Managing Multi-Tiered Access Using Spectrum Consumption Models

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Recommendation

- **The Spectrum Access System (SAS) should be a Model-Based Spectrum Management (MBSM) System**
- **Why?**
  - Enables the multi-tiered spectrum management
    - Supports management of coexistence
  - Enables revelation of spectrum use without revealing sensitive details of system capabilities and operations
  - Supports distributed management using a vendor independent technology

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What is MBSM?

- **Spectrum management (SM) based on the creation and exchange of spectrum consumption models (SCMs)**
- **SCMs**
  - Capture spectrum use, using the minimum common set of data that is shared among machines, systems, processes, and organizations
  - Have attendant computations for assessing compatibility among models (A common means across the entire SM system)
 - Loosely couples SM and provides a common means for communities to communicate spectrum use

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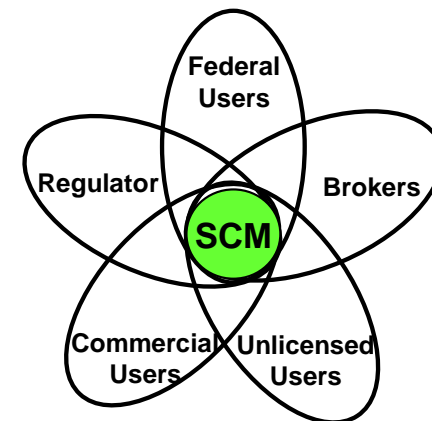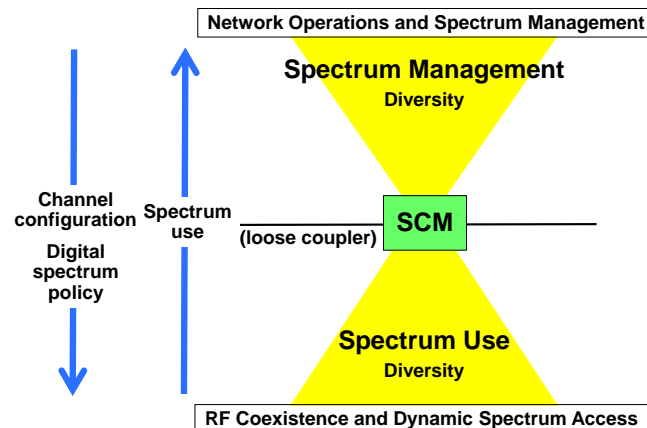
12 Constructs for Building SCMs

- **Total power** ← **Captures the spectral content of the signal and the unique characteristics of spread spectrum systems**
- **Spectrum mask** ←
- **Underlay mask** ← **Captures a definition of interference**
- **Power map** ← **Can capture antenna effects**
- **Propagation map** ← **Can capture environmental effects**
- **Intermodulation masks**
- **Platform** ← **Captures susceptibility to intermodulation**
- **Location**
- **Start time** **Enable greater spatial and temporal resolution in spectrum management**
- **End time**
- **Minimum power spectral flux density**
- **Protocol or policy** ← **Can capture behaviors that enable compatible reuse**

Most constructs have probability data elements to declare confidence in parts that are variable or are uncertain

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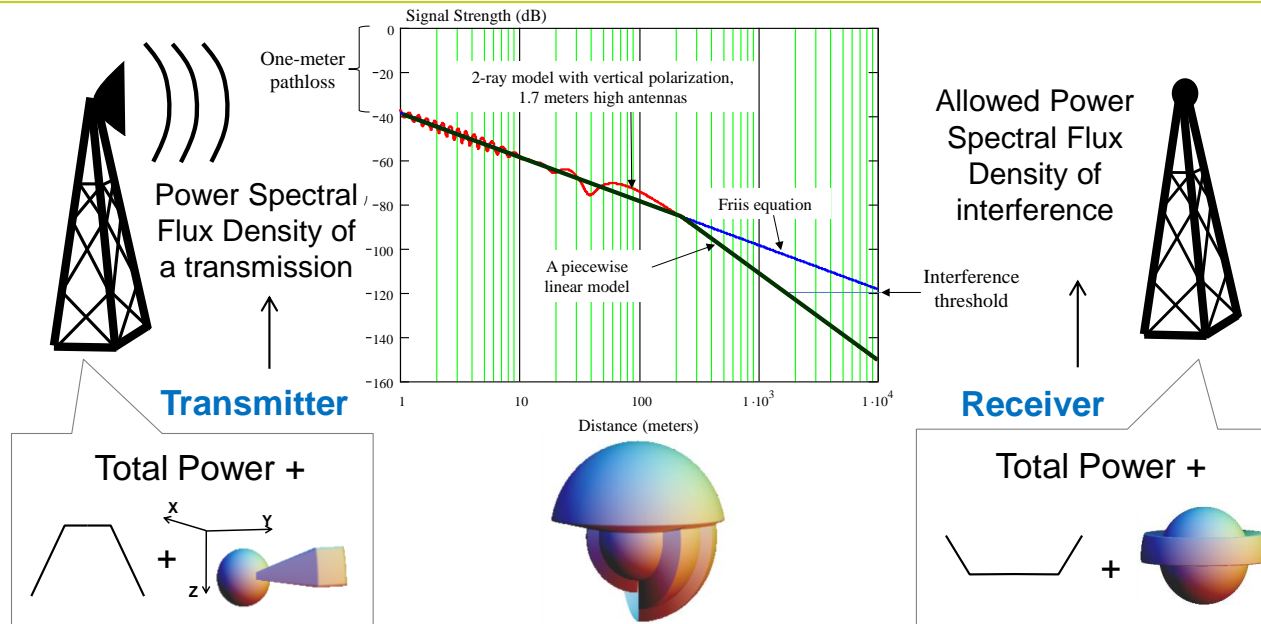
Combining Constructs into Models
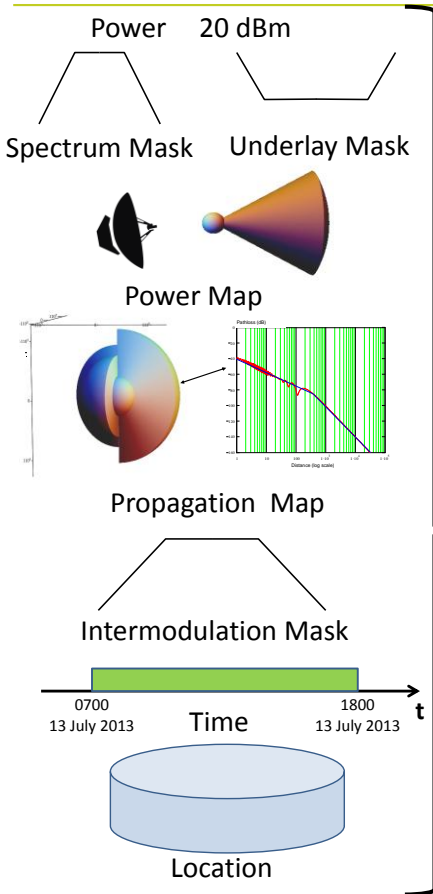
Constructs are used to model transmitters and receivers
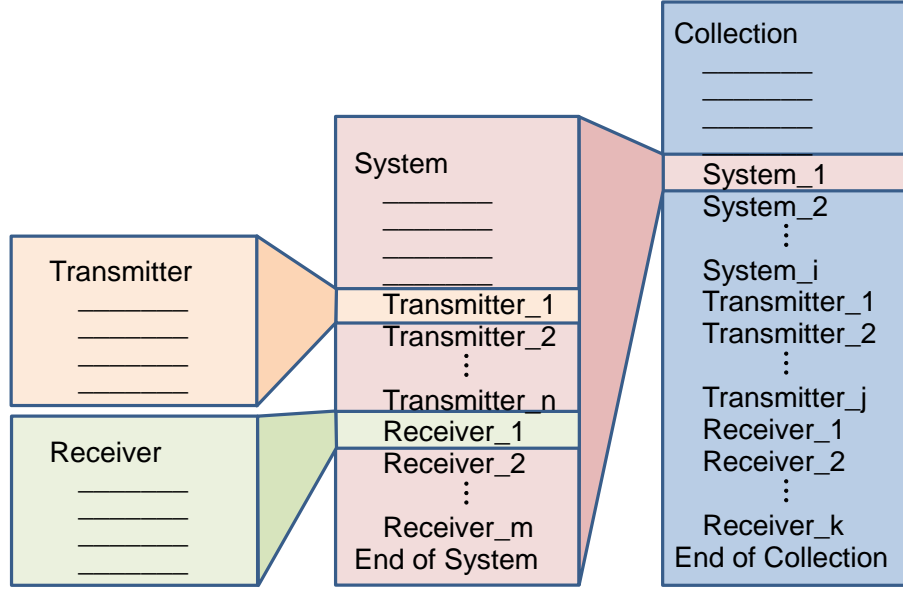
There is an XML schema for model construction

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Compatibility Computations

- **Constructs are a means to specify the factors that determine a link budget**
- **Modelers build SCMs to identify the power spectral flux density of transmissions and allowed interference**

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Multi-Tiered Management

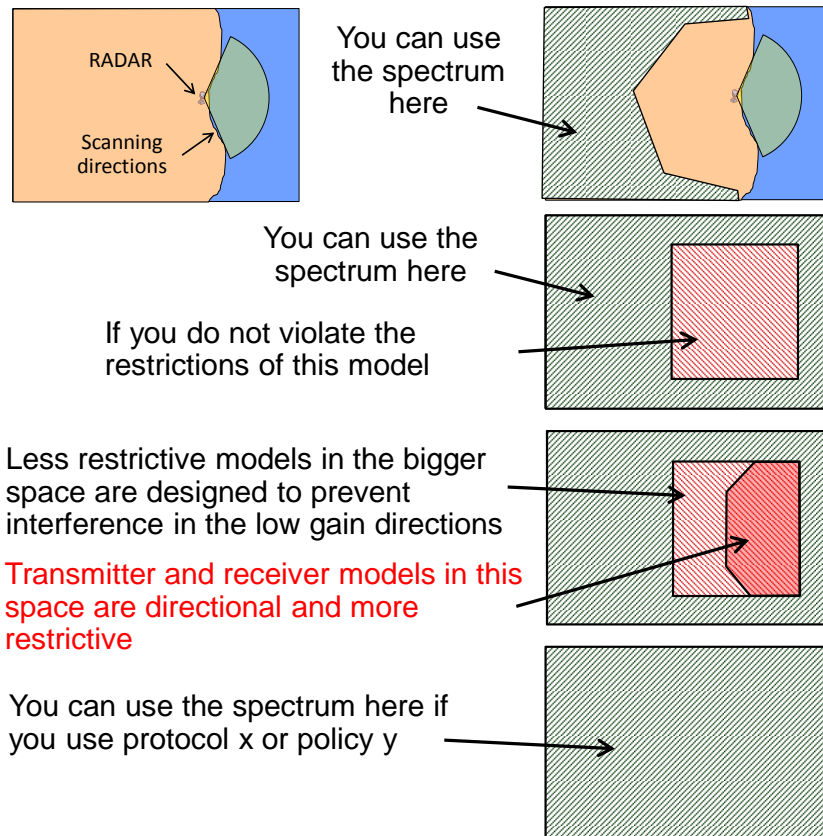- **Very different from a TVWS database**
  - Rather than a regulator providing contours all users provide SCMs of their spectrum use
  - SCMs serve as contours
  - Rather than the administrator just providing a list of available channels the system supports the distributed management of coexistence
  - The distinction between user tiers is an administrative difference controlled by process

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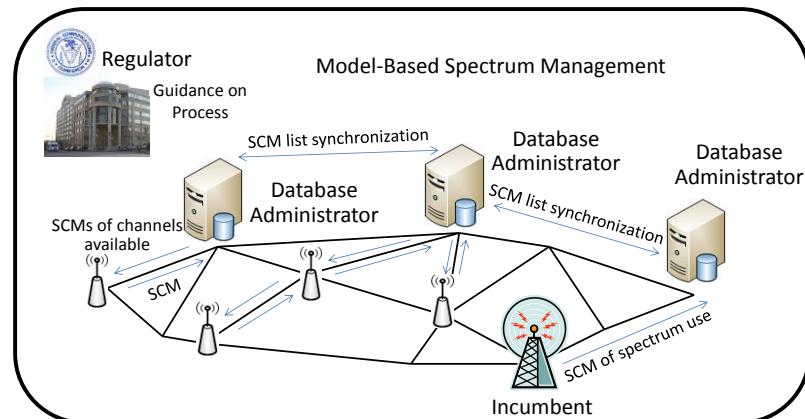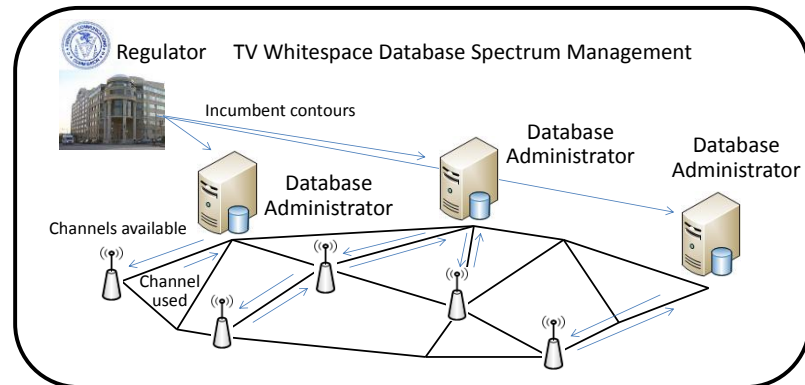
Protecting Sensitive Details

- **Models that reveal opportunities for secondary use may be permissive or restrictive**

- **Modeling provides multiple options on how to model spectrum reuse**

- **Spectrum modeling can evolve to reveal more reuse opportunities once parties come to trust each other**

Coastal Radar Scenario

RADAR

Scanning directions

You can use the spectrum here

You can use the spectrum here

If you do not violate the restrictions of this model

Less restrictive models in the bigger space are designed to prevent interference in the low gain directions

Transmitter and receiver models in this space are directional and more restrictive

You can use the spectrum here if you use protocol x or policy y

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Vendor Independent

- **Spectrum consumption modeling is being standardized by the IEEE Dynamic Spectrum Access Networks Standards Committee (DySPAN-SC) in P1900.5.2**

- **This is a new project started this year and new participants are welcome**

- **For details on the IEEE 1900.5 WG go to http://grouper.ieee.org/groups/dyspan/5/index.htm**

- **To join a MITRE's MBSM Handshake group, send an email to jstine@mitre.org for an invitation**

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