Dynamic Spectrum Access Policy Assessment

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TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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1. Assessment Overview

1.1. Purpose

This report was developed under task DP-006, *Spectrum Architecture and TF ODIN Spectrum Supportability Assessment Architecture Development Program* (ADP) for the Office of the Army Chief Information Officer (CIO/G-6), Architecture, Operations, Networks and Space (AONS). Its purpose is to collect, define and categorize a comprehensive list of the various policies that might be useful for military devices employing Dynamic Spectrum Access (DSA) capabilities. It will also identify those external data elements that may be available to help define or express a policy. The initial listing of these policies is identified in Appendix A of this document, and aligned by Domain.

1.2. Scope

This assessment is part of a larger effort to define the architecture for a DSA Spectrum Policy Generation Service (DSA-PGS). Later products will examine and define the structures and data elements needed to pull required data from existing databases, to generate policies and to validate them prior to delivering them to end users and devices.

This assessment does not attempt to weigh or prioritize the policies by their utility or ubiquity. Some policies listed may be used very rarely or perhaps only by certain devices specifically designed to enable these policies.

1.3. Constraints

This is not an exhaustive list of possible DSA policies. For the purposes stated above only those with a military application or of use to the military are included. Consequently, those policies with purely a commercial or scientific purpose or application were excluded. This list was produced primarily from an endogenous view point; that is policies executed and enforced at the end device. An equally valid view point would be exogenous, whereby a central management system executes DSA policy, and then transmits the various instructions to each user device. Some of the Network specific policies could be considered as exogenous ones.

2. Introduction

Dynamic Spectrum Access or DSA is the topic of much debate and research in the DOD today. This technology provides great promise for better utilizing our limited spectrum. Given the successes of programs like DARPA's Next Generation Communications (XG) and the flexibility provided by advanced software defined radios, a consensus is forming behind adopting DSA as the best means of improving spectrum utilization efficiency. The basic concept of DSA is that by exploiting the multiple dimensions (e.g. frequency, time, space) of the radio frequency spectrum and by enhancing awareness of both historical and instantaneous spectrum utilization within a geographical area, dynamic sharing will improve spectrum utilization and efficiency. DSA can be realized through wireless communications and networking technologies that enable radio systems to dynamically adapt their spectrum access according to criteria such as policy constraints, spectrum availability, propagation environment, and application performance requirements. In short, DSA devices will "share" spectrum by opportunistically utilizing the large amounts of unused (but otherwise reserved) spectrum that is available at any given moment.

To ensure that these devices do not interfere with other legitimate users or violate spectrum use regulations, policies will need to be created that will control all behaviors. Other policies will be

needed to enable DSA devices to provide capabilities desirable for military and network operations.

It is not a stretch to assume that DSA technologies will be fielded in some fashion by 2015. In all probability DSA capable radios and networks will be rapidly replacing legacy ones by this date. There will certainly be a mix of legacy and newer, advanced radios in the field. The legacy ones will still require frequency reservations and manual tuning while the newer ones will automatically sense the local environment and either pick the optimal frequency autonomously or will feed this environmental data to a NMS which will then select the optimal frequency to use. The radios may either tune themselves or provide recommendations to the operator.

Cognitive features will further improve on DSA techniques and will start to be incorporated. In addition to selecting frequencies on a not-to-interfere basis, radios and NMS will select the optimal modes to operate in as well. Power levels, beam steering, waveform, timing, data compression levels, dynamic bandwidth management and advanced filtering may all one day be utilized singly, or in combination, to squeeze every bit of efficiency out of our spectrum usage.

These new technologies will produce other changes as well. Spectrum Managers will spend less time gathering requirements, brokering allotments and provisioning assignments and spend much more time building and maintaining the rule/policy sets that will govern how DSA and CR should behave. How these policy sets are generated and what data elements go into them are the focus of this assessment.

3. Policy Organization

The policies listed in Appendix A of the spreadsheet are grouped into one of nine Types. Assigning types is not only useful for sub-categorizing the policy list but also for building an ontology of DSA terms and definitions and may also be useful for structuring the data elements that are needed to define and express a policy. Using the sort function at the top of Column A of the DSA Policy Sheet, the reader can select groups of policies by type. The nine policy types are:

3.1. Geospatial (G) – Policies that are based on distance or position as their primary trigger factors

3.2. Time Based (T) – Policies for which time or relative time are the primary trigger factors Identity based – Policies that are triggered by the particular ID of the device, the user or the network.

3.3. Identity based (ID) – Policies that are triggered by the particular ID of the device, the user or the network.

3.4. Frequency Based (F) – Policies that regulate the selection of frequency

3.5. Technical Parameter Enforcement (P) – Policies that regulate or are triggered by the operating characteristics of the device.

3.6. Group Behavior (B) – These Policies govern how DSA devices interact with each other.

3.7. Directive Control (D) – Policies that are triggered by entities external to the device and which are often temporary in nature.

3.8. Monitoring Behavior (M) – These policies dictate how the sensing capabilities of a DSA device are utilized.

3.9. Network Specific (N) – These policies only make sense when implemented by DSA devices connected to a network.

In order to further categorize the various policies, each has been placed into one or more of three major domains; Regulatory, Technical and/or Operational. Depending upon the intent of the policy, the Regulatory domain includes those policies that enable the DSA device to satisfy or comply with DOD, National or International laws and regulations regarding spectrum use. The Technical domain includes those policies that are designed to improve a device's access or use of the spectrum or perhaps to leverage the technical capabilities of a DSA capable device. The Operational domain includes those policies that help provide an exclusively military capability or fulfill a strictly operational purpose.

Each policy is assigned a priority. Assigning priorities to each policy will be necessary for a couple of reasons. If two or more policies conflict with each other a priority schema is a common method for resolving the conflict. Priority is also an effective scheme for implementing 2nd and 3rd order policies that are not as important as primary ones. The vast majority of policies will likely fall into the Mandatory or Priority categories. The priority number assigned corresponds to the following list:

- Override
- Mandatory
- Priority
- Routine
- Optional or for future designation
- User defined

The current list of priorities is a "best guess" and will undoubtedly be refined as testing and operational experience reveal more data and dictate differing conclusions. The proposed rationale for the selection of the policies, by category, is reflected in Appendix B, Policy Logic.

Policy generation, validation and management will be an essential support service for enabling DSA technologies. A Spectrum Policy Service (SPS) on SIPRnet is envisioned as the most practical way for the DOD to implement a DSA policy making capability. To the extent possible this service should be able to automate a significant portion of the policy generating process. To do this however it must be able to automatically "pull" required data elements from various SM databases. A listing of expected "Data Element Inputs" is shown at Appendix C. Included on this list are data elements that also exist elsewhere and that might be available to the SPS. The most likely databases from which the SPS could draw this data are the Joint Data Repository for equipment data, the Host Nation Spectrum Management World Wide Database Online (HNSMWD-O) for host nation restrictions and regulations, and the Spectrum Management Transformation Initiative (SMTI) central server for National and DOD regulations, spectrum assignment data and restricted frequencies. Another source of data will come from databases attached to various Network Management Systems (NMS). Not only will these be the source of device, network and users' identification data but could eventually provide entire policy sets specifically generated for devices connected to those networks. All other data needed to generate policies would then be drawn from a dedicated DSA Policy DB or be selected directly by the Spectrum Manager.

Integral to the development and establishment of DSA Policy is the necessity to assure compliance across the board with respect to approved directives/regulations, defined technical capability and limitations, and operational mission requirements and necessity. Accordingly it is

paramount that effective policy development and implementation assure the proper and positive correlation of requirements and constraints across those three domains. This correlation is reflected in Appendix D, the Policy Domain Traceability Matrix.

One policy that is not included specifically in this list is a Coexistence Policy. However, the requirement to not cause unacceptable levels of interference with other SDS is inherent in nearly every policy imaginable (Anti-jamming or policies executed in highly permissive environments being a couple of exceptions). Any particular policy may trigger one or several actions to be taken by the DSA device and/or invoke other related policies. Several of the most common actions that a policy can dictate are designed to ensure coexistence. These actions include, abandoning a frequency, limiting transmission power, increasing bandwidth (spreading the spectrum), changing the antenna direction or perhaps changing the antenna polarization. In the extreme, the policy could dictate that the DSA device cease transmission - period. The necessity of these behaviors would be emphasized by the relative primacy of them when multiple actions are dictated. In a hierarchy of possible policy actions, the actions that ensure coexistence would necessarily trump most others and thus be enacted first. When conflicts between multiple policy actions occur, the action most likely to ensure coexistence would take precedence. For these reasons, a specific coexistence policy is deemed unnecessary.

4. References:

- Army Spectrum Management Roadmap – CERDEC, May 2008
- Dynamic Spectrum Access (DSA): Standards Assessment and Recommendations – Kevin Zhang and Darcy Swain (MITRE), Nov. 2007
- DARPA NeXt Generation Communications (XG) Policy Controls Brief – Preston Marshall, Mar 2008
- Categorization of DSA Behaviors for Test Planning - Chapin, Berger, Sickin, Thommana & Gonzalez for DYSPAN SCC 41. , Apr 08
- Dynamic Spectrum Access Technologies Brief - Jones, Leu & Perich, March 2008

5. Appendix A: DSA Policies:

DSA POLICIES				
Domain	**Policy Name**	**Description of Desired Behavior**	**Domain/Scope**	**Type**
G1	Location	Operation of the device or implementation of a particular action or policy is allowed or disallowed within the confines of a particular pre-defined or definable area.	Regulatory Technical Operational	Geospatial
G2	Relative Distance	Operation of the device or implementation of a particular action or policy is allowed or disallowed based on a definable, two or three-dimensional distance from another device, a geographic point, or a geographic area.	Regulatory Technical Operational	Geospatial
G3	Altitude	Operation of the device or implementation of a particular action or policy is allowed or disallowed based on a definable altitude; either above mean sea level {MSL} or above ground level {AGL}.	Regulatory Technical Operational	Geospatial
G4	Mobility	Certain policies might be change depending upon the speed at which the transmitter is moving. (e.g., Relative distance restrictions may be increased for transmitters in fast moving aircraft.)	Regulatory N/A Operational	Geospatial
T1	Time of day	Operation of the device or implementation of a particular action or policy is allowed or disallowed based on a pre-defined or selectable time span.	Regulatory Technical Operational	Time Based
T2	Date	Operation of the device or implementation of a particular action or policy is allowed or disallowed based on a pre-defined or selectable date or series of dates.	Regulatory Technical Operational	Time Based
T3	Lapsed time	Operation of the device or implementation of a particular action or policy is allowed or disallowed based on time lapsed since a previous event, transmission or since the reception of an external stimulus (e.g., a radio command or beacon).	Operational Technical Operational	Time Based
I1	Device ID	Operation of the device or implementation of a specific action or policy is based on the specific ID code of the device. Optional policy could designate a particular RF device as "protected" whereby other devices are restricted by frequency, power or mode from interfering with it.	N/A Technical Operational	Identity Based
I2	Network ID	Operation of the device or implementation of a specific action or policy is based on the specific ID code of the network it is joined with. Optional policy could designate a particular network ID as "protected" whereby other devices outside that network are restricted by either frequency, power or mode from interfering with it.	N/A Technical Operational	Identity Based

I3	User Role	Operation of the device, user privileges or implementation of a specific action or policy, is based on the specific ID code or license of the user or perhaps a selectable role. Optional policy could designate a particular user as "protected" whereby other devices are restricted by frequency, power or mode from interfering with it.	N/A N/A Operational	Identity Based
I4	Identified Protected User	Predefined operating characteristics of a particular device are constrained if it detects the ID of a "protected" User/Network/Radio within a predefined range or at a predefined signal threshold.	N/A Technical Operational	Identity Based
F1	Restricted Frequency	Device is restricted in some manner while operating on a specified frequency or range of frequencies. This is the most common type of policy. (E.g. from the JRFL or a device may be allowed to monitor a frequency like an emergency distress beacon but not transmit on that frequency)	Regulatory Operational	Frequency Based
F2	Designated Frequency	Device is restricted to operation only on designated frequencies or ranges of frequencies	Regulatory Technical Operational	Frequency Based
F3	Paired/Federated Frequency	In certain cases transceivers will transmit on one frequency and receive on a paired, second frequency. If the transmitted frequency is detected that has a known paired frequency, then the paired frequency can be protected.	Regulatory Technical Operational	Frequency Based
F4	Frequency Hopping	Cognitive radios programmed to develop their own frequency hopping schemes. Sets the parameters for developing the hop sets. DSA devices determine the 25 best frequencies to use; then share a hop set using those 25 frequencies. If one or more of those frequencies become occupied, then the devices on the net would adjust the hop set "on the fly" to avoid interference. The number and interval of hops would be limited by the available spectrum and the processing power of the devices.	Operational	Frequency Based
F5	Frequency & Power Mask	The transmit signal power (either transmit power or EIRP) is limited to a value specified by a power-frequency curve (mask). Can be tied to a distance or time table to produce a more refined and flexible behavior.	Regulatory Technical N/A	Frequency Based
F6	BW & Frequency Mask	This policy implements a traditional channel plan function. The transmit signal occupied bandwidth (BW) is limited to a value specified by a BW-frequency curve (mask).	Regulatory Technical N/A	Frequency Based
F7	Band Specific Policies	This is a dependent or qualifier policy. If the allowed frequency or frequency range	Regulatory	Frequency Based

		falls within preset bands then this policy will automatically specify additional policy/ies that will apply. (E.g. If operating within band X then Max X-mit power is Y watts.)	Technical N/A	
P1	Status Reporting	The device must report its operational status in specified cases (e.g., Policy load is invalid or expired)	N/A N/A Operational	Technical parameter enforcement
P2	Max Bandwidth	The device is constrained to operate in a selectable, predefined or device-negotiated bandwidth. Could also be used dynamically to improve performance or increase spectrum efficiency.	Regulatory Technical Operational	Technical parameter enforcement
P3	Max X-mit Power	Device constrained to operate using a selectable, predefined or device-negotiated maximum transmit power level. This is critical to ensuring peaceful coexistence with other systems but could be used dynamically to improve performance or increase spectrum efficiency.	Regulatory Technical Operational	Technical Parameter Enforcement
P4	Max Ambient Signal Level	Predefined maximum ambient signal level; triggers a change of mode or frequency or requires the radio to limit its Max Transmit Power.	Regulatory Technical Operational	Technical parameter enforcement
P5	Frequency Exclusion Time	The device may not attempt to utilize an abandoned frequency again for a predefined or selectable length of time.	Regulatory Technical N/A	Technical parameter enforcement
P6	Waveform Type	A device is restricted from using predefined or selectable waveforms in its operation. Alternatively, it may be required to use a certain waveform.	Regulatory Technical Operational	Technical parameter enforcement
P7	Directivity of Antenna	This policy would impose certain policy restrictions for sophisticated transmitters with directional/steerable antennas, if the antenna is aimed in a selectable direction. An alternate method would be to impose other restrictive policies if the antenna were to transmit into designated restricted geographic areas.	Regulatory Technical Operational	Technical parameter enforcement
P8	Antenna Polarization	For sophisticated transmitters with tunable antennas this policy would restrict or require a particular polarization.	N/A Technical N/A	Technical parameter enforcement
B1	Group Rendezvous	When a device in a group sends out an abandon signal it sends out a rendezvous signal as well. All devices in the group will then join on that new frequency.	N/A Technical N/A	Group Behavior
B2	Group Power Regulation	Power is adjusted amongst groups of devices (within the max and min X-mit power parameters) in order to seek a	N/A Technical	Group Behavior

		target signal strength amongst the group.	Operational	
B3	Group Mode Change	The mode of operation is change amongst groups of devices in order to seek an improved operating parameter like QoS or to lower the probability of detection.	N/A Technical Operational	Group Behavior
D1	Command Signal/Beacon Detection	This policy invoked by a Beacon, a Net Master device, or a Network Management System which broadcasts a predefined signal that triggers either action, other policies or combinations of policies to be implemented by each device (e.g., in response to the detection of a distress beacon, all the radios in a network would immediately search for that beacon and report the results so the NMS could work out a geolocation.)	Regulatory Technical Operational	Technical Parameter Enforcement
D2	Operational Phase	More of a Macro command rather than a separate policy. In this case a Commander may predesignate different policy combinations for DSA Radios based on the phase of operation. The operator or the NMS could activate an Operational Phase change which would modify all the specific policies needed to match the Commanders Intent; e.g., Phase A may mean "Restrictive-pre-Hostility"; Phase B may be "Unrestrictive-Hostilities Prevail"; Phase C may be "Mandatory Restrictions-Normal Peacetime Ops".	N/A N/A Operational	Directive Control
M1	Band Monitoring	The Band Monitoring policy is the primary policy for controlling how a DSA device's spectrum sensor is used. To ensure coexistence with other spectrum users a DSA device must monitor not only the current frequency it is using but alternate frequencies in the allowable bands that might be needed on a moments notice should the net need to shift frequencies. The sensor must constantly shift monitoring from the current frequency to alternate frequencies, to Beacon/Coordination frequencies and so on.	Regulatory Technical N/A	Monitoring Behavior
M2	Additional Frequency Monitoring	A DSA device's spectrum sensor will monitor specified frequencies in addition to the proscribed bands. Distinct from the Band Monitoring policy so that a different sequence, interval, or monitoring pattern can be proscribed.	Regulatory Technical N/A	
M3	Roll Call Response	Why, When, with what data a device must respond when it receives a Roll Call Request from other devices must be	N/A	Monitoring Behavior

		mapped out in a policy. In particular, when it must provide position data must be reported will vary depending upon several factors; security being foremost among them.	N/A	
			Operational	
M4	Monitoring Duration	A DSA device spectrum sensor will monitor or sample each proscribed bit of spectrum for a specified amount of time. E.g. each frequency within a band will be sampled for 10ms before moving on to the next.	Regulatory	Monitoring Behavior
			Technical	
			N/A	
M5	Monitoring Interval	A DSA device spectrum sensor will monitor or sample only proscribed frequencies more often than all other frequencies.	Regulatory	Monitoring Behavior
			N/A	
			Operational	
M6	Jamming Detection	Certain devices may be able to tell whether or not jamming is occurring on a particular frequency (e.g., continuous signals above the jammer warning threshold on numerous frequencies). In such cases it may be desirable to have the device do something other than abandon the frequency. (e.g., increase power or report the interference to the NMS).	N/A	Monitoring Behavior
			Technical	
			Operational	
N	Listed below are some possible policy types that would be initiated/directed by or even generated by a Network Management System (NMS).			
N1	QoS Threshold	When a predefined or selectable bit error rate, throughput, latency or connectivity threshold is reached the device will initiate some change to mitigate the problem.	N/A	Network Specific
			Technical	
			N/A	
N2	Network Connectivity	If a device is connected with a network it adopts the policies for that network. If it is not, then it adopts the predesignated policies for autonomous radios.	N/A	Network Specific
			Technical	
			N/A	
N3	Network Abandon	When the proper command signal is received from the network the device will abandon the current operating frequency.	N/A	Network Specific
			Technical	
			N/A	
N4	Network Join	When the proper command signal is received from the network the device will join or rejoin the network on a designated rendezvous frequency.	N/A	Network Specific
			Technical	
			N/A	
N5	Network Power Regulation	When the proper command signal is received from the network the device will adjust its Minimum and/or Maximum X-mit power output.	N/A	Network Specific
			Technical	
			N/A	
N6	Network Load Balancing	When the proper command signal is received from the network the device will adjust its Min/Max bandwidth to relieve temporary data bottlenecks in the network.	N/A	Network Specific
			Technical	
			N/A	

6. Appendix B: Policy Logic:

Domain	Policy	Event/Trigger	Condition/Qualifier	Possible Actions	Data Elements
G1	Location	External GPS Position Measurement	If Lat/Long = Defined Position	Stop Transmitting	Geo Position
		User Defined Position	If Lat/Long falls within multiple waypoints that define a geographical area	Reset Max X-MIT Power to X	Geo Position
		Externally Generated Position (Network, INS, etc…)		• Abandon Freq • Switch Mode to X • Adjust Max BW to X • Chg Antenna Polarization to X • Chg Transmit Steering to X • Monitor Freq X or X-Y • Adjust Monitoring Time to X • Report Status Every X Seconds • Report all Sensor Data • Report Sensor Data for Freq X or X-Y • Override/Dis-regard Policy X • Implement Alternate Policy Set B • Invoke Related Policies	
G2	Relative Distance	External GPS 3D Position Measurement	If distance from current Lat/Long is <,> or = to a defined position	Stop Transmitting	Geographic Position
		User defined 3D position	If distance from current Lat/Long is <,> or = closest point of a defined geo area (Defined by Multiple waypoints)	Reset max x-mit power to x	Geographic Area
		Externally generated 3D position (Network, INS, etc.	If distance from current Lat/Long is <,> or = Location of another designated DSA device	Abandon frequency	Distance
		External GPS 3D Position Measurement	If slant distance from current Lat/Long is <,> or = to a defined 3D position or Geo area	• Switch mode to x • Adjust Max BW to X • Chg Antenna Polarization to X • Chg Antenna Steering to X • Monitor Freq X or X-Y • Report all Sensor Data • Report Sensor Data for Freq X or X-Y • Report Status Every X Seconds • Override/Dis-regard Policy X	

Domain	Policy	Event/Trigger	Condition/Qualifier	Possible Actions	Data Elements
				• Invoke Related Policies	
G3	Altitude	User defined 3D position	If current altitude is <,> or = to a Defined Altitude	Stop Transmitting	Altitude Restrictions
			If current altitude is <,> or = to the altitude of another designated DSA device	Reset max x-mit power to x	Geo Position
		Externally generated 3D position (Network, INS, etc.)	If current altitude is x feet above or below a defined altitude.	Abandon frequency	Geo Area
			If current altitude is x feet above or below the altitude of another designated DSA device	• Switch Mode to X • Monitor Freq X or X-Y • Adjust Monitoring Time to X • Report Status Every X Seconds • Report all Sensor Data • Report Sensor Data for Freq X or X-Y • Override/Dis-regard Policy X • Invoke Related Policies	
G4	X-MTR Mobility	External GPS 3D Speed Measurement	If current speed is < or > a defined speed	Stop Transmitting	Speed
		Externally Generated Speed (Networked, INS)		• Reset Max X-MIT Power to X • Abandon Freq • Switch Mode to X • Monitor Freq X or X-Y • Adjust Monitoring Time to X • Report Status Every X Seconds • Override/Dis-regard Policy X • Invoke Related Policies	
T1	Time of Day	Internal time clock	If current time is <,> or = defined time in Hours, Min, Sec, Msec (L or Z)	Stop Transmitting	Time Interval
		Externally acquired time (Network, GPS signal, etc.)	If current time falls within defined time span in Hours/Min/Sec/Msec	Reset Max X-MIT Power to X	
			If current time falls within defined time span from time A to time B (L or Z)	• Abandon Freq • Switch Mode to X • Adjust Max BW to X • Chg Antenna Polarization to X • Chg Transmit Steering to X • Monitor Freq X 0 X-Y • Adjust Monitoring Time to X • Report all Sensor Data • Report Sensor Data for Freq X or X-Y • Report Status	Time

Domain	Policy	Event/Trigger	Condition/Qualifier	Possible Actions	Data Elements
				Every X Seconds • Override/Dis-regard Policy X • Invoke Related Policies	
T2	Date	Internal Calendar Externally Acquired Date (Network, GPS Signal, etc…)	If current date <,> or = defined date in D/M/Y	Stop Transmitting	Date
			If current date is between two defined dates.	• Reset Max X-MIT Power to X • Abandon Freq • Switch Mode to X • Adjust Max BW to X • Chg Antenna Polarization to X • Chg X-MIT Steering to X • Monitor Freq X or X-Y • Adjust Monitoring Time to X • Report all Sensor Data • Report Sensor Data for Freq X or X-Y • Report Status Every X Seconds • Implement Alternate Policy Set B • Override/Dis-regard Policy X • Invoke Related Policies	
T3		Internal Time Clock	If the days, hours, minutes, seconds and/or Msec=time lapsed since a defined date, time or definable event	• Stop X-MITTING • Reset Max X-MIT Power to X • Abandon Freq • Switch Mode X • Adjust Max BW to X • Chg Antenna Polarization to X • Chg X-MIT Steering to X • Monitor Freq X or X-Y • Adjust Monitoring Time to X • Report all Sensor Data • Report Sensor Data for Freq X or X-Y • Report Status Every X-Seconds • Override/Dis regard Policy X • Invoke Related Policies	• Date • Time • Time Frame • Defined Event
I1	Device ID	Internally Hardcoded ID	If Radio/Device ID = Pre-designated Radio/Device ID	Stop X-MITTING	
		External User Defined ID	If Radio/Device ID < or > Pre-designated	Reset Max N-MIT	

Domain	Policy	Event/Trigger	Condition/Qualifier	Possible Actions	Data Elements
			Radio/Device ID	Power to X	Radio Device ID
		External Network Assigned ID		• Abandon Freq • Switch Mode X • Adjust Max Bandwidth to X • Monitor Freq X or X-Y • Adjust Monitoring Time to X • Report Status Every X Seconds • Override/Dis-regard Policy X • Invoke Related Policies	
I2	Network ID	External User Defined ID	If Radio/Device ID = Pre-designated Network ID	Stop X-MTTG	Network ID
		External Network Assigned ID	If Radio/Device ID <, or > Network ID	• Reset Max X-MIT Power to X • Abandon Freq • Switch Mode X • Join Network X • Adjust Max BW to X • Monitor Freq X or X-Y • Adjust Monitoring Time to X • Report Status Every X Seconds • Override/Dis-regard Policy X • Invoke Related Policies	
I3	User Role	If a New User Code is Entered	If Entered Code = Pre-designated Code for Privileged User	Set Max X-MIT Power to X	User ID
			If Entered Code = Pre-designated Code for Restricted User	• Adjust Max BW to X • Override/Dis-regard Policy X • Invoke Related Policies	Radio, Device ID
I4	Identified Protected User	External Signal Received With Detectable ID	If Detected Radio ID = Pre-designated Radio ID	Stop X-MTG	Radio, Device ID(s)
			If Detected Network ID = Pre-designated Network ID	• Reset Max X-MIT Power to X • Abandon Freq • Switch to Mode X • Adjust Max BW to X • Monitor Freq X or X-Y • Adjust Monitoring Time to X • Report Status Every X Seconds • Invoke Related Policies	Network ID(s)
F1	Restricted Frequency	Internal Frequency Selection Change	If Frequency = Pre-designated Restricted Frequency	Stop X-MTG	Restricted Frequency
			If Frequency Falls Within a	• Reset Max X-	Restricted

Domain	Policy	Event/Trigger	Condition/Qualifier	Possible Actions	Data Elements
			Pre-designated Restricted Frequency Range	MIT Power to X • Abandon Freq • Switch to Mode X • Adjust Max BW to X • Monitor Freq X or X-Y • Adjust Monitoring Time to X • Report Status Every X Seconds • Invoke Related Policies	Frequency Range
F2	Designated Frequency	Internal Frequency Selection Change	If Frequency = Pre-designated Restricted Frequency	Stop X-MTG	Designated Frequency
			If Frequency Falls Within a Pre-designated Restricted Frequency Range	• Switch to Designated Freq • Invoke Related Policies	Designated Frequency Range
F3	Paired Frequency	Measurement of EME	If Occupied (signal detected) Frequency = Frequency From a Predefined List of Paired Frequencies	• Stop X-MTG On Both Primary & Paired Frequencies Listed • Reset Max X-MIT Power to X • Invoke Related Policies • Notch Out Frequency X	Designated Frequency
F4	Frequency Hopping	Frequency Hopping Mode Selected	Frequency Hopping Allowed on Current Net	Invoke Frequency Hopping Generator	• Designated Frequency • Designated Frequency Range
			Frequency Hopping Not Allowed On Current Net	Alert User	• Restricted Frequency • Restricted Frequency Range • Time • Max Hop Rate
F5	Frequency & Power Mask	Internal Power Setting Increase	If X-MIT Power > or = X-MIT Power Limit (PLIM)	• Stop X-MTTG • Abandon Freq • Reset Max X-MIT Power to X • Reset Antenna Gain to X • Invoke Related Policies	• X-MIT Power • Freq • EIRP • Designated Freq • Designated Freq Rng
		Internal EIRP Increase	If EIRP is > or = to Max EIRP Limit		
		Internal Frequency Selection Change	If Frequency = Designated Frequency, or if Frequency Range = Designated Frequency Range		
F6	Bandwidth/ Frequency Mask	Internal Bandwidth Selection Change	If BW is > or = Max BW	• Stop X-MTTG • Abandon Freq • Adjust Max BW to X • Invoke Related Policies	• Bandwidth • Designated Frequency • Designated Frequency Range
			If Frequency = Designated Frequency or Frequency Range = Designated Frequency Range		
F7	Band Specific Policy	Internal Frequency Selection Change	If Frequency Falls Within a Predesignated Frequency Range	• Override/Dis-regard Policy X • Invoke Related Policies	Designated Frequency Range

Domain	Policy	Event/Trigger	Condition/Qualifier	Possible Actions	Data Elements
P1	Status Reporting	A Change in Specified, Internal, Measureable Parameters	If the Measured Parameter is Out of Limits for a Specified Parameter Selected for Status Reporting	Transmit Status	N/A
		Receipt of an External Command Signal to Report Status	N/A	Report Status Every X Seconds	
		A Scheduled Interval Dictates a Status Report	N/A	• Alert User • Invoke Related Policies	
P2	Max Bandwidth	Any Attempt to Increase Bandwidth	If Selected Bandwidth is > or = Predesignated Maximum Bandwidth	• Adjust Max BW to X • Chg BIT Rate • Invoke Related Policies	Bandwidth
P3	Max X-MIT Power	Any Attempt to Increase X-MIT Power Level	If Selected X-MIT Power Level is > or = Pre-designated Maximum X-MIT Power Level.	• Invoke Related Policies • Reset Max X-MIT Power to X	Transmit Power
		Any Position Change	If a Known System is Operating Within Range X or Within a Designated AO		
P4	Max Ambient Signal Level	If Turned On If Altered by Any Other Policy If not Assigned as a Priority User If Assigned as a Priority User	Detected Noise Floor/Threshold is > or = Predesignated Noise Level in dB	• Stop X-MTTG • Abandon Freq • Reset Max X-MIT Power to X • Switch Mode to X • Notch Out Freq X • Chg BIT Rate • Chg How Frequently (Rate) Data is Transmitted • Chg EN Queuing Rate • Chg Polarization to X • Invoke Related Policies	• Noise Threshold – R x S/(1+N) Ratio • Interference Protection Criteria (IPC) • Avg Gain • Max Gain (GMax) • Freq Dependent Rejection (FDR) • Propagation Loss • Antenna Angle of Elevation • Antenna Angle Off Azimuth • Other Losses
P5	Frequency Exclusion Period	An “Abandon Frequency” Action is Initiated	The Abandon Frequency Action is Initiated Due to too Much Noise or Interference on a Selected Frequency	Abandon Frequency for X Msec	Abandonment Time
			The Abandon Frequency Action is Initiated Due to Any Other Reason	• Abandon Freq For as Long as Original Condition Exists • Invoke Related Policies	
P6	Waveform Type	Any Attempt to Change Bandwidth	If Selected Waveform Type is < or > the Designated Waveform Type	• Stop X-MTTG • Switch Mode to X • Invoke Related Policies	Waveform Type
			If Antenna Beam Direction is Outside of a Pre-		Antenna

Domain	Policy	Event/Trigger	Condition/Qualifier	Possible Actions	Data Elements
P7	Directivity of Antenna	Any Attempt to Chg Antenna Direction	designated Sector in Degrees of Arc (Magnetic)	Stop Transmitting	Directionality
			If Antenna Beam Direction Points/Extends into or Towards the Lat/Long of a Defined Position	Reset Max X-MIT Power to X	
			If Antenna Beam Direction Points/Extends Into or Towards a Defined Geographical Area	• Abandon Freq • Switch Mode to X	
		Any Attempt to Chg Antenna BW	If Antenna Beam Width > Predesignated Maximum Beam Width	• Adjust Max Beam Width to X • Chg X-MIT Steering to X • Invoke Related Policies	
P8	Antenna Polarization	Any Change in Antenna Polarization	If Antenna Polarization is > or > the Designated Polarization	• Stop X-MTTG • Chg Antenna Polarization to X • Invoke Related Policies	Antenna Polarization
B1	Group Rendezvous	A Group Rendezvous Signal Received	From Participating Device in Your Net	Re-join of Freq X	Command Signal
			From NMS	Invoke Related Policies	
B2	Group Power Regulation	If Group Power Limit Signal Received	From Participating Device in Your Net	Reset Max X-MIT Power to X	• Command Signal • Max X-MIT Power
			From NMS	• Override/Dis-regard Policy X • Invoke Related Policies X	
B3	Group Mode Change	If Group Mode Change Signal is Received	From Participating Device In Your Net	• Switch Mode to X • Invoke Related Policies	• Command Signal • Waveform
			From NMS		
D1	Command/ Beacon Signal Detection	Any Command Signal is Received	If the Signal Parameters = Predefined Signal Parameters	• Stop X-MTTG • Reset Max X-MIT Power to X	Command Signal Beacon Signature
			If the Signal Source Has a Valid Identification (Network ID or Radio/Device ID)	• Abandon Freq • Switch Mode to X • Adjust Max Bandwidth to X • Chg Antenna Polarization to X • Chg X-MIT Steering to X • Adjust Max Beam Width to X • Monitor Freq X or X-Y • Adjust Monitoring Time to X • Monitor Each Freq for X Msec • Monitor Only Freq(s) X,Y,Z,…for X Msec • Monitor Freq X, Y, Z…1.5 Times (or 2X or 4X)	• Radio/Device ID(s) • Network IDs

Domain	Policy	Event/Trigger	Condition/Qualifier	Possible Actions	Data Elements
				More Often Than All Other Freqs • X-MIT Status • Report Status Every X Seconds • Report All Sensor Data	
		Any Beacon Signal is Received	If the Signal Parameters = Predefined Signal Parameters	• Report Sensor Data for Freq X or X-Y • Override/Dis-regard Policy X. • Implement Po0licy Set X • Zeroize Radio • Revoke Policy X • Update/Replace Policy X With New One • Invoke Related Policies • Alert User	
D2	Operational Phase	Any change in operational phase (e.g., Op phases A , B & C)	A policy set for that phase is loaded/available	• Implement Alternate Policy Set B • Override/Dis-regard Policy X	Operational Phase
			The policy set for that phase is not loaded/available	• Report Status • Invoke Related Policies • Alert User	
M1	Band Monitoring	As scheduled by the Monitoring Interval policy	NONE	Monitor Freq Band X-Y	• Designated Frequency • Time Frame • Time Intervals
		If Altered By Any Other Policy		• Monitor Altered Freq Band X-Y • Monitor Each Freq For X Msec • Adjust Monitoring Time to X • Report All Sensor Data • Report Sensor Data for Freq X or X-Y • Invoke Related Policies Alert User	
M2	Additional Frequency monitoring	As scheduled by the Monitoring Interval policy	NONE	Monitor Freq(s) N, Y, Z….	Designated Frequency
		If altered by any other policy		• Report All Sensor Data • Report Sensor Data for Freq(s) X, Y, Z…	• Designated Frequency Range • Time Frame • Time Intervals
M3	Roll Call Response	Roll Call Request is received	If Network and Device ID is valid	• Reply with own device ID • Reply with own network ID &	• Network IDs and Names

Domain	Policy	Event/Trigger	Condition/Qualifier	Possible Actions	Data Elements
				Name • Reply with own center frequency • Reply with own bandwidth • Reply with own power level • Reply with own operating mode • Invoke related policies	• Beacon/Coordination Scheme
M4	Monitoring Duration	If turned on	NONE	Monitor each freq for X MSec	• Duration • Designated Frequency • Designated Frequency Range
		If altered by any other policy		• Monitor only freq(s) x, y. z … for x Msec • Invoke Related Policies	
M5	Monitoring Interval (how often)	As scheduled by the Monitoring Interval policy	NONE	Monitor Frequencies X, Y, Z, … 1.5 times (or 2x or 4x) more often than all other Frequencies	• Frequency of Occurrence • Duration • Designated Frequency
		If altered by any other policy		Invoke related policies	
M6	Radio Status	Internal error check schedule	If fault x, y, or z is detected	X-MIT Status	Predefined Device Fault
		Status call command signal received	• If Policy Load is Invalid or Expired • If Policy for Current Location not Loaded	Invoke Related Policies	
M7	Jamming	Whenever a new frequency is monitored	If S/(I+N) ratio ≤ predesignated threshold in Db and if no modulation is detected	• Abandon Freq • Switch Mode to X • Adjust Max Bandwidth to X • Report All Sensor Data on Jammed Frequency • Notch Out Frequency X • Chg BIT Rate X • Chg How Frequently (Rate) Data is X-MTTD • Chg EN Queuing Rate • X-MIT Status • Invoke Related Policies • Alert User	• Jamming Indicators? • S/(1+N) Ratio
N1	QoS Threshold	Internal QoS Check Schedule	If BER is ≤ predefined BER	Reset max x-mit power to x	Target BER
			If throughput is ≤ predefined value in KB/S	Abandon frequency	Target Data Throughput
			If data latency is ≤ predefined value in ms	Switch mode to x	Target Data Latency
			If connectivity of circuit is ≤	• Adjust Max	Target Ping

Domain	Policy	Event/Trigger	Condition/Qualifier	Possible Actions	Data Elements
			predefined %	Bandwidth to X • Chg Beam Steering to X • Notch Out Frequency X • Chg BIT Rate X • Chg How Frequently (Rate) Data is X-MTTD • Chg EN Queuing Rate • X-MIT Status • Report Status Every X Secs • Invoke Related Policies	Response
N2	Network Connectivity	If Responses to Network Pings ≥ Pre-defined %	Predefined %		Defined By NMS
N3	Network Abandon	See B1 Above			Defined by NMS
N4	Network Join	See B2 Above			Defined by NMS
N5	Network Power Regulation	See B3 Above			Defined by NMS
N6	Network Load Balancing	Very Complex to Express			Defined by NMS
N7	Network Topology Management	Very Complex to Express			Defined by NMS
N8	Network Monitoring	Very Complex to Express			Defined by NMS

7. Appendix C – Data Elements:

Data Elements					
No	**Data Element Type**	**SSRF X-Ref PG**	**Data Source**	**Units**	**Comments**
1	Geographical Position	121	FIDB	Waypoints	The geographic location of a reference point
2	Geographical Area	N/A	FIDB	Lat/Long Waypoints	The Sum area of multiple geographic reference points. Often expressed as an overlay.
3	Distance	N/A	FIDB	Meters/KM	From the radio/device to a specified point or area.
4	Altitude restrictions	N/A	Policy DB	Feet	The desired altitude above, at or below which a policy is triggered. MSL or AG
5	Speed	N/A	Policy DB	m/s, k/h, m/h	The desired speed (velocity) above, at or below which a policy is triggered
6	Radio/Device IDs	N/A	NMS or TBD	Text	A list of all radio or device identification codes within a geographic area
7	Date	N/A	Policy DB / NMS/ FIDB	D/M/Y	The calendar date when a policy comes into or out of effect
8	Time Frame	97	Policy DB / NMS/ FIDB	MS/S/M/H	The time period when a policy is in effect. Alt: The time lapse from a trigger event. 2nd Alt: a period of time during which a policy is in effect or a policy action lasts for.
9	Time Intervals	N/A	Policy DB / NMS/ FIDB	MS/S/M/H/D/M/Y	Two or more time frames (regular or non-regular) in which a policy is in effect
10	Frequency of Occurrence	N/A	Policy DB / NMS/ FIDB	Number or Fraction	How often an event should occur. Frequency of occurrence
11	Jamming Indicators	N/A	Policy DB	TBD	Indicators that a radio could sense that would indicate the presence of hostile
12	Radio ID	N/A	NMS	Text	A discrete identifying code for a particular DSA device
13	Network ID	N/A	NMS	Text	A discrete identifying code for a particular DSA capable network
14	User ID	N/A	NMS or Policy DB	Text	A discrete identifying code for a particular user
15	Beacon Signature	N/A	Policy DB	TBD	A signal that a DSA device could detect, identify and correlate. Reception of a discrete or general beacon signal would trigger a change in operations.
16	Command Signal	N/A	NMS or Policy DB or net control radio	TBD	A signal that a DSA device could detect, identify and correlate. Reception of a predefined Command signal would trigger a change in operations.
17	Authorized Frequency	83	SMTI DB	MHz, GHz	Specific frequency that a device may transmit on.
18	Authorized Freq Range	86	SPXXI Reg Server or FE-DB	MHz, GHz	Specific frequency range(s) that a device may operate within.
19	Prohibited Frequency	83	JRFL	MHz, GHz	Usually taken from the Joint Restricted Frequency List
20	Prohibited Freq Range	86	JRFL	MHz, GHz	Usually taken from the Joint Restricted Frequency List
21	Designated Frequency	83	NMS or Policy DB	MHz, GHz	Specified when a particular frequency is required to express a policy.
22	Designated Frequency	86	NMS or Policy DB	MHz, GHz	Specified when a particular frequency is required to express a policy.

23	Channelization Plan	136	FE-DB	MHz, GHz	Preset frequency ranges and bandwidths for operation.
24	Hop Set	N/A	NMS	MHz, GHz	A set of frequencies for a particular communications circuit or network. The only ones that might be available from a database would be those generated by a Network Management System
25	EMS Power Limit	146	SCS/TBD	dB/W	Power limit parameters for particular emitters; Or the max allowable power for transmission
26	X-Mit Power	231	SCS/TBD	dB/W	The power output of a particular emitter; or a specified power level for a device to use.
27	EMS BW	143	SCS/TBD	KHz	Emission Bandwidth: The bandwidth parameters of a particular emitter; Or the maximum bandwidth allowable for a transmission.
28	EMS Modulation	143	SCS/TBD	Text	Type of Modulation scheme
29	Noise Threshold	N/A	Policy DB	dB	Typical Noise levels for a given frequency in a given region
30	Access Codes	N/A	Policy DB	Number	A list of access codes with their related permissions and priorities.
31	Abandonment Time	N/A	Policy DB	MSec	The length of time an emitter must not use a particular frequency if it detects that frequency in use.
32	Bit Error Rate (BER)	N/A	Policy DB	Errors/Sec	One measure of QoS. In this case a BER that represents the lowest level acceptable to meet operational requirements.
33	Data Throughput	N/A	Policy DB	Kb/Sec	One measure of QoS. In this case a data Throughput that represents the lowest level acceptable to meet operational requirements.
34	Data Latency	N/A	Policy DB	MSec	One measure of QoS. In this case a latency that represents the lowest level acceptable to meet operational requirements.
35	Connectivity	N/A	Policy DB	%	An expression of the percentage of time a device remains connected to a network
36	Sector	N/A	Policy DB	Degrees	Predesignated sector in degrees of arc (Magi) from one azimuth to another
37	Rx S/N Ratio	N/A	Policy DB	dB	A specified ratio that would trigger a policy or change in operation
38	Rx S/(I+N) Ratio	N/A	Policy DB		
39	Antenna Directionality	133	NA	Degrees	Antenna direction can be moved and set electronically in some antennas
40	Antenna Polarization	133	Policy DB	Text	Type of polarization for a particular antenna
41	Operational Phase	N/A	Policy DB	Number	Number corresponds to a predefined group of policies that can be invoked and implemented all together based on this code.
42	Predefined Device Fault	N/A	NMS or Policy DB	Text	A predefined list of faults (hardware or software) that might trigger a status update
43	Priority	N/A	Policy DB	Number	Assigned policy priority
44	Policy number	N/A	Policy DB	Number	A discrete identity code assigned to each policy to allow it to be referenced.
45	Policy Expiration date(s)	N/A	Policy DB	Date	The date after which the policy will no longer be valid
46	Owner	N/A	Policy DB	Text	A listing of who or what organization controls or "owns" a particular policy
47	Waveform Type	N/A	NMS or Policy DB	Text	A discrete identifying name for each type of waveform that might be used
48	Non-occupancy Period	N/A	Policy DB	MSec	A definable period during which a DSA device must not attempt to occupy a frequency that has been abandoned.
49	Bandwidth	143	Policy DB	Hz, KHz, MHz	Short for Occupied Bandwidth or that part of the signal that contains 99% of the spectral energy.
50	EIRP	160	Policy DB	dBi	The sum of the transmission power and the antenna gain
	Interference Protection Criteria		Policy DB		A relative or absolute interfering signal level defined at the receiver input, under specified

51	(IPC)	N/A		dB	conditions, such that the allowable performance degradation is not exceeded. This is usually defined as an absolute interference power level 1. Interference –to-noise power ration 1/N, or carrier-to-interfering signal power ration C/I.
52	Antenna Height	N/A	Policy DB	Feet or Meters	Distance between transmitter or receiver and the terrain or above MSL
53	Frequency Dependent Rejection (FDR)	N/A	Policy DB	dB	FDR is the sum of attenuation of the undesired signal due to OFF-Frequency-Rejection (OFR) and the On-Tuned-Rejection (OTR) in dB. FDP (db) = OFR (dB) + OTR (db)
54	Propagation Loss	N/A	Policy DB	dB	The attenuation of signals passing between two points of a transmission.
55	Antenna Angle of Elevation	N/A	NMS, Policy DB	Degrees	Vertical angle between transmitted beam and natural obstructions sufficient for both transmitting and receiving antennas.
56	Antenna Angle of Azimuth	N/A	NMS, Policy DB	Degrees	Horizontal direction determined to assure concentrated beam transmission to realize maximum advantage
57	Average Gain	N/A	Policy DB	dB	With respect to antennas; value derived from ratio of diameter of parabola to wavelength of transmitted frequency. Dictated by signal power, attenuation in transmission and noise.
58	Maximum Gain	N/A	Policy DB	dB	With respect to antennas; value derived from ratio of diameter of parabola to wavelength of transmitted frequency. Dictated by signal power, attenuation in transmission and noise.
59	Pmax	N/A	Policy DB	Watt	Maximum transmission power level

8. Appendix D – Policy Domain Traceability Matrix:

Policy Domain Traceability Matrix			
Type	**Regulatory**	**Technical**	**Operational**
Geospatial	• To ensure non-interference with authorized users • To comply with NTIA policy on geographic separation of devices • To comply with Host-nation policy • To Comply with DoD policy such as in the Standard Frequency Action Format (SFAF)	To ensure optimal use of spectrum by a network within a geographic area	• To comply with a CC's intent • To comply with a CJTF's intent • To comply with JRFL restrictions • To flexibly leverage a device's exact location to perhaps use spectrum that would otherwise be off limits (e.g., a remote mountain valley may sufficiently screen transmissions so as not to interfere with outside transmitters)
Time Based	• Regulations are primarily fixed and for long terms. However certain exceptions may require policies that are based on time such as for time-based sharing of spectrum between federal and non-federal entities. • To Comply with DoD policy such as in the Standard Frequency Action Format (SFAF)	Many DSA policies may require triggers that are based on Date, Time or Lapsed Time	Most operational requirements for time-based policies stem from the need to coordinate conflicting usage of the spectrum. For example, A particular frequency may be scheduled for exploitation by intelligence assets. During the period of that exploitation such policies could prohibit friendly use of that frequency.
Identity Based		• To ensure communications security and integrity • Identities allow policies to be imposed on specific devices or on groups of devices as desired.	Operational security and communications security will both impose requirements for identity based policies.
Frequency Based	• To comply with the Federal and non-Federal tables of frequency allocations. Chapter 4 of the NTIA manual. Specifically to comply with § 4.1.3 of the NTIA manual: non primary service stations (a) shall not cause harmful interference to stations of primary services to which frequencies are already assigned or to which frequencies may be assigned at a later date; • Cannot claim protection from harmful interference from stations of a primary service to which frequencies are already assigned or may be assigned at a later date. • To Comply with DoD policy such as in the Standard Frequency Action Format (SFAF)	• To ensure maximum spectral efficiency amongst multiple DSA devices • Internal device logic may determine that only certain frequencies or ranges of frequencies are optimal for a given set of environmental and technical parameters	• To comply with a CC's intent • To comply with a CJTF's intent • To comply with JRFL restrictions
Technical Parameter Enforcement	To comply with Chapter 5 - Spectrum Standards, of the NTIA manual	Environmental constraints may require the need for policies that will take consideration of those restraints	Policies to control particular technical parameters will have direct operational requirements. For example, power may need to be limited to ensure low probability of detection.
Directive Control	In certain narrow cases regulatory authority may apply here. For example, the requirement for units to respond to distress beacons could be greatly enhanced by networks designed to automatically detect and geolocate such	While most technical justification for directive control policies only apply to networked DSA devices these policies could be used for technical purposes such as requiring status reports	Being able to direct or influence entire groups of devices to perform some behavior is very operationally useful. For example, if policy sets are compromised all radios could be commanded to invoke certain policies or report

	beacons	for troubleshooting or testing.	status.
Group Behavior		Group behavior policies are integral to the successful functioning of DSA	While most of the justification for group policies is technical a few are operational in nature. For example, requiring whole groups of devices to move frequencies or operating modes to avoid detection.
Monitoring Behavior	DSA techniques are only authorized if they can consistently ensure non-interference with existing authorized users of the EM spectrum. The ability to monitor and "sense" the EME and avoid such interference is integral to DSA.	DSA devices could only operate in the most elementary capacity unless there are policies to control their monitoring behavior.	Certain secondary DSA capabilities are only of use in an operational setting. For example, Jamming detection and intelligence gathering.
Network Specific		• To ensure optimal use of spectrum by a network. • To ensure optimal QoS of a network.	