September 18, 2008

VIA ELECTRONIC FILING

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: Ex Parte Notice
WT Docket No. 07-195

Dear Ms Dortch:

On September 17, 2008, Thomas Sugrue, Kathleen O'Brien Ham, Sara Leibman, Pablo Tapia, Patrick Welsh and Yasmin Karimli of T-Mobile USA ("T-Mobile"), Howard Symons of Mintz Levin, Cohn, Ferris, Glovsky and Popeo, P.C. and Thomas Dombrowsky (Engineering Consultant) of Wiley Rein LLP, met with Julius Knapp, Geraldine Matise, Rashmi Doshi, Jamison Prime, Patrick Forster, Ahmed Lahjouji, Jim Szeliga of the Office of Engineering and Technology and Martin Liebman of the Wireless Telecommunications Bureau to discuss the above-captioned docket.

The specific issues discussed during the meetings are reflected in the attached written presentation, which was provided in the meeting.

Pursuant to section 1.1206(b) of the Commission's rules, an electronic copy of this letter and attachment is being filed electronically with the Office of the Secretary for inclusion in the above-referenced docket and served electronically on the Commission participants in the meetings.

Please direct any questions regarding this filing to the undersigned.

Sincerely,
/s/ Kathleen O'Brien Ham

Vice President, Federal Regulatory Affairs
T-Mobile USA, Inc.
401 9th Street, NW
Suite 550
Washington, DC 20004

cc: Julius Knapp, Geraldine Matise, Rashmi Doshi, Patrick Forster, Jamison Prime, Ahmed Lahjouji, Jim Szeliga, Martin Liebman

AWS-3 Interference: Lab Testing, Simulations, and a Path Forward

September 17, 2008

Outline

- T-Mobile is Making Wireless Broadband a Reality
  - Rapidly rolling out 3G service in AWS-1
  - Launched in major markets
  - 3G rollout in AWS-1 vital for competition and consumers
- Lab Testing at Boeing Facility Demonstrated Serious Interference to AWS-1
  - Background on testing
  - Lab tests performed
  - Lab test results and conclusions
- Optimi's Monte Carlo Simulations
  - Assumptions in simulation model
  - Simulation results and conclusions
- A Path Forward
  - Asymmetrical Pairing of AWS-3 with J Block
  - Enables new entrant and others to bid
- Conclusions

T-Mobile is Making Wireless Broadband a Reality

- 3G Launched in major markets
- Will deploy in the top 25 markets in the U.S in 4Q 08

Testing for AWS-3 Interference at Boeing Test Facility

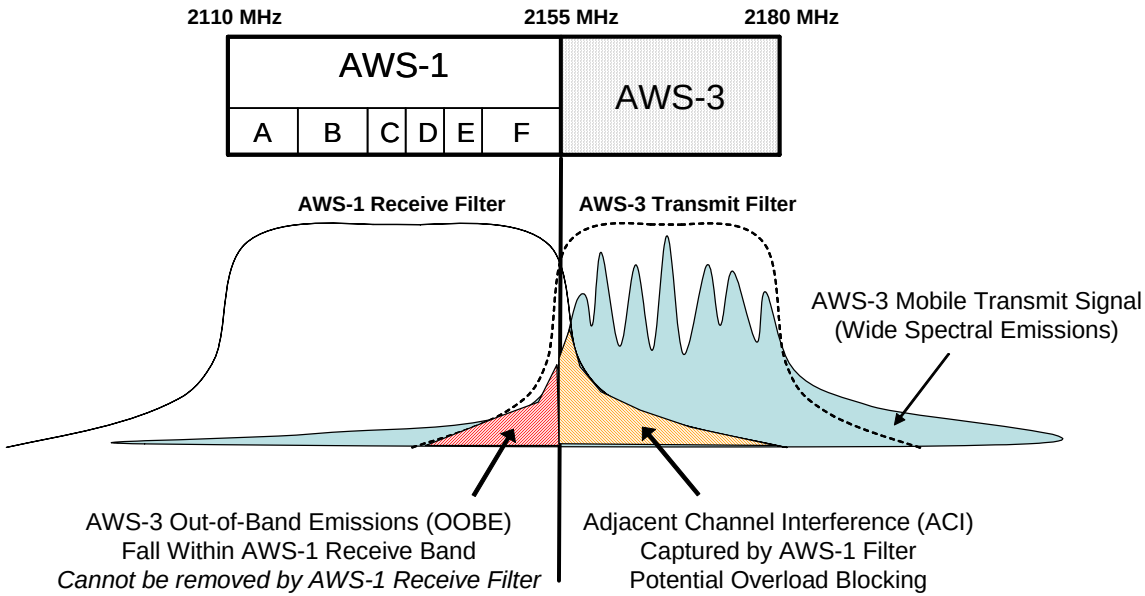
Tests Confirm Interference Concerns

- Under the FCC's proposed rules, AWS-1 operations will suffer harmful interference due to OOBE and receiver overload/blocking
- T-Mobile's AWS-1 customers would be unable to communicate within a large radius around an AWS-3 device transmitting at even moderate power levels
- Debilitating impacts include call set-up failures, degraded speech quality, degraded data throughput and dropped calls – all evidence of serious quality and reliability degradation
- The interference would be a high probability event, occurring in many common situations
- Industry observers (other than M2Z) concur
  - AT&T, CTIA, MetroPCS, Motorola, Nokia, Sony Ericsson, 3G Americas, Qualcomm, VZW

Lab Tests Performed

1. OOBE + ACI/Overload Tests at Different Receive and Transmit Powers
   - Repeat OOBE+ACI/Overload tests at -105, -100, -90 dBm RSCP
   - Perform additional OOBE+ACI/Overload test at -85 dBm RSCP
   - Increase AWS-3 transmit power until harmful interference occurs
     - Harmful interference defined in prior lab tests (access failures, dropped calls, high BLER)
2. Test with WiMAX as an Interference Source
3. External Filter and Test Equipment Spectrum Responses
   - Measure spectral mask of test equipment alone
   - Characterize custom transmit filter

Handset "Filters" Will Not Cure Interference



- Tests prove that the FCC's proposal would allow AWS-3 mobiles to create "out-of-band" interference to AWS-1 mobiles
- "Out-of-band" emissions from an AWS-3 mobile device are "in-band" as far as the AWS-1 device is concerned (red shaded area above), making significant portions of AWS-1 spectrum unusable

Lab Test Results: UMTS vs WiMAX Interferer

Combined OOBE and Rx Overload Tests (without external AWS-3 Transmit Filter)

Table lists AWS-1 Mobile received Interference Signal Strength when Setup Failure occured (dBm)

Convert to equivalent AWS-1 mobile transmit power by scaling to dBm/MHz and adding 40 dB coupling loss for 1 meter separation (Measured value - 10*log(3.84) + 40 dB)

Results for fixed serving signal frequency at 2152.5 MHz vs different interference signals (UMTS and WiMAX) at various frequencies

Serving Signal: 5 MHz UMTS centered at 2152.5MHz

Received Serving Pilot RSCP levels (dBm)	5 MHz UMTS Interference Signal				20 MHz WiMAX 5 ms frame duration (2.5 ms for uplink)		5 MHz WiMAX 5 ms frame duration (2.5 ms uplink)
	0 MHz Guard Band (2157.5 MHz)	5 MHz Guard Band (2162.5 MHz)	15 MHz Guard Band (2172.5 MHz)	20 MHz Guard Band (2177.5 MHz)	2.5 MHz Guard Band (2167.5 MHz) 100% Activity Factor	2.5 MHz Guard Band (2167.5 MHz) 25% Activity Factor	2.5 MHz Guard Band (2160 MHz) 100% Activity Factor
-105 dBm	-44.2	-43.2	-43.2	-45.2	-33.2	-31.2	-30.2
-100 dBm	-37.2	-34.2	-34.2	-35.2	-28.2	-28.2	-25.2
-90 dBm	-29.2	-23.2	-24.2	-25.2	-24.2	-24.2	-21.2
-85 dBm	-27.2	-20.2	-18.2	-20.2	-22.2	-22.2	-19.2
-75 dBm	-11.2				> -11.2		

- Harmful interference at FNPRM levels with UMTS or WiMAX as the AWS-3 interference source
  - Across range of real-world AWS-1 received power levels
  - Activity factor for WiMAX does not make a significant difference

Lab Test Results: OOBE & Overload vs Guard Band

Combined OOBE and Rx Overload Tests (without external AWS-3 Transmit Filter)

Table lists AWS-1 Mobile received Interference Signal Strength when Setup Failure occured (dBm)

Convert to equivalent AWS-1 mobile transmit power by scaling to dBm/MHz and adding 40 dB coupling loss for 1 meter separation (Measured value - 10*log(3.84) + 40 dB)

Results for fixed serving signal frequency vs various interference signal frequencies

Serving Signal: 5 MHz UMTS centered at 2112.5MHz

	5 MHz UMTS Interference Signal		
Received Serving Pilot RSCP levels (dBm)	0 MHz Guard Band (2107.5MHz)	2.5 MHz Guard Band (2105MHz)	5 MHz Guard Band (2102.5MHz)
-105 dBm	-43.2	-44.2	-44.2
-100 dBm			
-90 dBm	-26.2	-24.2	-23.2
-85 dBm		-20.2	-18.2
-75 dBm			

- Out-of-band emissions (OOBE) is the primary cause of interference
  - Better filters on AWS-1 handset receivers will not eliminate OOBE from AWS-3

Lab Test Results: With and Without External AWS-3 Transmit Filter

Combined OOBE and Rx Overload Tests (without external AWS-3 Transmit Filter)

Table lists AWS-1 Mobile received Interference Signal Strength when Setup Failure occured (dBm)

Results for fixed interference signal frequency vs various serving signal frequencies

	5 MHz UMTS Interference Signal		
Received Serving Pilot RSCP levels (dBm)	0 MHz Guard Band (Serving at 2112.5MHz; Interference at 2107.5MHz)	0 MHz Guard Band (Serving at 2152.5MHz; Interference at 2157.5MHz)	10 MHz Guard Band (Serving at 2142.5MHz; Interference at 2157.5MHz)
-105 dBm	-43.2	-44.2	-43.2
-100 dBm		-37.2	-35.2
-90 dBm	-26.2	-29.2	-23.2
-85 dBm		-27.2	-19.2
-75 dBm		-11.2	

(with external AWS-3 Transmit Filter)

	5 MHz UMTS Interference Signal	
Received Serving Pilot RSCP levels (dBm)	0 MHz Guard Band (Serving at 2152.5MHz; Interference at 2157.5MHz)	10 MHz Guard Band (Serving at 2142.5MHz; Interference at 2157.5MHz)
-105 dBm	-34.2	-27.2
-100 dBm	-30.2	-23.2
-90 dBm	-26.2	-16.2
-85 dBm	-25.2	N/A
-75 dBm		

- External filter on AWS-3 interference source test equipment makes its emissions far better than FNPRM levels
  - Due to overload mechanism, harmful interference exists with external filter at about 10 dB higher levels

Lab Test Results: Comparison to Previous Tests

Comparison A - OOBE tests with WCDMA interfering source

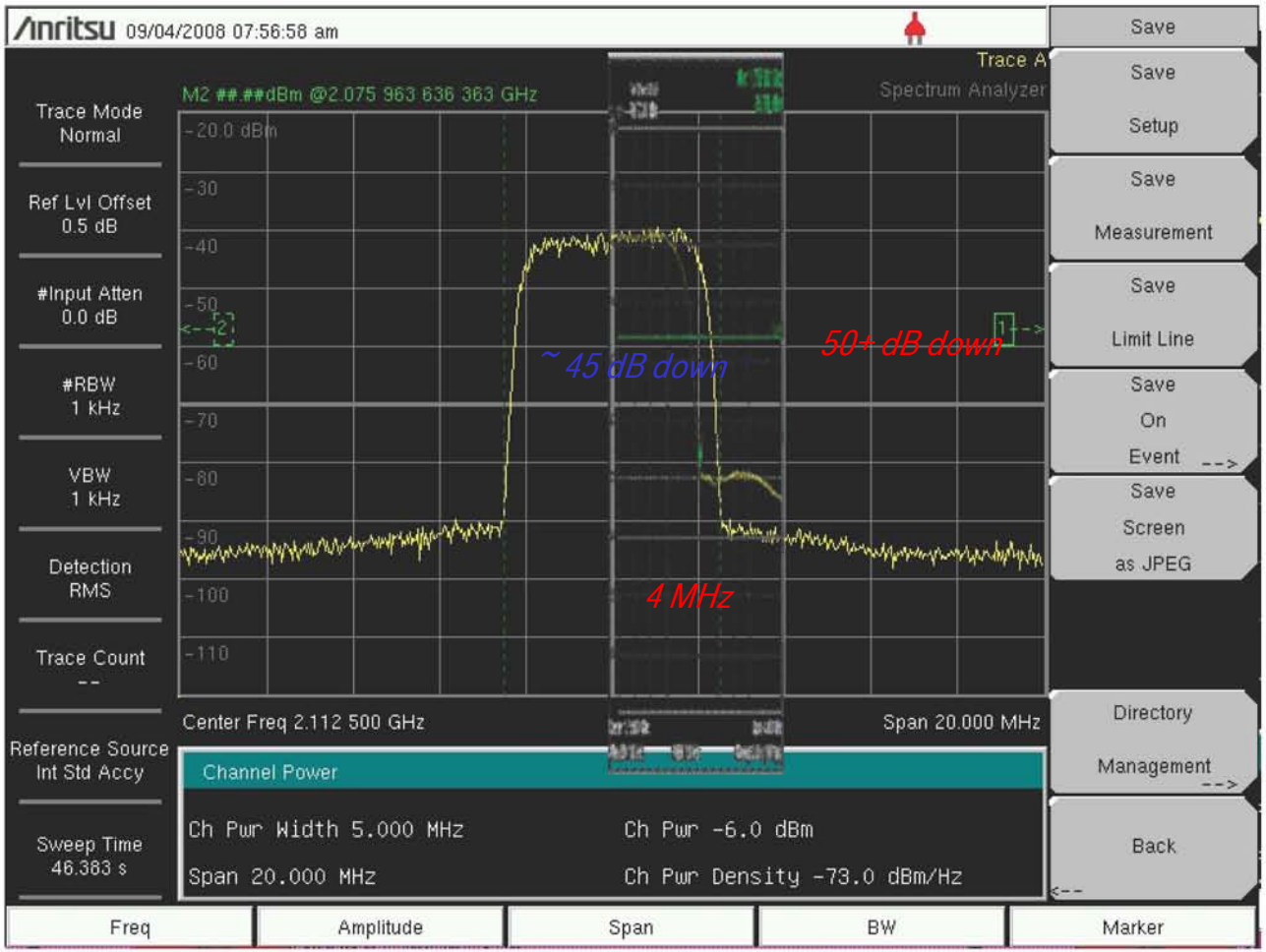
Serving pilot RSCP (dBm)	FCC public lab test - Derived maximum interference level (dBm/MHz)	T-Mobile lab test - Derived maximum interference level (dBm/MHz)
-105	-63.2	-60 to -66
-100	-56.2	-51 to -56
-90	-44.2	-41 to -44
-85	-39.2	N/A

Comparison B - Allowed Tx power with WiMAX interfering source, serving pilot RSCP = -105 dBm, WiMAX channel bandwidth = 20 MHz

	0 MHz Guard Band AWS3 Tx pwr level (dBm/MHz) at 1 meter separation	2.5 MHz Guard Band AWS3 Tx pwr level (dBm/MHz) at 1 meter separation
FCC public lab test - 100% activity	N/A	-6.2
FCC public lab test - 25% activity	N/A	-4.2
T-Mobile lab test - 100% activity	-9	N/A
T-Mobile lab test - 25% activity	-7	N/A

- FCC public lab test results consistent with T-Mobile's prior lab results

Emissions Characteristics: Comparison of Test Equipment Signal Generator (CMU200) versus Commercial WCDMA Handset



Sources:

- The CMU200 screen shot was taken at the Boeing lab during the FCC-joint tests
- The commercial handset screen shot was taken from a WCDMA handset Certificate of Compliance report – FCC ID: A3LSGHT819

Conclusions:

- Test equipment emissions meets FCC FNPRM specification limits
- Test equipment emissions lower than handset within 15 MHz of carrier

Summary and Conclusions from Lab Tests

- Tests showed harmful interference from AWS-3 devices to AWS-1 handsets
- FCC engineers should provide analysis and tentative conclusions based on results and provide opportunity for comment
- Both UMTS and WiMAX as AWS-3 interference sources caused interference
  - Interference from WiMAX occurred at about 10 dB higher levels than UMTS
- Better receive filters on AWS-1 handsets would not eliminate the interference
- With external filter on AWS-3 interference source, interference still occurred
  - At 10 dB higher level, due to overload blocking
- Interference levels and tolerable AWS-3 transmit powers similar between recent FCC public tests and T-Mobile's prior lab tests
  - Tests showed consistent and comparable results

Optimi's Monte Carlo (Probabilistic) Simulation of AWS-3 Interference

Accurate Simulation *Confirms* Test Results

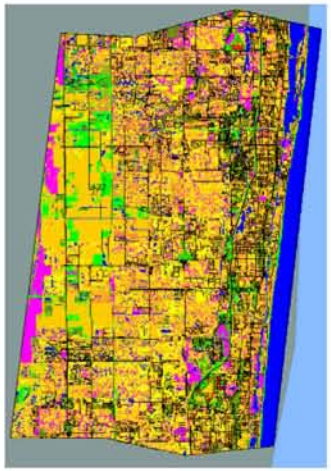
- Statistical analyses presented by M2Z did not incorporate many of the characteristics of real networks, such as uneven distribution of traffic (*e.g.,* hotspots and busy hours) and indoor use
- When these are factored in, simulation demonstrates widespread and persistent call failures due to interference from AWS-3 devices
- Around one-fifth of cell sectors suffered capacity degradation worse than 10% due to AWS-3 interference
- Home users experiencing 10.6% capacity loss
- Users with an AWS-3 router inside their homes had a 67% chance of lost calls when there was simultaneous AWS-3 transmission
- Users that had a neighbor with an AWS-3 router had a 28% chance of lost calls when the AWS-3 router was transmitting

Monte Carlo Simulation Assumptions

- Traffic distribution
  - 41 sites with 123 sectors total. AWS-1 and AWS-3 sectors were assumed to be collocated
  - Users were statistically distributed in the simulation area according to traffic maps
  - 5000 Erlangs of UMTS traffic, 60% indoor and 40% outdoor
    - Average load was 40 Erlangs/sector, which was a conservative value
  - AWS-3 network carried 600 Mbps of uplink traffic.
    - Number of AWS-3 devices in the area was calculated based on expected WiMAX capacity (5.4 Mbps/sector in uplink) and average user throughput (125 kbps/user). The effective ratio of AWS-3 devices to AWS-1 mobiles was 2.88:1
  - AWS-3 devices did not transmit all the time (20% uplink activity factor)
- Power settings
  - AWS-1 base stations had a maximum transmit power of 61 dBm EIRP. AWS-1 devices received their signal at a power level that was based on the path loss to their server
  - AWS-3 devices had a maximum transmit power of 36 dBm (= 23 dBm/MHz for 20 MHz, based on FNPRM). The actual transmit power level was based on the path loss to their server
  - AWS-3 devices had an OOBE attenuation of 53 dB (= 60+10 log(P), based on FNPRM)
  - AWS-1 devices had an adjacent channel selectivity ranging from 68 dB to 46 dB (based on results from FCC tests).
  - Simulator incorporated “hard limits” on AWS-3 interference based on lab test results
- Time of day
  - Simulations performed at two different times of the day, following typical network behavior:
    - Afternoon busy hour: significant share of users at offices
    - Evening busy hour: majority of the indoor traffic was at home

Simulation Area and Traffic Maps

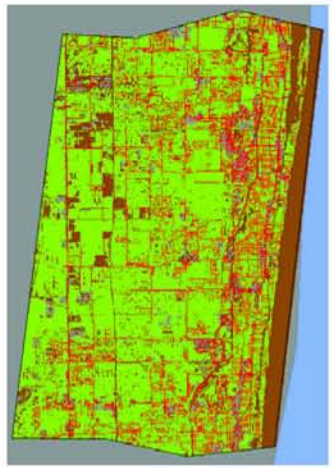
Clutter info



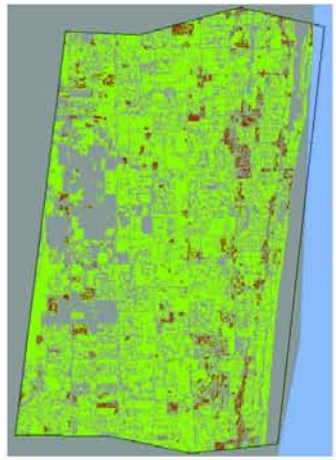
DenseUrban
Urban
HighDensityResidential
LowDensityResidential
Open
Water
Deciduous
Coniferous
CommercialAndIndustrial
CoreUrban
Airports
Transportation

Residential traffic map

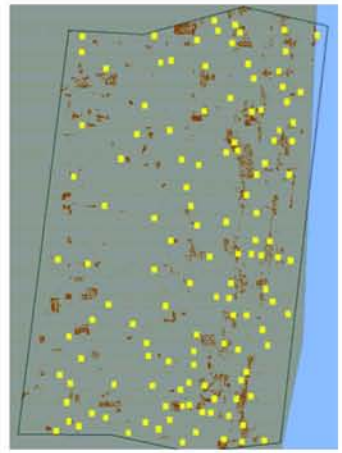
Outdoor traffic map



Office traffic map



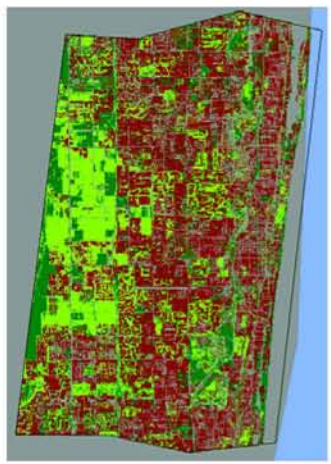
Office traffic map with hotspots



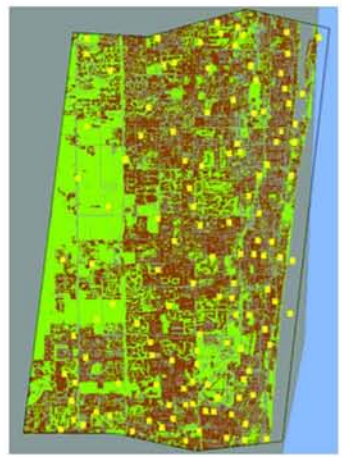
Weighting

0<=value<1
1<=value<2
2<=value<4
4<=value<6
6<=value<10
10<=value<12
12<=value<14
14<=value<15
15<=value<16
16<=value<100
100<=value<200
200<=value<500
value >= 500

AWS-3 traffic map



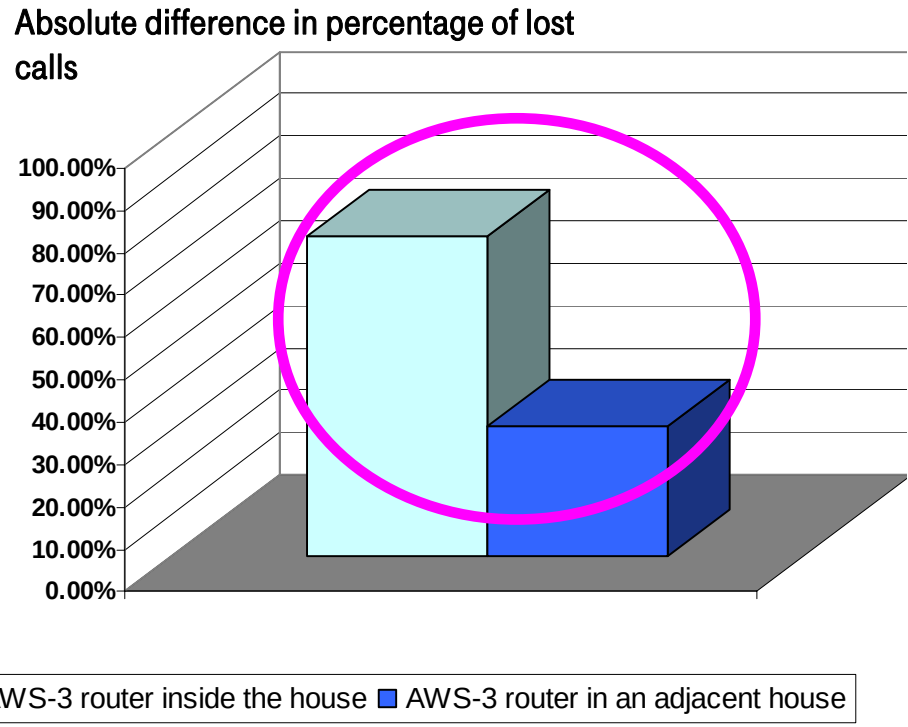
AWS-3 traffic map with hotspots

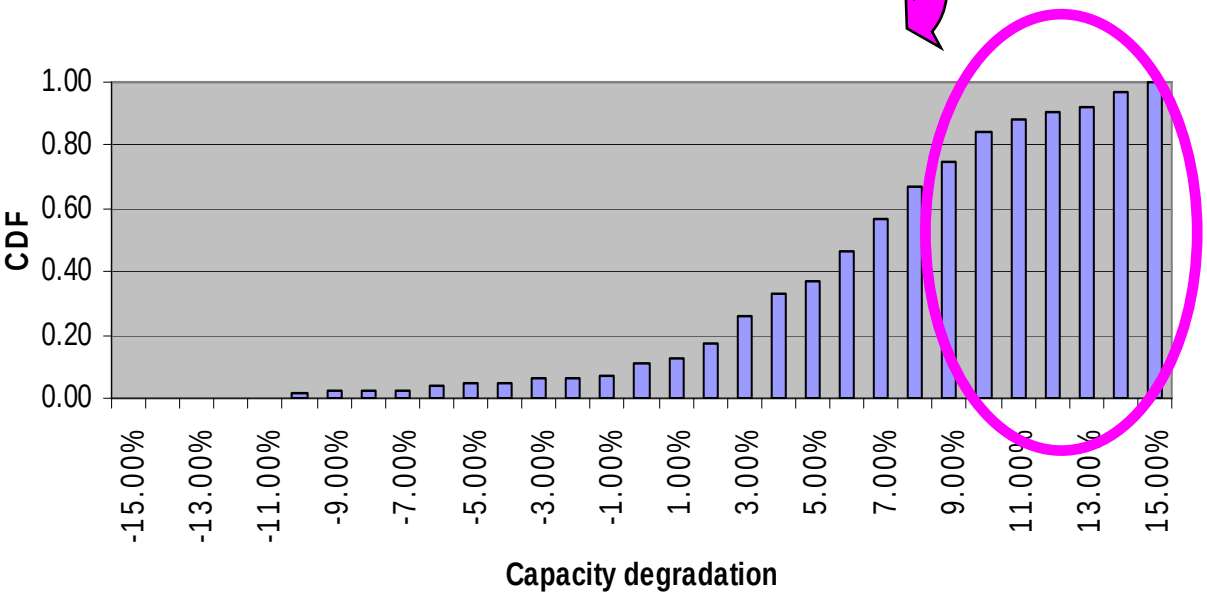


Simulation Results

Conclusions:

- Users with AWS-3 routers in their homes have 67% chance of lost calls during AWS-3 transmissions
- Users with AWS-3 routers in their neighboring homes have 28% chance of lost calls during AWS-3 transmissions
- Almost one-fifth of sectors suffer more than 10% capacity degradation due to AWS-3 interference
- Overall network capacity loss of 5.4%, with home users experiencing 10.6% capacity loss

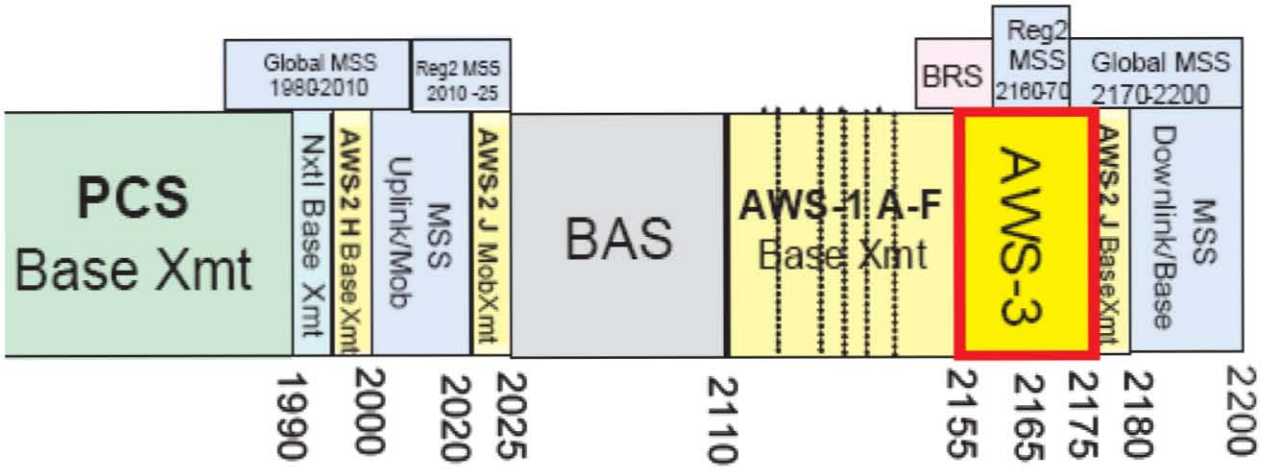




Distribution of incremental capacity degradation per sector due to AWS-3 interference

A Proposal: Asymmetrical Pairing of AWS-3 Spectrum Is a Reasonable Alternative

- Asymmetrical pairing of AWS-3 downlink with J Block



- The AWS-3 downlink could be paired with J Block uplink/downlink
- Standards bodies have confirmed viability of asymmetrical pairing
- Eliminates TDD adjacent to AWS-1 FDD, along with associated interference
- Facilitates bi-directional use of the new bands
- Allows new entrants, including M2Z, to bid

Conclusions

- Lab tests performed in an open, public forum
  - Tests evaluated interference at specification levels proposed in FCC FNPRM
  - Assessed Out-of-band Emissions and Adjacent Channel Interference (overload)
  - Performed with and without external filter on output of test equipment interference source
- Results again demonstrate harmful interference
  - Access failures and dropped calls in AWS-1 from AWS-3 interference
  - Consistent with prior tests performed by T-Mobile and observed by Nokia
- Results also demonstrate that better AWS-1 receive filtering will not solve the problem
  - Tests performed on both high side and low side of AWS-1 band
  - On low side, AWS-1 handset receive filter rolls off at band edge
  - Tests show that harmful interference exists even with handset filter that rolls off at band edge
- Optimi's Monte Carlo simulations performed to determine if AWS-3 interference would be a problem for AWS-1 network performance
  - Around one-fifth of the sectors suffered capacity degradation worse than 10% due to AWS-3 interference:
  - Users with an AWS-3 router inside their homes had a 67% chance of lost calls, and those with AWS-3 in neighbor homes had 28% chance of dropped calls when there was simultaneous AWS-3 transmission
- T-Mobile proposes asymmetrical pairing of AWS-3 with J block