



Presentation to WANN Proposer's Day



XG Communications Program Information Briefing



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**Defense Advanced Research Projects Agency
Advanced Technology Office**

**Rescue
Radio**

**Retro-Directive
Noise
Correlating
Radar**

**Radio-Isotope
Micro-power
Sources**

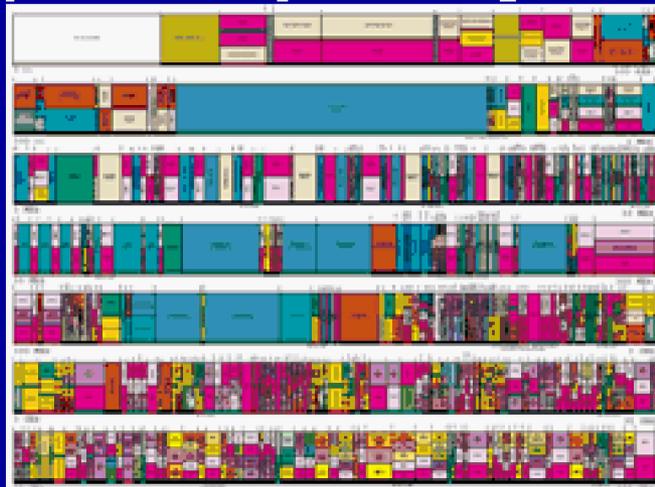


**Disruption
Tolerant
Networks**

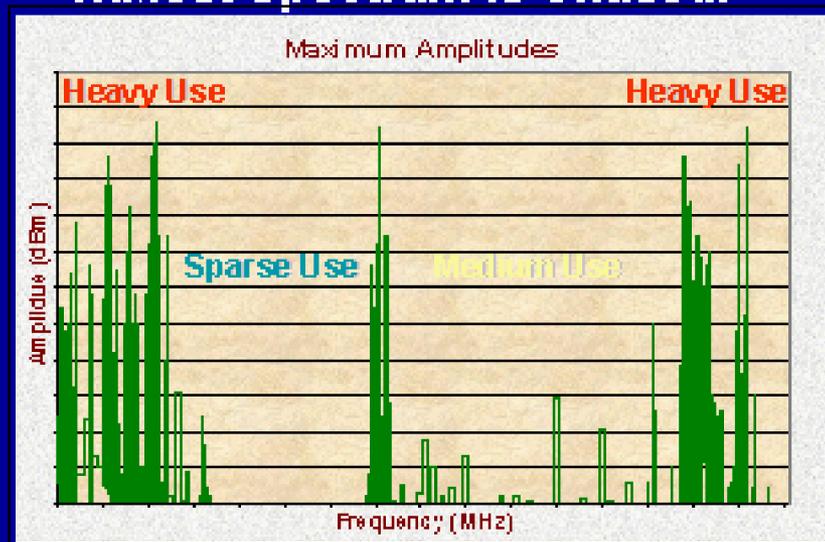


XG
Next Generation Communications

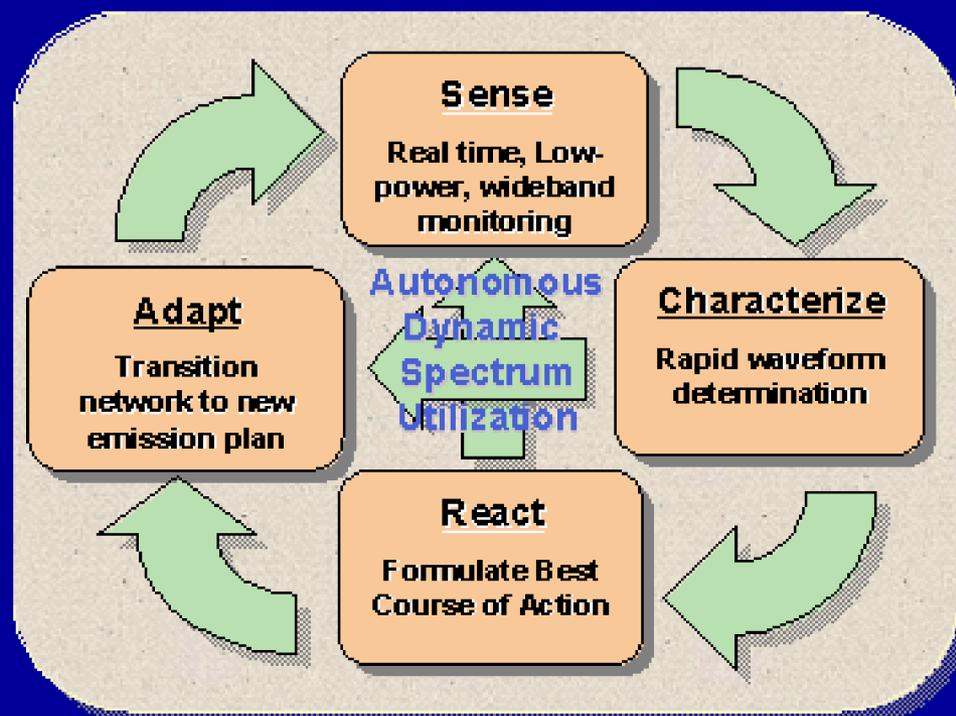
All Spectrum May Be Assigned, But...



...Most Spectrum Is Unused!



XG is Developing the Technology and System Concepts for DoD to Dynamically Access All Available Spectrum



Goal: Demonstrate Factor of 10 Increase in Spectrum Access



XG Key Principles

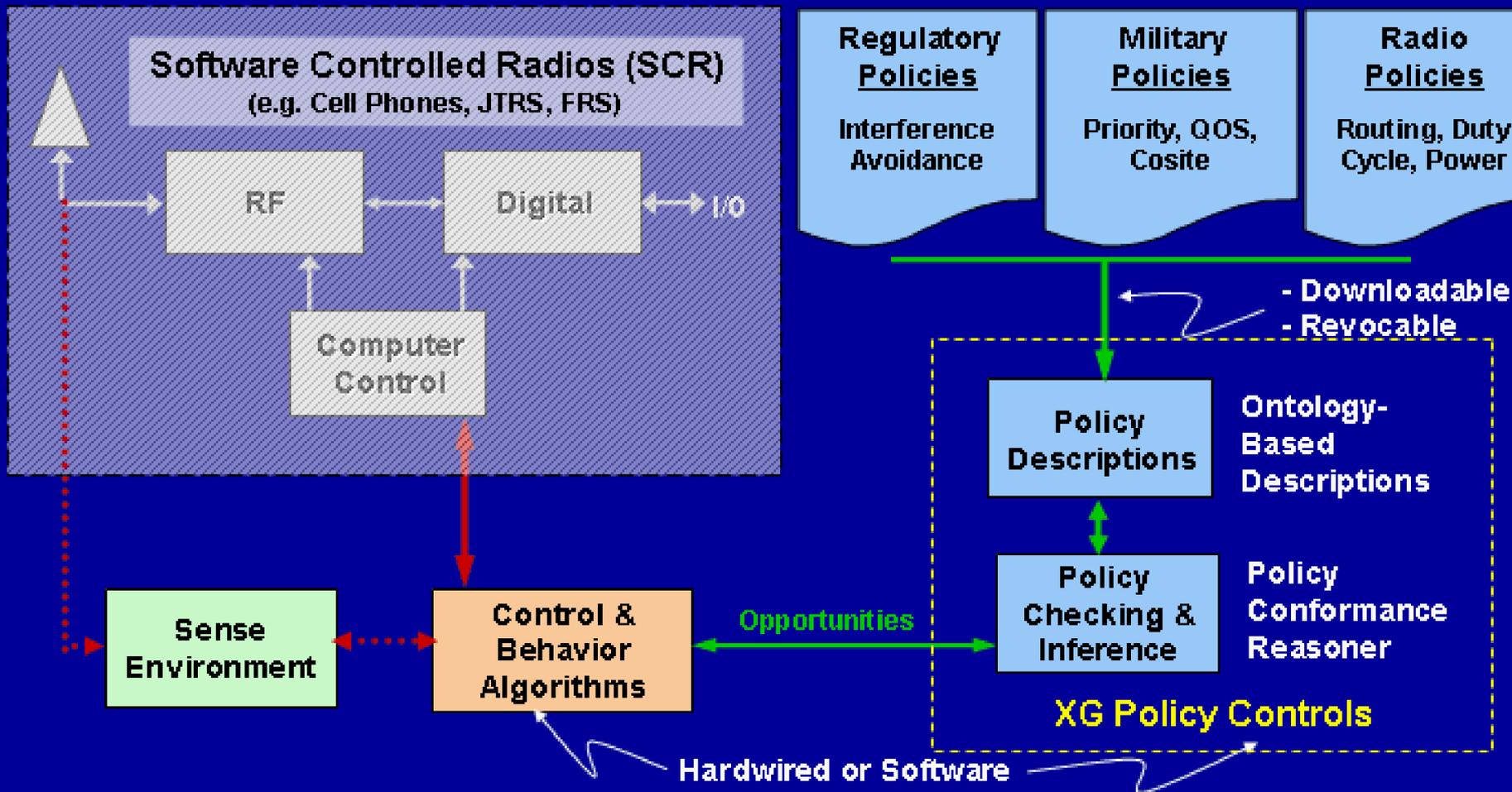


- **Suitable for Range of Architectural Implementations**
 - Centralized And Decentralized
- **Identify “Interference-Preventing” Core Set**
 - Flexible with Respect to Desired Interference Threshold(s)
 - Extensible To Other Features (Subleasing, Microcharging,...)
- **Separate Spectrum Access Policies From Engineering**
 - Spectrum Usage Rules Not Imbedded/Implicit in Radio Hardware
 - Enable Radio to Adapt to Range of Specific Sharing Policies
- **Provide For Complexity of Policies and Diversity of Policy Sources**
 - Regulations Neither Flat Nor Hierarchical
 - Peer-Peer And Hierarchical Policy Authorities
- **Enable Extension To “Cognitive” Optimizing Logic**

Policy “Layer” Flexible for Implementations to Use Without Revisiting for Engineering & Policy Changes



XG – Program Components



The Primary Product XG Program is **Not a New Radio**, but **The Critical Technologies** for Dynamic Military Access to Spectrum

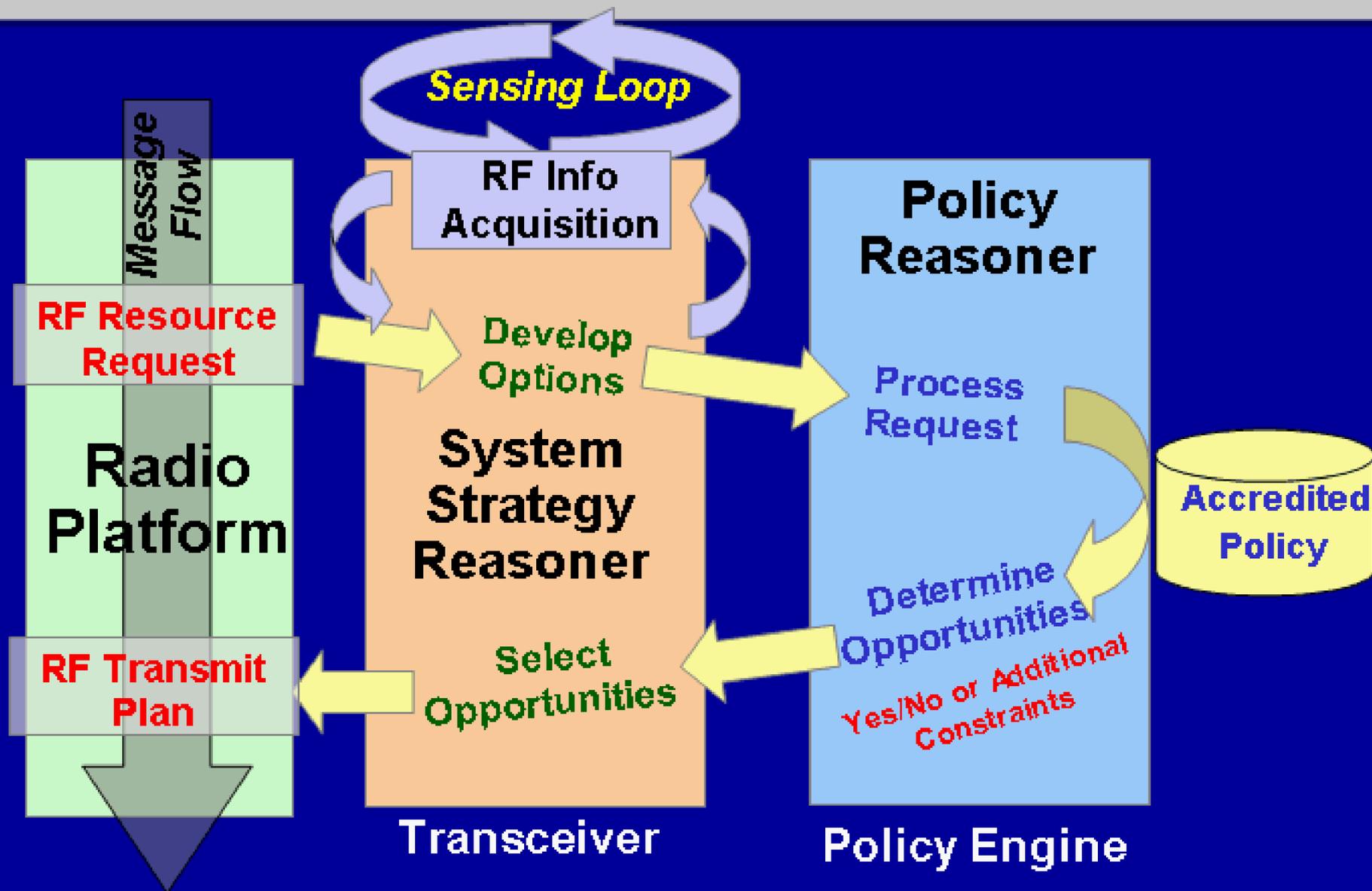


XG Policy-Based Controls



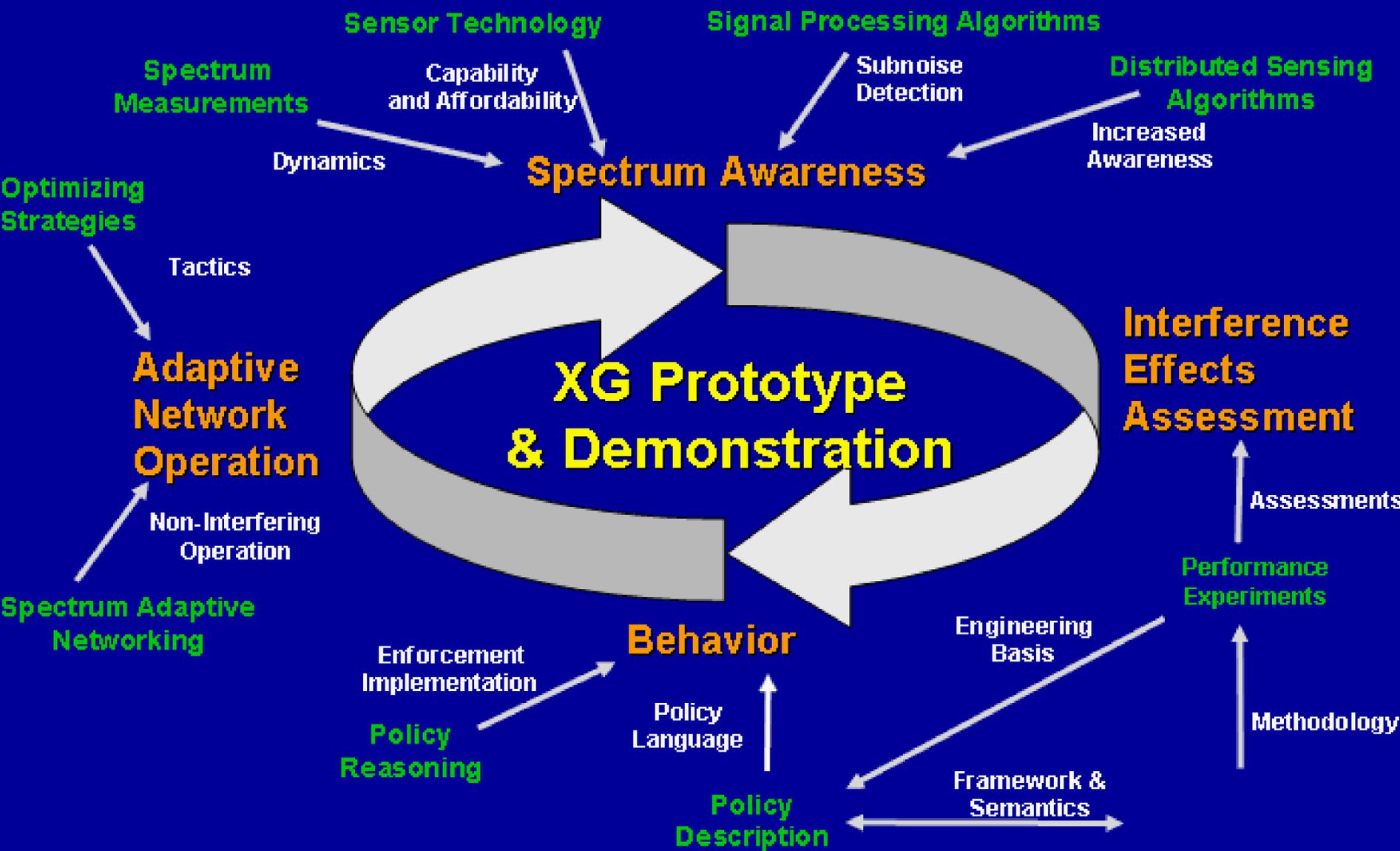
- **XG Being Developed In Advance of Policy Framework**
 - Implementations Must Fit With National And International Regulations
 - Algorithms Must be Adaptable
 - Regional and operational situations
 - Evolving policies and host nation agreements
- **Policy-Based Control Features**
 - Resolve Multiple (Uncoordinated) Sources Of Policy Without Causing Failure
 - Approachable Implementation: Policy Development and Management by Trained Operators
 - Provable Structure: Must Assure Rule Compliance
 - Host Implementation Independent: All Policies Can Run On Any Compliant Device

Policy-Based Controls Will Draw on Practices & Methodologies Currently Employed Manually by Spectrum Managers





DARPA XG Program Investments



- **XG Wideband Sensor Focuses on Capabilities and Features Needed for Transition**

- Small footprint (RF card is 2X2 inches)
- Wide frequency coverage 30 MHz – 2.5 GHz
- Low power (1 W average)
- Fast FFT frame rate
- Provides fast snapshot of spectrum



- **Will be Deployed in Phase 3 Prototypes in Conjunction with High-Sensitivity Detector**

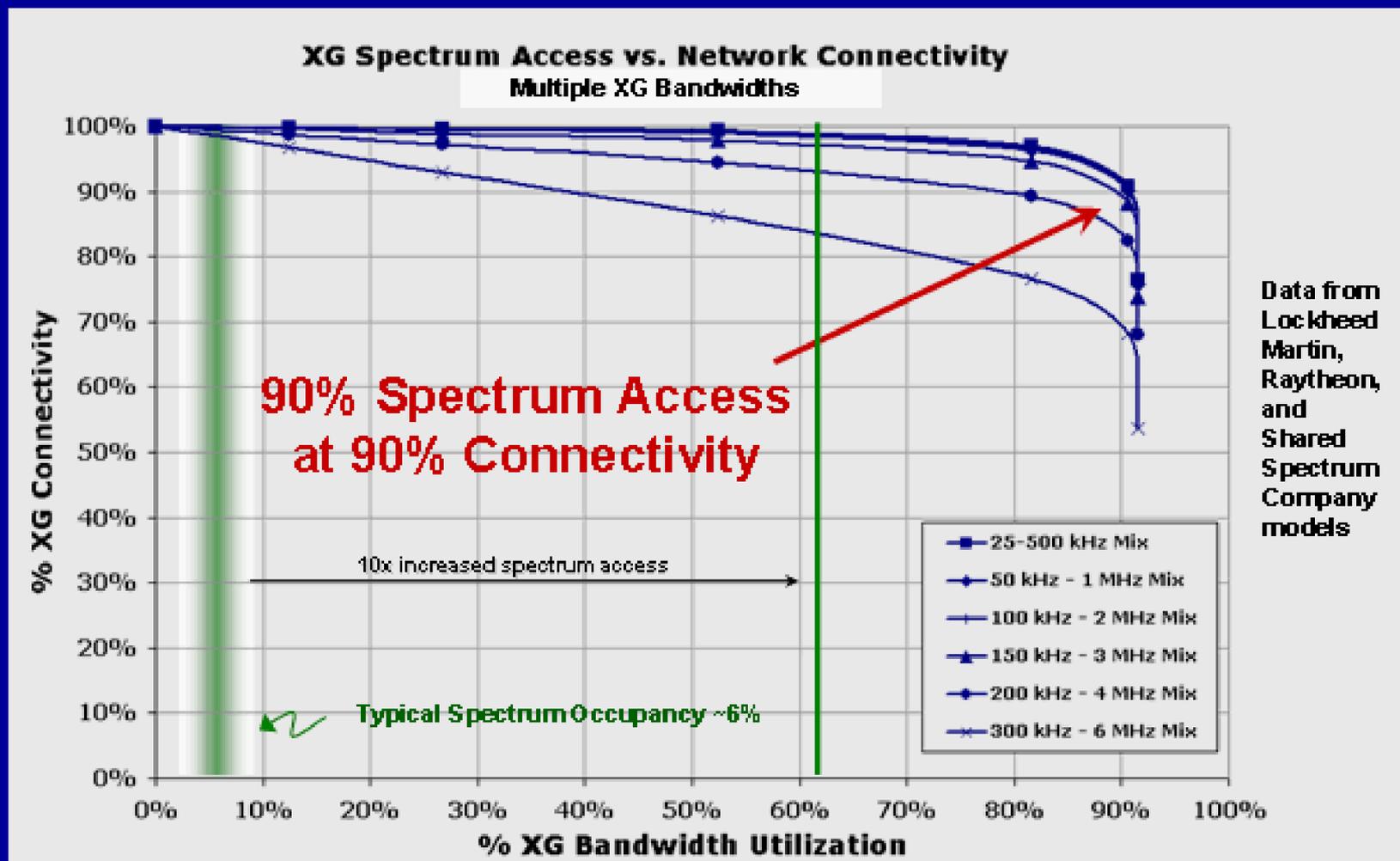
- Subnoise detection for protection of advantaged nodes

Detector Prototypes



High Spectrum Sensing Performance Necessary for XG Implementation to Protect Non-XG Signals

- Simulation of Early Designs Using Recorded Spectrum Measurements Shows Significant Potential





XG Deployment Strategy



- **XG is Not the Universal Solution to All Problems**
 - Some Cases are Likely to be *Too Hard to Deal With*
 - One Hard Case Does Not Invalidate XG Usefulness
- **Testing to be Focused on Identifying and Validating**
 - Low Hanging Fruit
 - Candidate Spectra that are Unsuitable for Sharing
- **Anticipate Incremental Adoption on a Not to Interfere Basis (NIB)**
 - Military on Military (10x Greater Packing of Radios)
 - Military on Shared (Technical Framework for Sharing)
 - Opportunistic (Widespread NIB Operation)

Not Necessary to Establish New Regulatory Framework, Either Nationally or Internationally

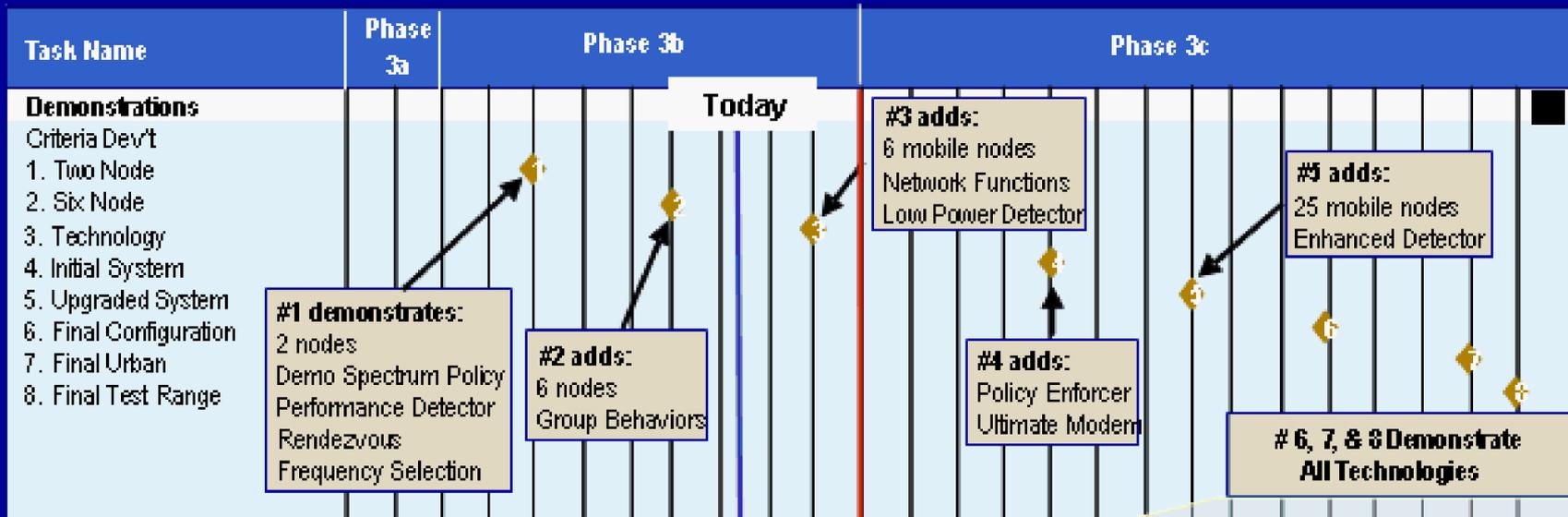


Demonstration Objectives to Show:

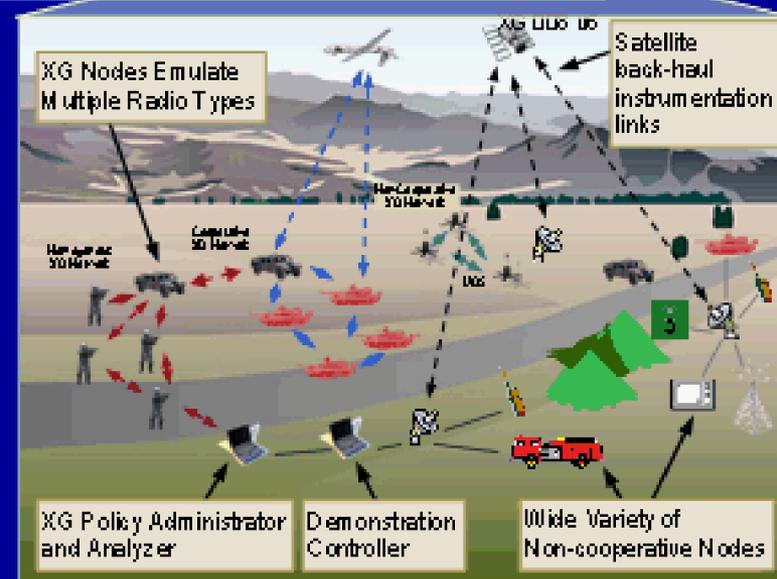


- **No Harm**
 - Detects Potential Victims Before Causing Harmful Interference
 - Disseminates Sensor Data For Spectrum Awareness
 - Incorporates Automated Spectrum Rule Enforcement Algorithms
- **XG Works**
 - Demonstrates Automated Rendezvous and Frequency Selection
 - Enables Node Transitions Between Networks
 - Conducts Operations With Multiple Cooperative and Non-Cooperative networks
- **Adds Value**
 - Increases Spectrum Access and Communications Capacity
 - Implements No Setup Networking
 - Implements Automated Spectrum Rule Updating Algorithms

XG Prototype Development and Demonstration Schedule



- **Conduct Series of Field Demos**
 - Incrementally Add Performance
- **Midterm Demonstration (Demo 3)**
 - 6 Nodes with Core Capabilities
 - Provide Confidence to Stakeholders
- **Final Demonstration**
 - 25 XG Nodes with Advanced Capabilities
 - Show Capability for Transition





Thank you!

Wireless Network After Next
Adapt,
Morph,
Proliferate

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**Rescue
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Polarization Rotation
Modulation



XG
Next Generation Communications