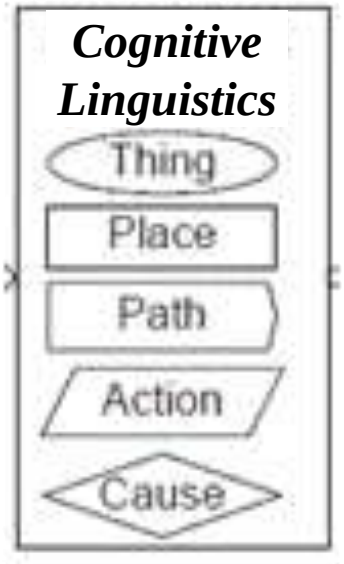
```
//This is the C code generated from XML.

void main() {

   double Signal_Bit;
   double Signal_Mod;
   if (Signal_arrival==1) {
      Signal_Mod= f_Signal_arrivalE1(Signal_Bit);
   }
}

double  f_Signal_arrivalE1(double Signal_Bit) {
   double Signal_Mod;
   Signal_Mod=Transmitter(Signal_Bit);
   return(Signal_Mod);
}

double Transmitter(double Signal_Bit) {
   double Signal_Code_Bit;
   double Signal_Mod;
   gnal_Code_Bit=Channel_Coding_C(Signal_Bit);
   gnal_Mod=Modulation_C(Signal_Code_Bit);
   turn(Signal_Mod);
}
```




***Reverse Engineer Existing Systems***

***Affordable Transition to new RF Platforms***

# Conclusion

- Cognitive Radio > Dynamic Spectrum Access
  - 3G/4G Wireless Internet of Things
  - Network awareness of Things, People, Places
- Computational Intelligence
  - Strengths in Machine Learning, I
  - Weak in Semantics for Policy.
  - Affordable Re-Engineering is
- Information Networks
  - Holistic Systems Engineering Approaches Needed

**DoD Systems Engineering Research Center Initiative**