

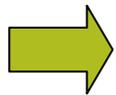


# BRS and ISM devices in 2496-2500 MHz

Docket ET 00-258

# Background

- July '04 -- FCC 4<sup>th</sup> R&O designates 2496-2500 MHz for BRS & makes no change to ISM rules
  - Part 18 – no in-band limit on ISM devices in 2400-2500 MHz
- Sept '04 – WCA and Sprint filed Recons on this issue
  - Latest proposal: apply Part 18 limit above 2500 MHz starting from 2496 MHz, phased in over 2 – 3 year period
- To date, extensive series of ex parte meetings & filings from parties on both sides of this issue



Motorola provides analysis & observations

# ISM Devices Pose Interference Threat

- **The Risk of Interference from ISM devices to BRS is real**
  - Analysis demonstrates significant potential for interference
  - Limits on ISM help limit risk
- **MMDS reallocation to “Comparable Spectrum”**
  - Increased risk of interference in new BRS band makes spectrum less than comparable to 2150-2162 MHz
  - Risk of interference impacts service and system design
  - Current unlimited ISM devices adds uncertainty to BRS design requirements

# Limiting ISM Power is Reasonable

- **Given changing use of band, it is reasonable to reassess factors impacting use**
- **Sprint Nextel Proposes Part 18 limits only in 2496-2500 MHz portion of ISM band**
  - Impacts small portion of ISM band
  - Limits should be applied on going forward basis
  - Based on NTIA's 1994 study, it appears feasible for microwave ovens to meet the Part 18 limit starting at 2496
    - Ovens that met the P18 limit outside 2500 MHz also met the P18 levels starting at 2496 MHz, except for one
- **There is no Reason to Believe that the Proposed Limits will Result in “US-Only” Product**
  - Products meeting the new limits can be sold globally

# Limiting ISM is Consistent With International Treaties

- **Footnote 5.150 of the International Radio Regulations states that Radiocommunication services operating within ISM bands must accept harmful interference from ISM devices.**
  - No Radio Regulation prohibits limiting ISM devices
  - Parties have not proposed changing underlying status between ISM and services
    - **Proposals merely limit the potential for interference**
- **The ITU recognizes the potential for interference and called for studies of ISM limits**
  - WRC-03 Resolution 63 calls for studies of in-band ISM limits:  
*Resolves*  
that, to ensure that radiocommunication services are adequately protected, studies are required on the **limits to be imposed on the radiation from ISM equipment** within the frequency bands designated in the Radio Regulations for this use and outside of those bands,  
*Invites ITU-R*  
to continue, in collaboration with CISPR, its studies relating to radiation from ISM equipment within the frequency bands designated in the Radio Regulations for this use and outside of those bands in order to ensure adequate protection of radiocommunication services, with priority being given to the completion of studies which would permit CISPR to **define limits in Publication CISPR 11 on radiation from ISM equipment** inside all the bands designated in the Radio Regulations for the use of such equipment.

# Interference Analysis

## Determination of Various Interfering Power Levels

	P 18 (< 500 W)	P 18 (> 500 W) <sup>1</sup>	P 15 intentional radiator limit	Average Microwave emission in 2496-2500 MHz <sup>3</sup>
Field strength, uV/m at 3 m			500	
Field strength, uV/m at 300 m	25			
Field strength, dBuV/m at 300 m	28.0			
To convert from 300 m to 3 m	40.0			
Field strength, uV/m at 1600 m		10		
Field strength, dBuV/m at 1600 m		20		
To convert from 1600 m to 3 m		54.5		
Field strength, dBuV/m at 3 m	68.0	74.5	54.0	83.0
Field strength, V/m at 3 m	0.0025	0.0053	0.0005	0.0141
Power flux density, W/m <sup>2</sup> at 3 m	1.66E-08	7.55E-08	6.63E-10	5.29E-07
Power flux density, dBm/m <sup>2</sup> at 3 m	-47.8	-41.2	-61.8	-32.8
Conversion factor, dB/m <sup>2</sup>	29.4	29.4	29.4	29.4
Power density, dBm/3 MHz <sup>3</sup> at 3 m				-62.2
Power density, dBm/1 MHz <sup>2</sup> at 3 m	-77.2	-70.6	-91.2	-66.9
Power density, dBm/5 MHz at 3 m	-70.2	-63.6	-84.2	-60.0
EIRP density, dBm/5 MHz	-20.3	-13.7	-34.3	-10.0

### Notes:

<sup>1</sup>Part 18 limit (> 500 W) is taken from footnote 1 to the Table in 18.305(b).

<sup>2</sup>Parts 15 and 18 specify a minimum measurement bandwidth of 1 MHz.

<sup>3</sup>The average Microwave oven emission is taken from p. 50 of NTIA's 1994 microwave oven report.

- NTIA used a measurement bandwidth of 3 MHz.

# Interference Analysis

## Determination of impact to BRS receivers

### Scenario: Interference to CPE, Indoors & Indoor-Outdoor

	P 18 (< 500 W)	P 18 (> 500 W)	P 15 intentional radiator limit	Average Microwave emission in 2496-2500 MHz
Bandwidth, MHz	5	5	5	5
Thermal noise (kTB), dBm	-107.0	-107.0	-107.0	-107.0
Receiver noise figure, dB	5.0	5.0	5.0	5.0
Noise floor (kTB + NF), dBm	-102.0	-102.0	-102.0	-102.0
Resulting I/N, dB (no separation)	81.7	88.3	67.7	92.0
Desired Noise floor degradation, dB	1	1	1	1
Allowed interference level, dBm	-107.9	-107.9	-107.9	-107.9
Associated I/N, dB	-5.9	-5.9	-5.9	-5.9
Additional attenuation to meet allowed level, dB	87.6	94.2	73.6	97.8
Required separation, m	48.5	80.4	16.6	106.7
Required separation, m (w/ 3.4 dB indoor wall attenuation)	37.4	61.9	12.8	82.2
Required separation, m (w/ 12 dB outer wall attenuation)	19.3	32.0	6.6	42.5
Desired Noise floor degradation, dB	3	3	3	3
Allowed interference level, dBm	-102.0	-102.0	-102.0	-102.0
Associated I/N, dB	0.0	0.0	0.0	0.0
Additional attenuation to meet allowed level, dB	81.7	88.3	67.7	92.0
Required separation, m	31.0	51.3	10.6	68.1
Required separation, m (w/ 3.4 dB indoor wall attenuation)	23.9	39.5	8.2	52.5
Required separation, m (w/ 12 dB outer wall attenuation)	12.3	20.4	4.2	27.1

Interference Impact  
Can Come From Devices  
Not Under the BRS  
User's Control

$PL = 37 + 30 \cdot \log(d)^*$   
 $PL = 40.4 + 30 \cdot \log(d)^*$   
 $PL = 49 + 30 \cdot \log(d)^*$

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#### Notes:

- Based on received power calculations on previous slide.
- Assumes 0 dBi gain of BRS receiver towards interferer.

\* ETSI, "Universal Mobile Telecommunication System (UMTS): Selection procedures for the choice of radio transmission technologies of the UMTS", UMTS 30.03 Version 3.2.0, April 1998. (Indoor Path loss)

# Review of Analysis

- Comments on key assumptions
  - **Measurement bandwidth**
    - Taking into account the measurement bandwidths leads to 2 to 7 dB increase in expected interference (over what Sprint determined, 10/3/05 ex parte)
  - **Noise figure**
    - 5 dB was used as representative of indoor CPE and interference environment
  - **Allowed noise figure degradation**
    - Both a 1 dB and 3 dB increase in noise floor were evaluated, and the associated separation distance determined
    - 1 dB has been used in relation to protection of BRS (e.g., in deriving criteria in Part 27 (See, e.g., §27.53(l)(2); WCA 2/7/02 filing in Dk 03-66)
  - **Propagation model**
    - Used an indoor ( $1/d^3$ ) model from ETSI technical report (TR)
    - A variety of attenuation values exist for additional wall or floor attenuation; 3.4 dB & 12 dB for inner & outer walls, respectively, from the ETSI TR

# How Do Other Devices Share the Band with ISM Devices?

- **WiFi, Cordless Telephone and Other Devices operate in the ISM band**
  - Unlicensed devices are generally short range
  - Performance in the vicinity of microwave depends on distance between user device and base unit
    - **ISM interference does result in device not working or a degradation in performance**
    - **Same interference mechanism as for BRS, but entire unlicensed system design and deployment is under control of user**
- **BRS is a primary service and should not be treated on par with Part 15 devices**

# Summary

- **Analysis shows a significant interference issue for BRS and ISM devices located in the same, or neighboring, houses**
  - The interference can be reduced by specifying an in-band limit on ISM devices, such as the Part 18 levels proposed by Sprint & WCA
- **An in-band ISM limit would provide co-frequency services greater certainty regarding the expected level of interference**
- **The limits proposed by Sprint Nextel are reasonable**
  - It appears feasible for microwave ovens to meet the Part 18 limit starting at 2496 MHz based on NTIA study
  - Will not isolate US from global market
  - Limits are consistent with treaty obligations