



Solving the Receiver Problem Without Receiver Standards

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Disclaimer

- The opinions expressed in this talk are those of the authors and do not necessarily represent the views of the FCC or any other member of its staff

Two Sides of Adjacent Band Interference

- Leaky Transmitters
 - Transmitters emit undesired emissions (an *externality*) into adjacent frequency bands causing interference to receivers in those bands.
 - Transmitter OOBEs *regulated* by FCC and can be adjusted to reduce interference.
- Leaky Receivers
 - Receivers admit undesired emissions from transmitters in adjacent bands, causing those receivers interference.
 - Receiver out-of-band admissions *not an externality and not regulated* by FCC

Policy Goal Is To Minimize *Total Cost of Interference*

- Cost of mitigation (receiver side and transmitter side) including
 - Filters
 - Guard bands (spectrum opportunity cost)
- Cost of service loss due to un-mitigated interference (receiver side only)
 - Zero interference not necessarily lowest cost solution.
- Bargaining and regulation costs (receiver side and transmitter side)

Current Policy Assigns Interference Protection Rights on a First-in-time Basis

- New allocations
 - When a new allocation is established, the new allocation must protect *existing* systems in adjacent bands from any interference and self-protect against interference from those systems.
- Existing allocations
 - Once licensed, the new system gains incumbent status and is protected against subsequent systems, who must also self-protect against that now incumbent system.

What's Wrong With First-in-time Rights That Never Expire?

- Insufficient Self Protection Over Time
 - New allocations self protect only against *existing* uses which often are not the highest valued use.
 - Receivers are then vulnerable to interference when an adjacent band is repurposed to higher valued use such as wireless broadband
 - Once a new allocation is deployed, adding self-protection (e.g., retrofitting existing receivers with better filters) can be much more costly than incorporating those protections initially.

What's Wrong With First-in-time Rights That Never Expire? (cont.)

- Costly Restrictions on Spectrum Use in Adjacent Bands
 - Protecting existing, vulnerable receivers to a no-interference standard can require strict power/deployment restrictions on adjacent band, greatly reducing its value.
 - When the value of additional self-protection is much greater than its cost, payments from higher valued use to cover costs are an option, but negotiations can be very difficult and costly.
 - **Large amount of valuable spectrum can be restricted for a very long time**

Objectives of New Interference Policy

- What we want policy to achieve
 - Create incentives for efficient (least-cost) management of adjacent band interference.
 - Sustainable and dynamically efficient as the costs of interference mitigation and service loss change (Moore's Law)
 - Minimize barriers to movement of spectrum to higher valued uses
 - Not rely on excessive and costly bargaining.
 - Less burdensome than mandatory receiver standards
- Apply To Spectrum Between 300 MHz and 3000 MHz

Proposal (part 1)

New Allocations Must Avoid Encumbering Adjacent Bands Targeted for Flexible Use

- When a *new* allocation is being established in a band adjacent to a band likely to be repurposed for flexible use, the new allocation must
 - protect existing systems *and future* flexible use systems in that adjacent band
 - flexible use systems = dense deployment of base, mobile and fixed transmitters operating at fully functional power levels typical of a modern wireless cellular architecture
 - self-protect against interference from those systems.
- Current first-in-time policy would apply to adjacent bands not targeted for repurposing.

Proposal (part 2)

Protect *Legacy* Systems for Limited Time When Adjacent Band is Repurposed for Flexible Use

- When a band is repurposed for flexible use, legacy allocations in adjacent bands would be protected from interference from the new flexible use deployment for X years from the date the rules for repurposing of that band are adopted.
 - X is the average number of years between receiver replacements (normal equipment replacement cycle) in that existing allocation.
 - X will likely vary across different services
 - “Legacy” refers to systems in existence at the time of adoption of the new policy.
 - Flexible use as defined in previous slide

Proposal (part 3)

Gradually Reduce Protection of Legacy Systems that Restrict Use of *Existing* Flexible Use Bands

- Phase in self protect regime for currently protected legacy bands consistent with schedule outlined in previous slide to remove restrictions on existing flexible use bands.

Proposal Meets Our Objectives

- ✓ Creates incentives for efficient (least-cost) management of adjacent band Interference since most costs/benefits tradeoffs are internalized.
- ✓ Provides sustainable and dynamically efficient incentives as the costs of interference mitigation and service loss change (Moore's Law)
- ✓ Minimizes barriers to movement of spectrum to higher valued uses
- ✓ Avoids excessive and costly bargaining.

Issues

- Enforcement
 - Government credibility to maintain policy when actual interference arises
 - What if government lacks credibility – system certification, receiver labeling?
- Defining “most valuable use” model that receivers must self-protect against
 - Is dense deployment of base, mobile and fixed transmitters likely to remain the most valuable use?
- What constitutes protecting flexible use systems (Slide 9)?
- What should we assume about band plans (FDD/TDD) for determining requirements for self-protection and protection of adjacent flexible use bands?
- Schedule for reducing protections of legacy systems
 - Is one life-cycle sufficient?
- Should services where receivers are not under control of licensee be treated differently?
 - TV
 - GPS
- How to regulate power (in-band and OOBE)
 - At transmitter or on the ground (PFD)
 - Should OOBE limit be tightened to better reflect current cost factors?



Thank you