IPA Volume 3: Cognitive Radio Context, WISDM, and Big RF

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1. **Cognitive Radio Technologies**
2. Peter G. Cook Consultancy
3. Harris Corporation
4. ON Semiconductor
5. King's College, Longon
6. NASA
7. Idaho National Labs

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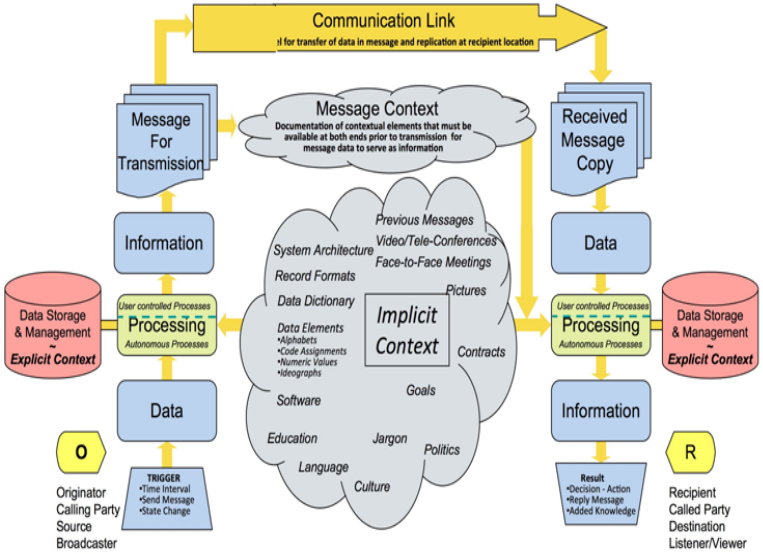
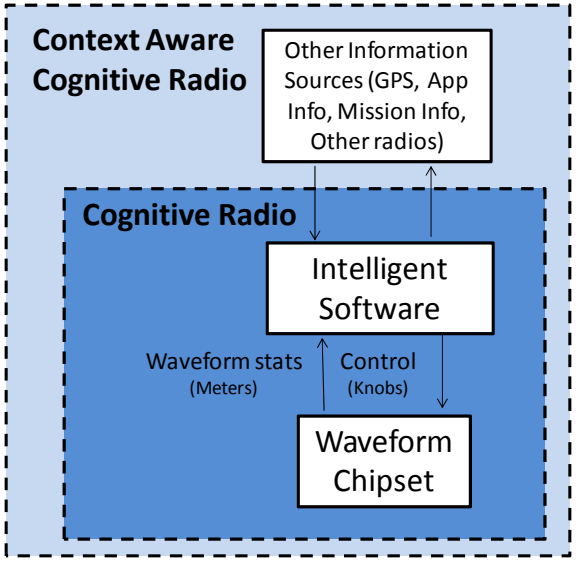
Context to… the context

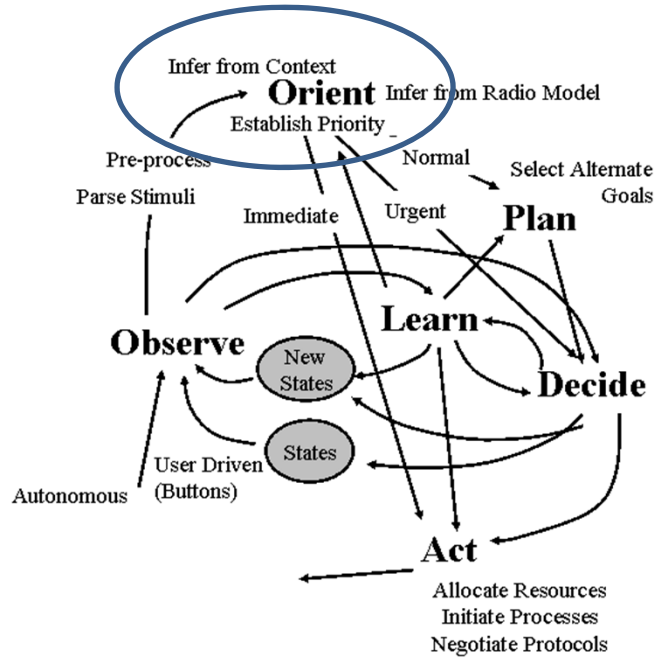
- Presentation intended to accompany report on CRWG project
- Unifying theme:
  - how can we enable cognitive radio systems to leverage information beyond the basic waveform stack
- Inspired by previous work that identified shared context was critical to communications
- Particularly motivated by what information beyond the waveform stack ("traditional CR") could be leveraged to improve radio and network performance
- How would you enable a CACR?
- How would you model a CACR?
- How could you make this info actionable?



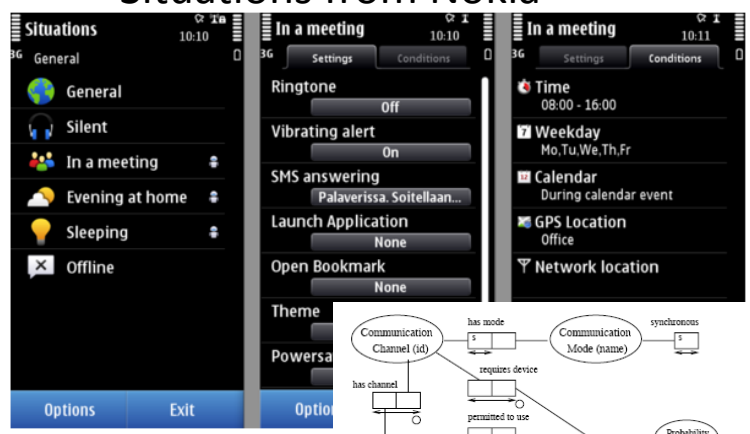


Cognitive Radio Context

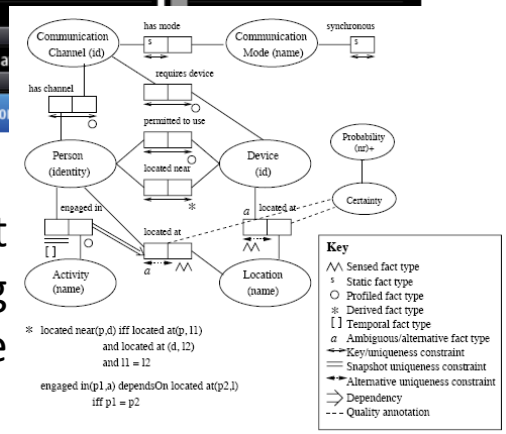
- **Context**:
  - the parts of [communications] not directly communicated that influence its meaning or effect (Modified from dictionary.com)
  - any information that can be used to characterize the situation of an entity (Dey)
- Old, but under-researched
- Extensive work providing context for applications (Gimbal, Situations) little used to change out waveforms



Situations from Nokia

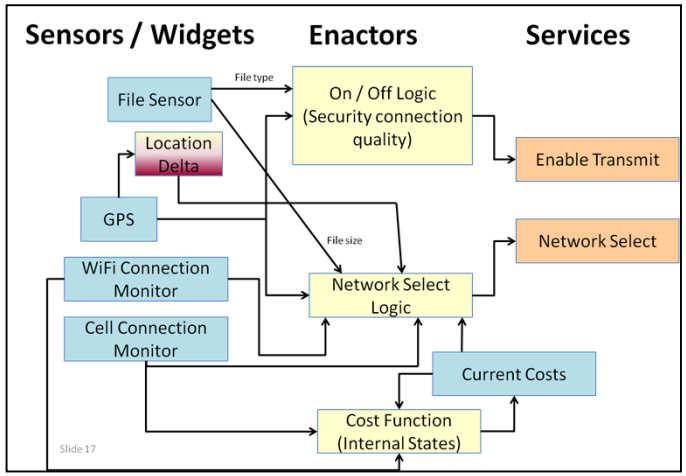


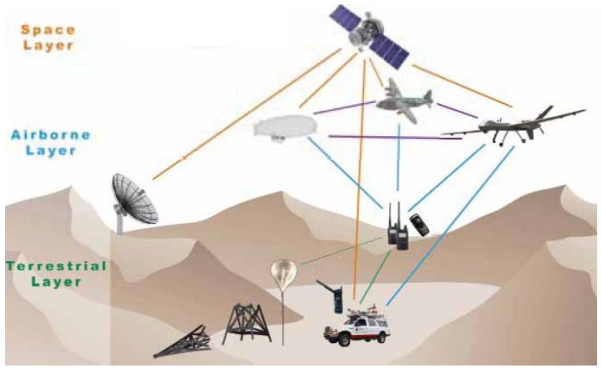
Context modeling language



Context Report Material

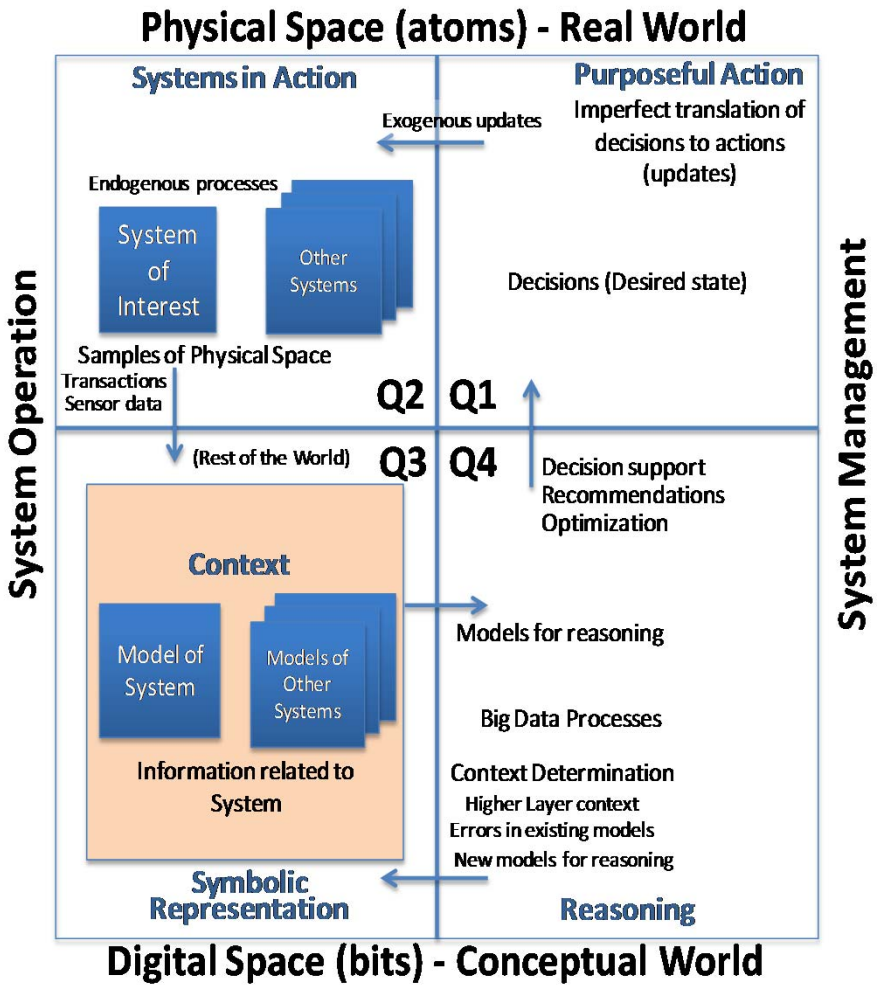
- Survey of context-aware applications and definitions
- Sample java implementation of a context aware cognitive radio application using Context Toolkit
- Formal representation of context and mechanism for assessing contextual “relatedness” in a closed system
- Proposal for a “context factory”
- Applications
  - Crypto / security
  - Hospital-room-of-future
  - Heterogeneous network management
- IPA v2 work looked at what fields are most common in contextual languages





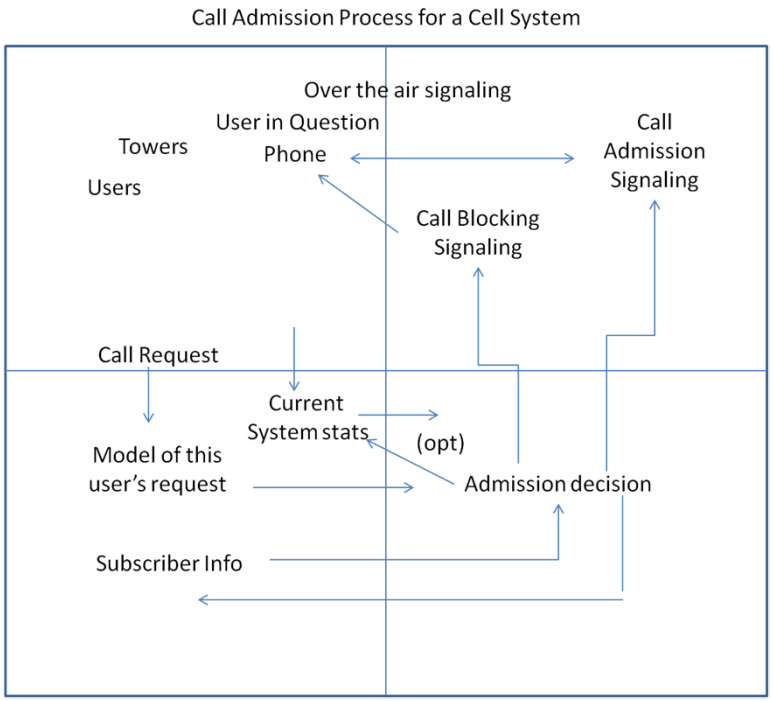
Wireless Information System Descriptive Model

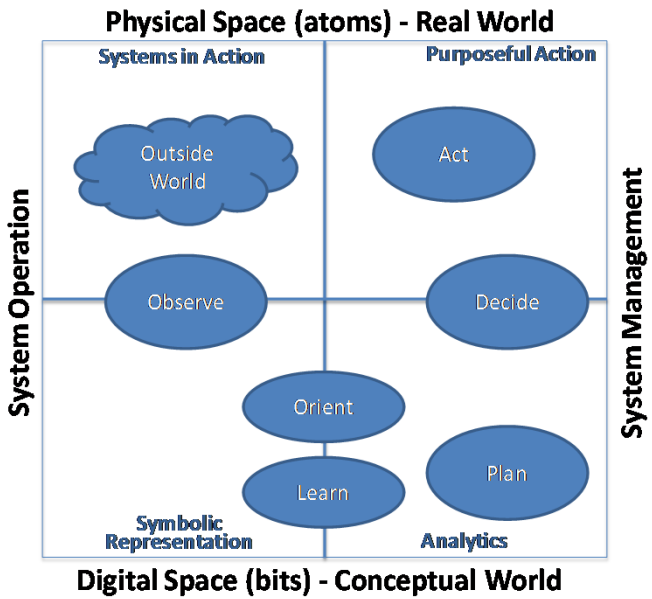
- Model of how a contextually aware system reasons and interacts with the world
- Insights
  - Reason over models
  - Models updated by observations and reasoning
  - Model selection and parameters determine context
  - Processes are error-prone



WISDM Report Material

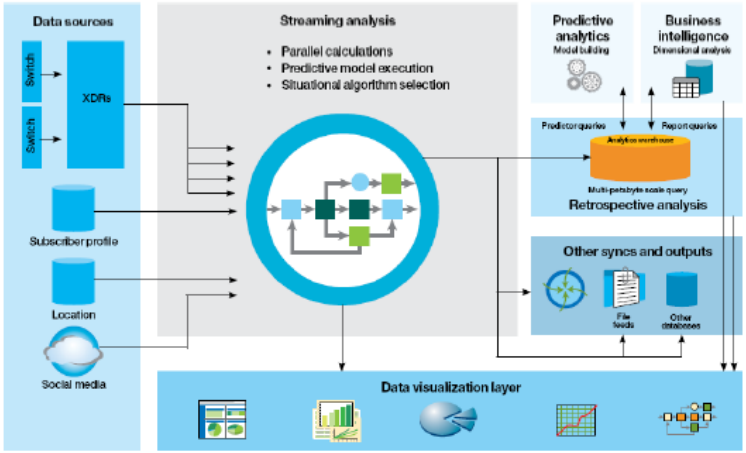
- Formal definition of WISDM
- Sample WISDM models of
  - OODA loop
  - Call admission
  - Credit card processing
  - Human reasoning
  - Context Toolkit
  - Big Data
  - Spectrum management

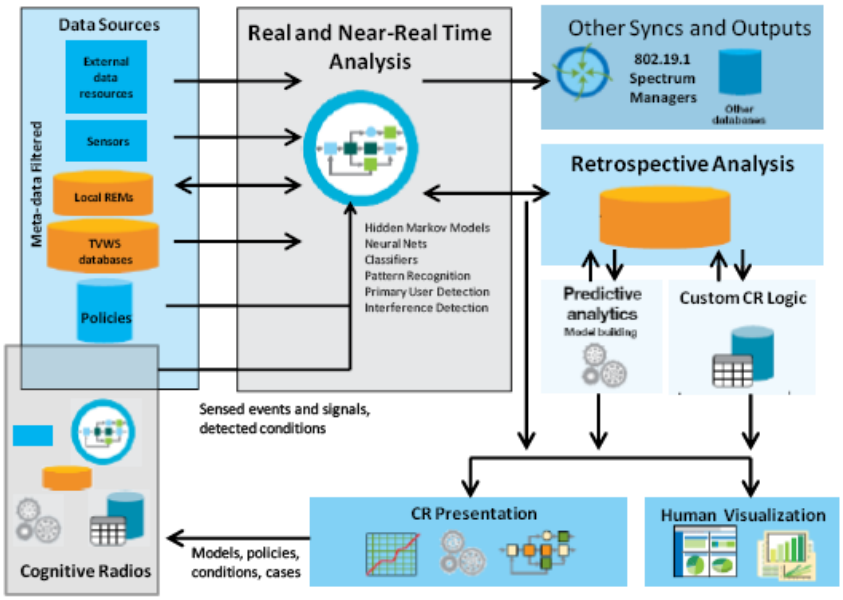




Big RF

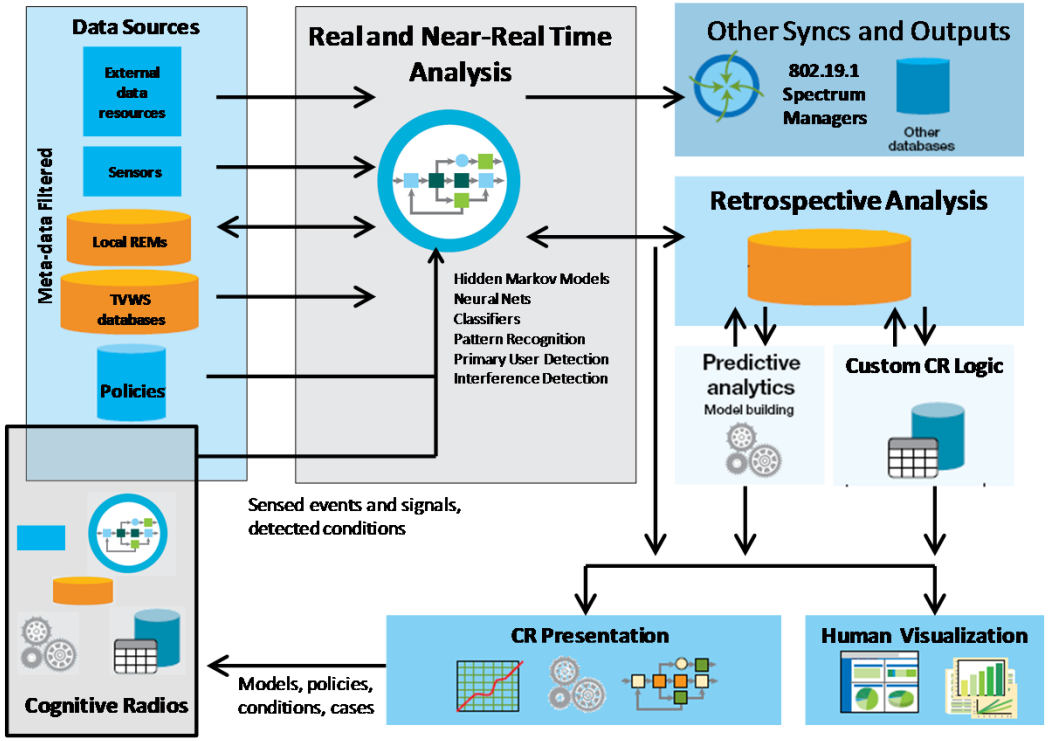
- Big Data (loosely defined)
  1. a collection of emerging techniques and processes for rapidly acquiring, classifying, and synthesizing meaning from Terabytes or Petabytes of data
  2. the data itself.
- Big RF (loosely defined)
  1. the application of Big Data tools / techniques / approaches to address RF-domain problems





Big RF vs Big Data

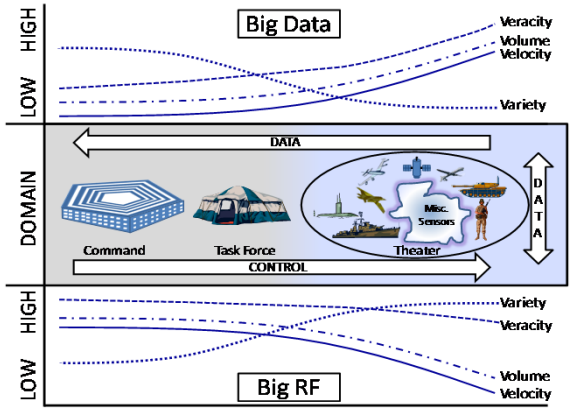
- **RF Focus**
  - Data sources are more focused on RF
  - Customized RF-specific logic
- **Multiple analysis consumers**
  - CR and human
  - Implies CR "presentation" layer for Big RF results
  - Could assist each other
- **Looping data flow** –
  - CR is both consumer and source
  - Feedback loops => stability concern
    - And security!

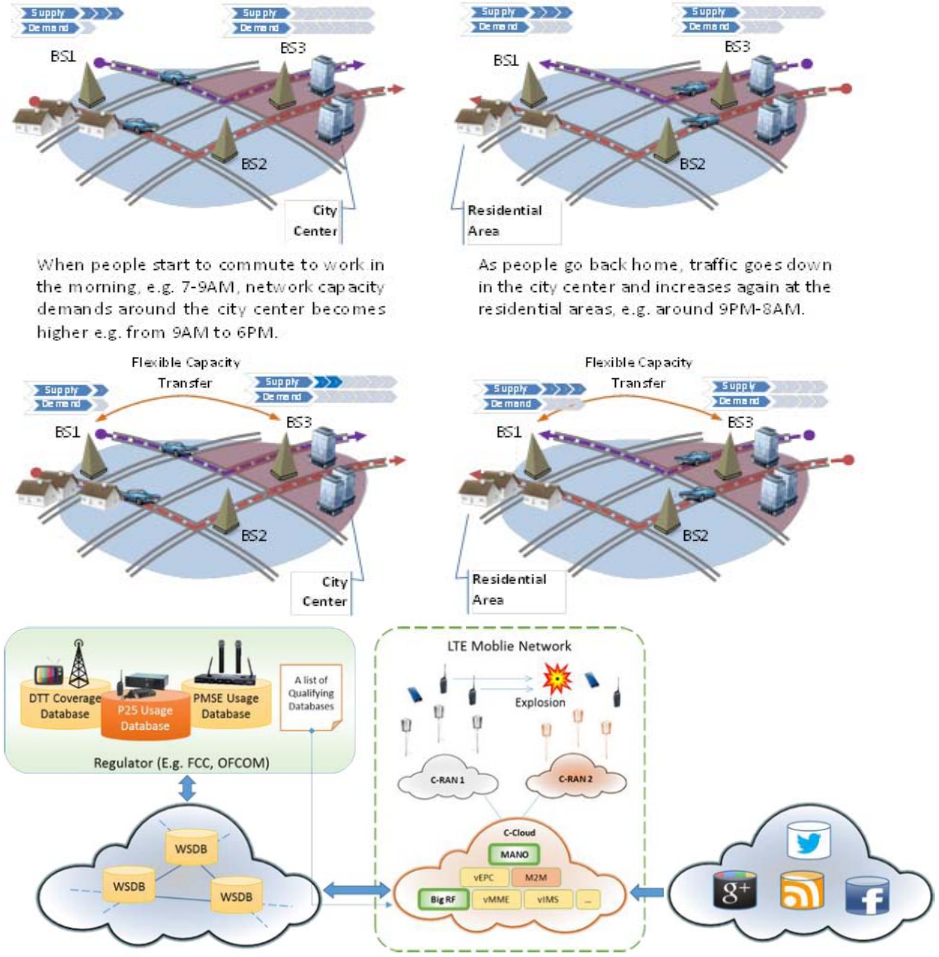


- **Self-similarity** –
  - Loosely, CR and Big RF are implementing the same processes
  - Implies
    - means to scale up
    - Possibility of distributed implementation

Report Material

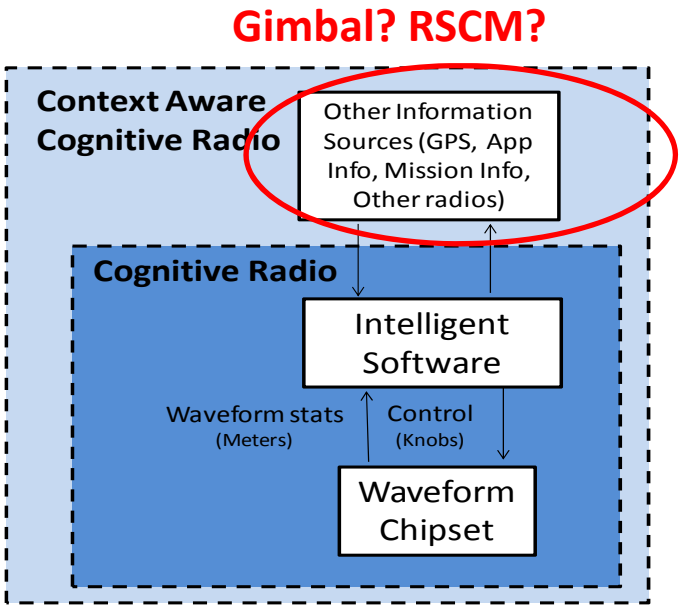
- Survey of Big Data tools and assessment of appropriateness to RF domain problems
- Big RF Reference Architecture
- Applications / use cases to: disaster responses, military, cellular network management
- Plans for Big RF Workshop at SDR 2015





Research Opportunities / Needs

- Extensible languages for modeling and reasoning on contextual information
- Appropriate mechanisms for assessing context
- Sharing context
- Programming languages for network managers
- User-interface for feedback
- Contextual pattern recognition
- Tools for automating the creation and updating of context models



- Applying context information to control wireless chipsets
- Big Data Tools applicable to RF problems

Want to Help?

- Weekly Virtual Meetings
  - Wednesday 11:30-12:30 (Eastern)
  - +1 (626) 521-0010
  - Go To Meeting ID: **950203273**
- "Meat-space" Meeting Tomorrow (Thursday)
  - 8:30-12:00 in Maletesta
- Have an existing document we should be aware of?
  - Email: james.neel@crtwireless.com
- Want to write something new related, but outside the group?
  - Big RF Workshop at San Diego 2015