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August 20, 2004

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VIA ELECTRONIC FILING

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

Re: WT Docket No. 00-32 – *Ex parte* Presentation

Dear Ms. Dortch:

On August 19, 2004, Steve Sharkey, and Stu Overby of Motorola, Inc. met with Ed Thomas and James Schlichting of the Office of Engineering and Technology to discuss technical issues associated with the 4.9 GHz band that are under consideration in the above-captioned proceeding. During this meeting, the attached slides were presented and discussed with Motorola reiterating its previously stated position that adequate safeguards must be adopted to protect adjacent channel operations in the 4.9 GHz band.

Pursuant to Section 1.1206(b)(2) of the Commission's rules, 47 C.F.R. §1.1206(b)(2), one copy of this letter is being filed electronically for inclusion in the public record of this proceeding. If you have any questions regarding this filing, please contact me at the above number.

Sincerely,

/S/ Michael A. Lewis
Michael A. Lewis
Engineering Consultant
Wiley Rein & Fielding

Counsel for Motorola, Inc.

cc: Ed Thomas
James Schlichting

4.9 GHz

**FCC
August 18, 2004**



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Agenda

- **Summary of Position/Recommendations**
- **Need to maintain high power**
- **Use Scenarios**
- **Interference Impact**
- **Competitive environment**
- **Conclusions**

NPSTC/CISCO Coalition

- Leverage cost-effective standards-based COTS technologies for mission critical broadband
- Use 802.11a mask
- Make power > 20 dBm (100 milliwatts) experimental
- Public safety already embraces 802.11 in unlicensed bands
- Coordination & Incident Command eliminates need for tight mask
- Interference means slower data
- Meeting tight mask prevents competitive market
- Use better receiver, not tight mask

Motorola

- We agree
 - We use standard COTS chipsets & partner w/ other companies who supply 802.11 & mesh technologies
 - Use standardized DSRC mask
- Limiting power results in need for more sites/much higher user costs
- 600 MHz of spectrum in unlic bands helps offset adj. chan. interference.
- Useful but not a substitute for mask
 - Incident commanders' main focus is overall safety, not interference
 - Fixed hotspots: Current COTS products all 20 MHz– coordination does not solve freq. re-use problem
- Denial of service will also occur
- Meeting mask is a \$3 cost business decision, not a barrier to entry
- Better receiver requires change to COTS chipsets, tight mask does not

Recommendations for MO&O

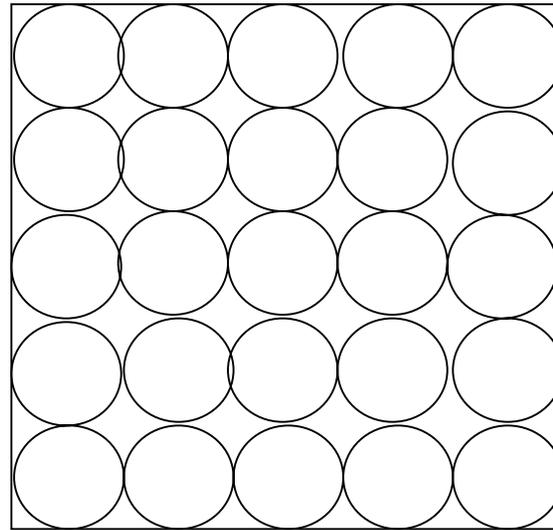
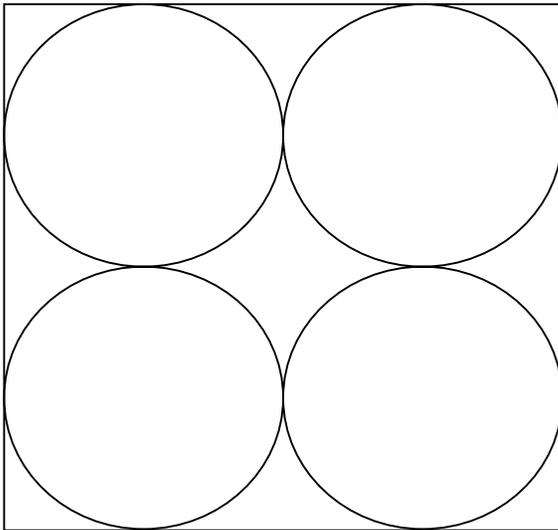
- Reaffirm transmitter power up to 2 watts routinely deployable under 4.9 GHz Part 90 licenses, if DSRC-C mask equipment is used
- Deploy a two tier mask structure:

Channel Width	Peak Transmit Pwr with DSRC-C Mask	Peak Transmit Pwr with 802.11a Mask
1 MHz	20 dBm	-5 dBm
5 MHz	27 dBm	2 dBm
10 MHz	30 dBm	5 dBm
15 MHz	31.8 dBm	6.8 dBm
20 MHz	33 dBm	8 dBm



Maintain Use of Higher Power Under Part 90

- **Current rules allow 33 dBm at 20 MHz, 30 dBm at 10 MHz, 27 dBm at 5 MHz**
- **NPSTC/CISCO 7/29 Ex Parte recommends experimental license for powers above 20 dBm at 20 MHz BW,**



Today's rule (33 dBm) Power limited to 20 dBm

• **Customer RFPs require connected hot zones**

• **Lower power drastically increases deployment and operating costs**

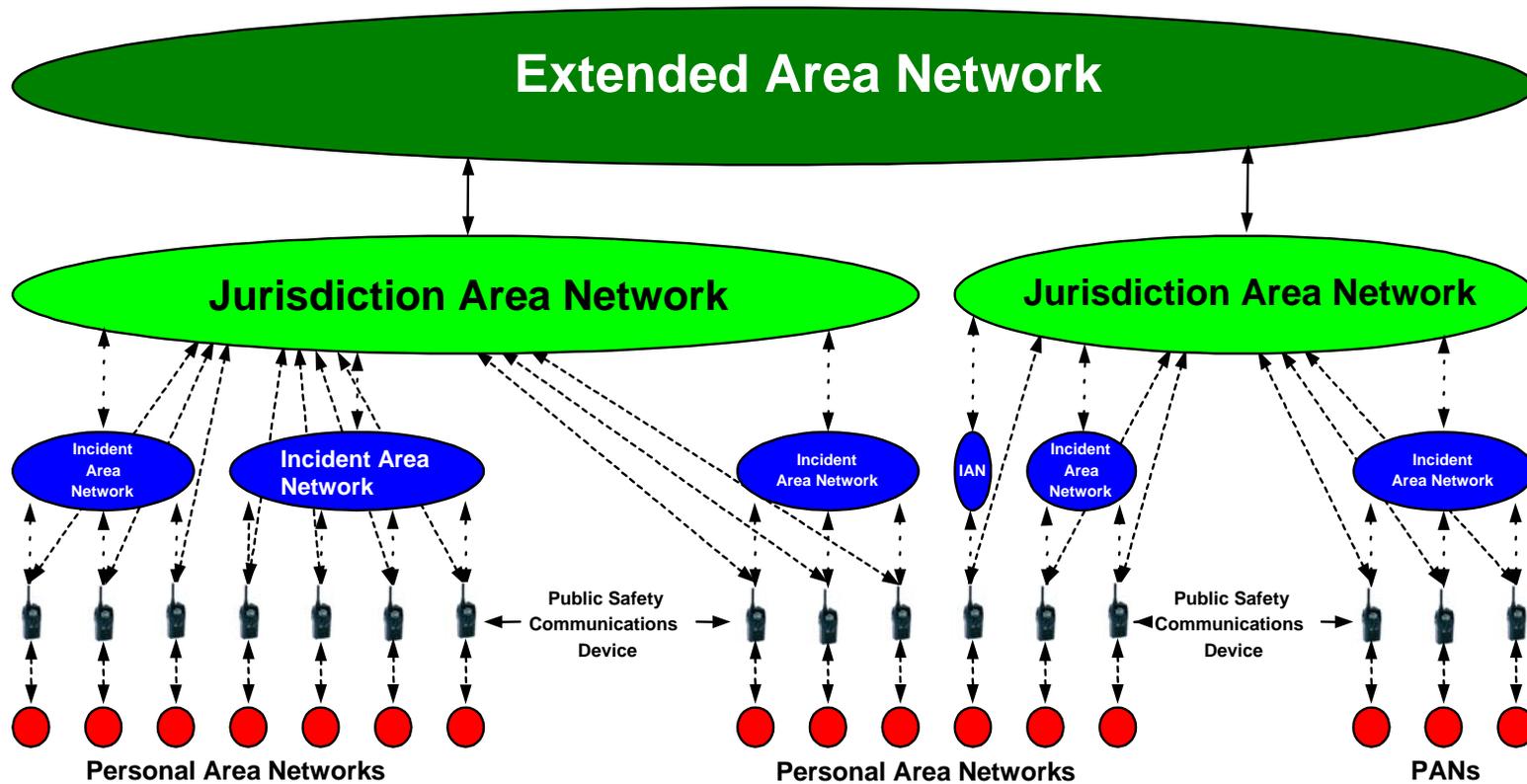
Keep 4.9 GHz Mission Critical

“Voice communications are critical, but voice communications requirements are not the only issue.....public safety agencies are increasingly dependent on the sharing of data, images, and video.”

DHS SAFECOM Program, Statement of Requirements, March 2004

- It's more than just improving Interoperability for major events
 - Day-to-day capabilities (“operable” as 1st step)
 - Shift in mission to add “prevention”
- 4.9 GHz was allocated based on mission critical need
- 600 MHz of unlicensed spectrum exists for admin traffic

SAFECOM SOR Architecture

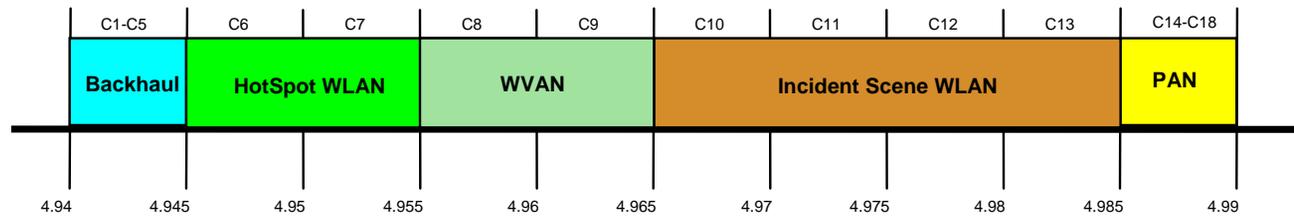


- **Multiple Networks & Users = Multiple Channels, BWs & Power Levels**
- **Customer RFPs Confirm this Vision**

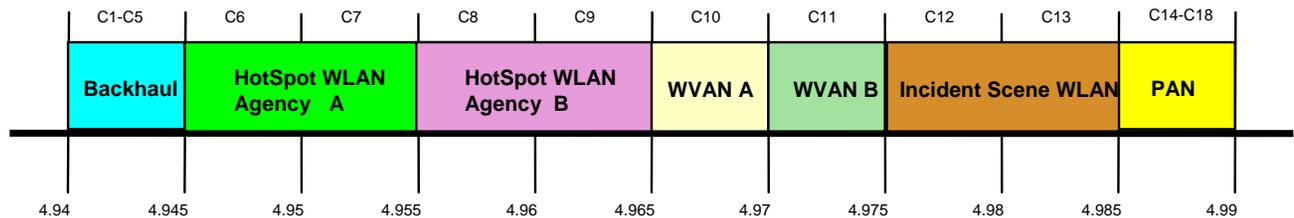
Channel Plan Options to Support SAFECOM's Vision

Adjacent channels can have multiple channel bandwidths and power levels

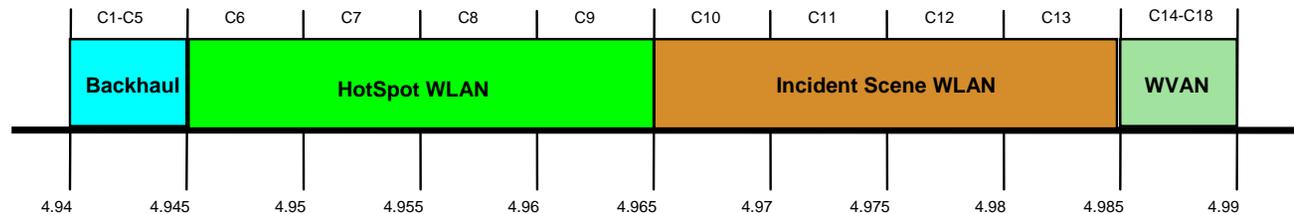
- Multi-service/
Multi-agency
(Fully Shared Networks)



- Multi-service/
Multi-agency
(Partial Sharing)



- Basic Services
(Shared Networks)

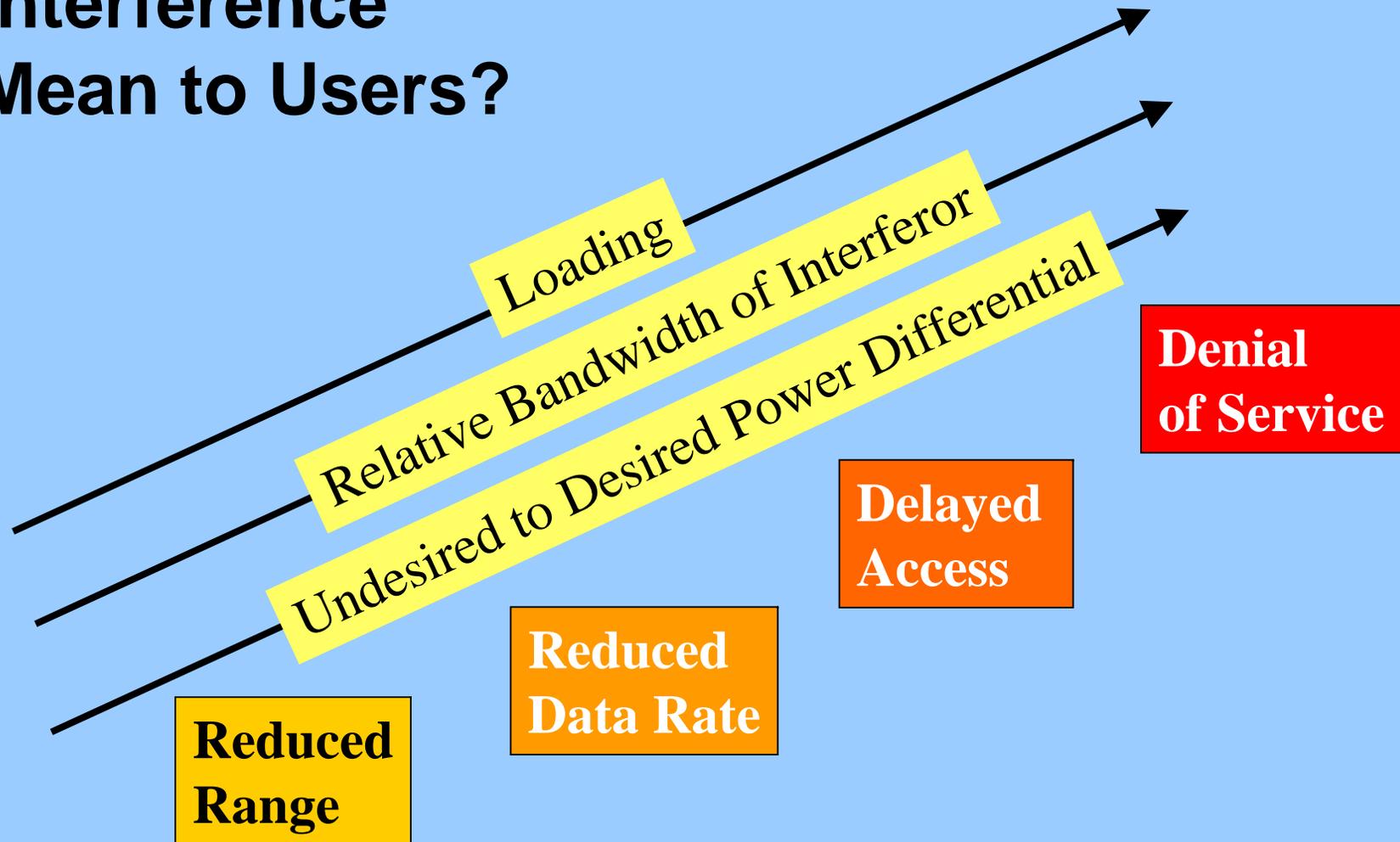


Increased Adjacent Channel Interference Reduces this Flexibility & Spectrum Efficiency

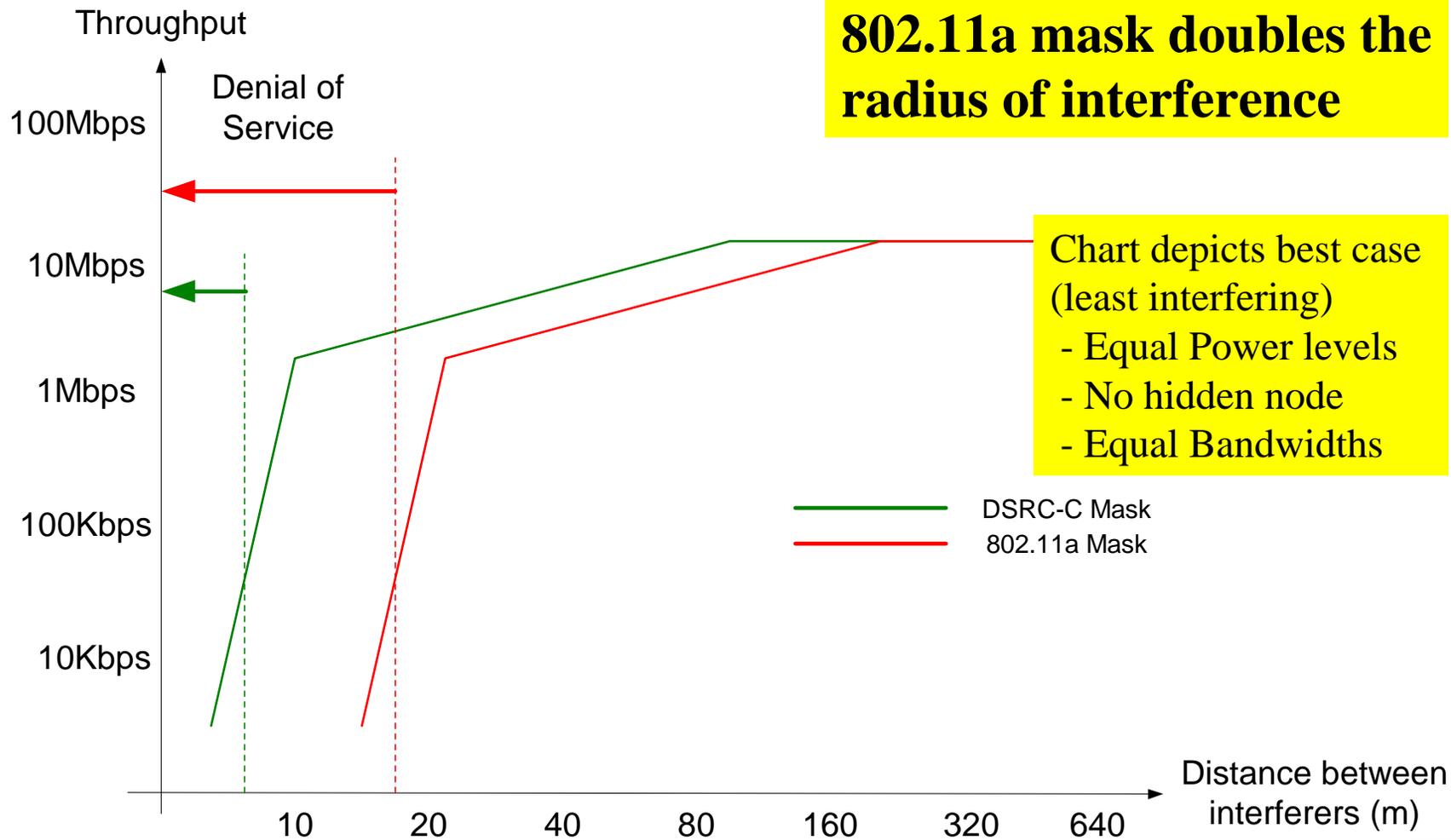
Mission Critical/Unlicensed Comparison

	Unlicensed	Mission Critical Public Safety	
Frequency band	2.4 & 5 GHz	4.9 GHz	
Spectrum Available	Unlicensed, >600MHz	Licensed, 50MHz	Unlicensed has 12X the spectrum as Public safety
Non-overlapping Channels	3 @ 2.4 GHz and 24 @ 5 GHz, all 20 MHz BW	2 @ 20MHz BW, or 5 @ 10MHz BW, or 10 @ 5MHz BW	With unlicensed, if channels conflict, user goes to another <u>non-adjacent</u> channel
Multiple overlapping networks	Use more channels	Use tighter specs	4.9 GHz has fewer channels
Deployment	Alternating channels	Adjacent channels	Public Safety does not have enough spectrum at 4.9 GHz to avoid using adjacent channels
Coverage reliability at a given data rate	Approx 80%	95%	% of coverage area where throughput is guaranteed
High availability and automatic disaster recovery	Not Required	Required	PS needs wider temperature and more stringent mechanical specs
Denial of Service	Not Catastrophic	Catastrophic	Public safety can't allow denial of service

What Does Interference Mean to Users?



Denial of service likelihood increases



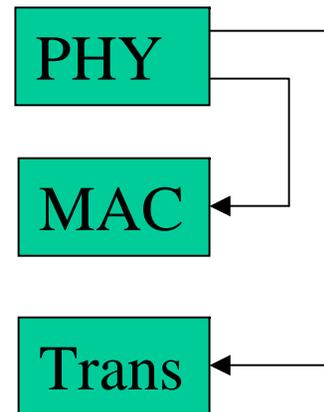
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Interference Will Cause Denial of Service, not Just Reduced Data Rates

Three major mechanisms of Denial of Service in 802.11a:

1. Interference
2. Hidden Nodes
3. TCP/IP artifacts



Problems at the Physical Layer Cascade to MAC and Transport Layers

Better adjacent channel protection is the key to minimizing Denial of Service.



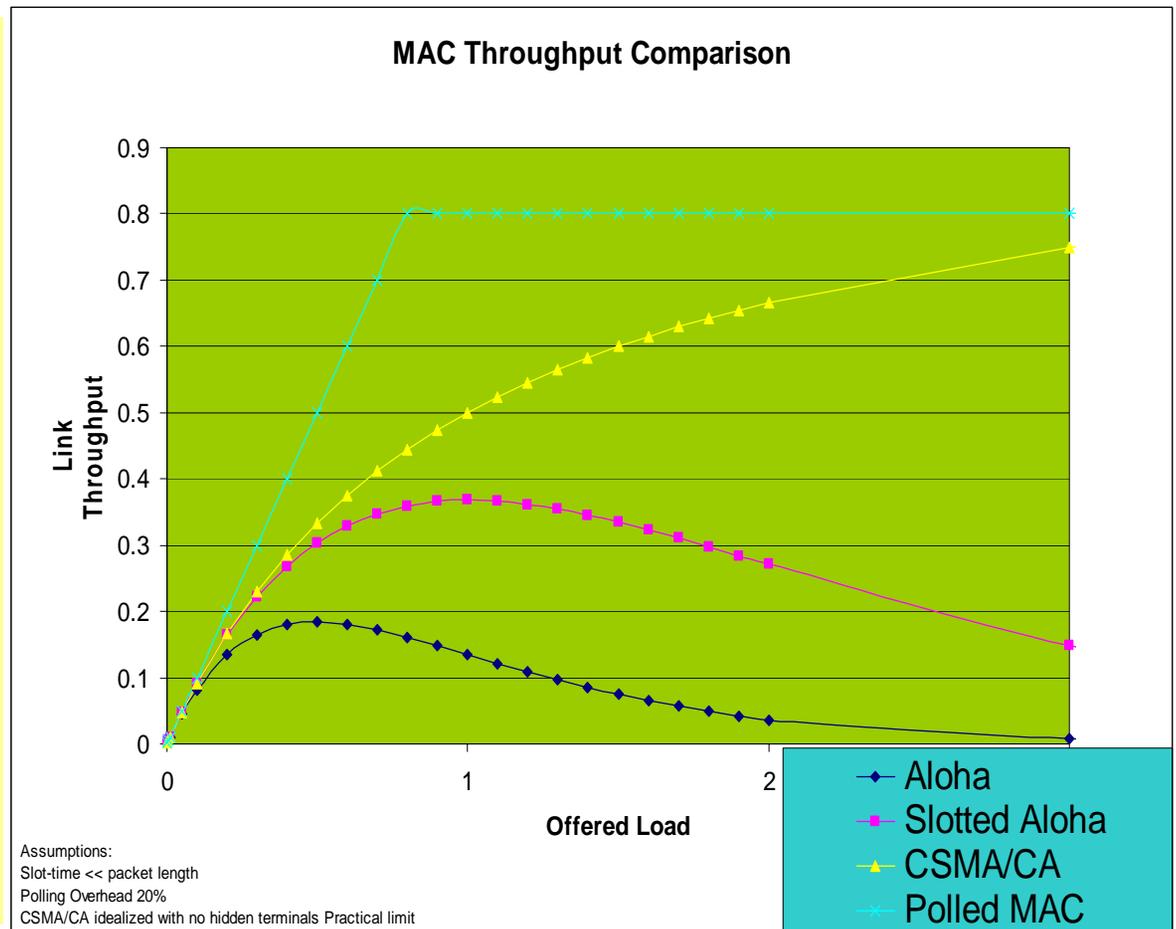
Denial of Service due to Adjacent Channel Interference

- Hand held devices transmit less power than infrastructure devices
- Classic Near-Far Interference Scenario - The link imbalance causes Denial of Service due to adjacent channel interference.
- 802.11 is based on Clear Channel Assessment (CCA) protocol. Interference exceeding the CCA threshold will block the receiver & deny service for long duration
- The denial of service is in the PHY layer, there are no mitigation procedures at higher layers.



Denial of Service due to Co-channel Hidden Nodes

- Propagation is near LOS, with very little diffraction.
- This environment creates “Hidden Nodes”, where nodes cannot hear each other.
- The 802.11 CSMA/CA network rapidly degrades, resulting in Denial of Service.



L. Kleinrock, F. Tobagi: "Packet Switching in Radio Channels...", IEEE Transactions on Communications, Volume: 23, Issue: 12, Dec 1975

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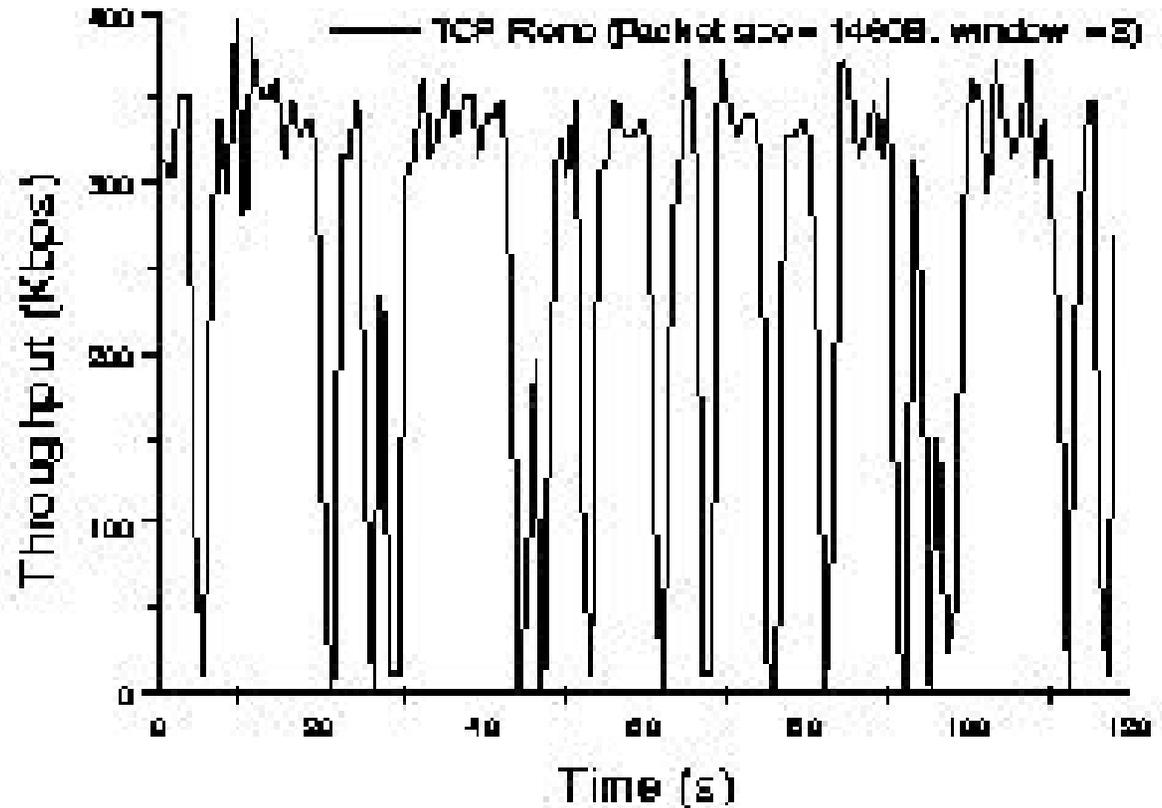


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Denial of Service due to TCP/IP

- The TCP layer is very sensitive to lost packets.
- When packets are lost, TCP reduces buffer size and transport speed.
- With BER worse than 0.01% TCP is blocked, resulting in Denial of Service.



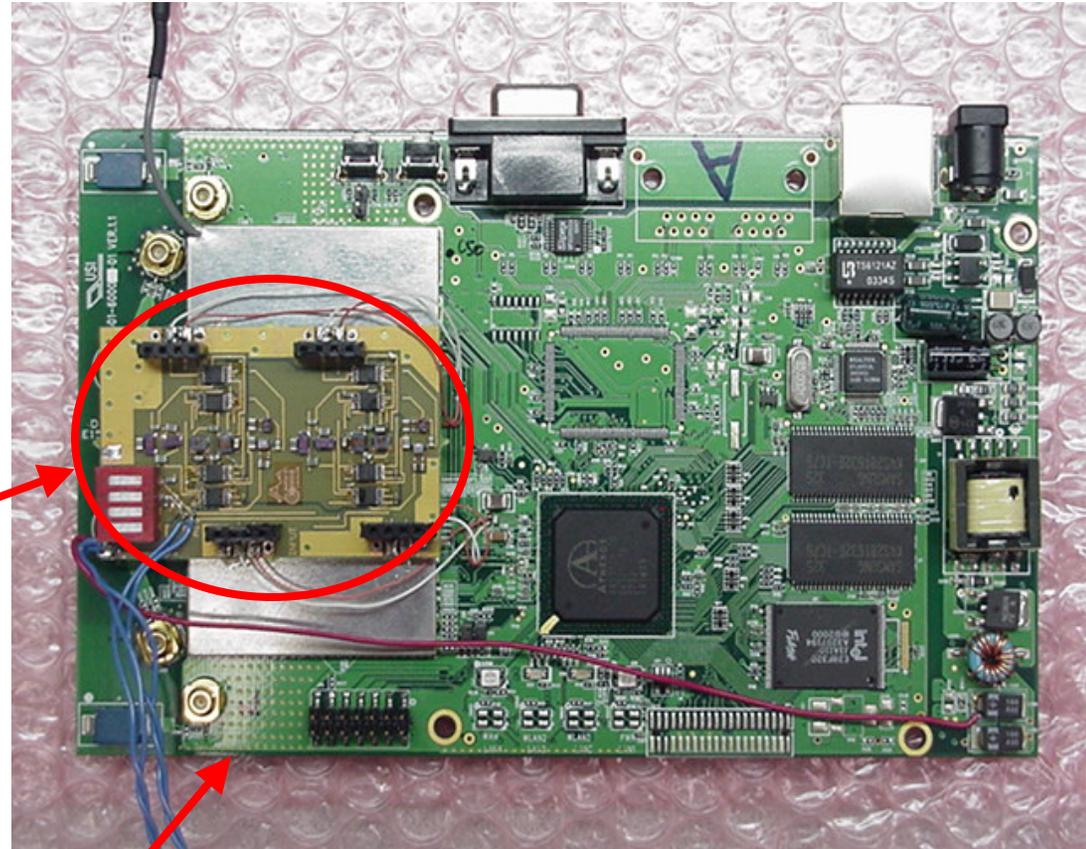
S. Xu, T. Saadawi: "Does the IEEE 802.11 MAC protocol work well in multihop wireless ad hoc networks?" IEEE Communications Magazine, Volume 39, Issue 6, June 2001.



Minimizing Interference Does Not Prevent a Competitive Market

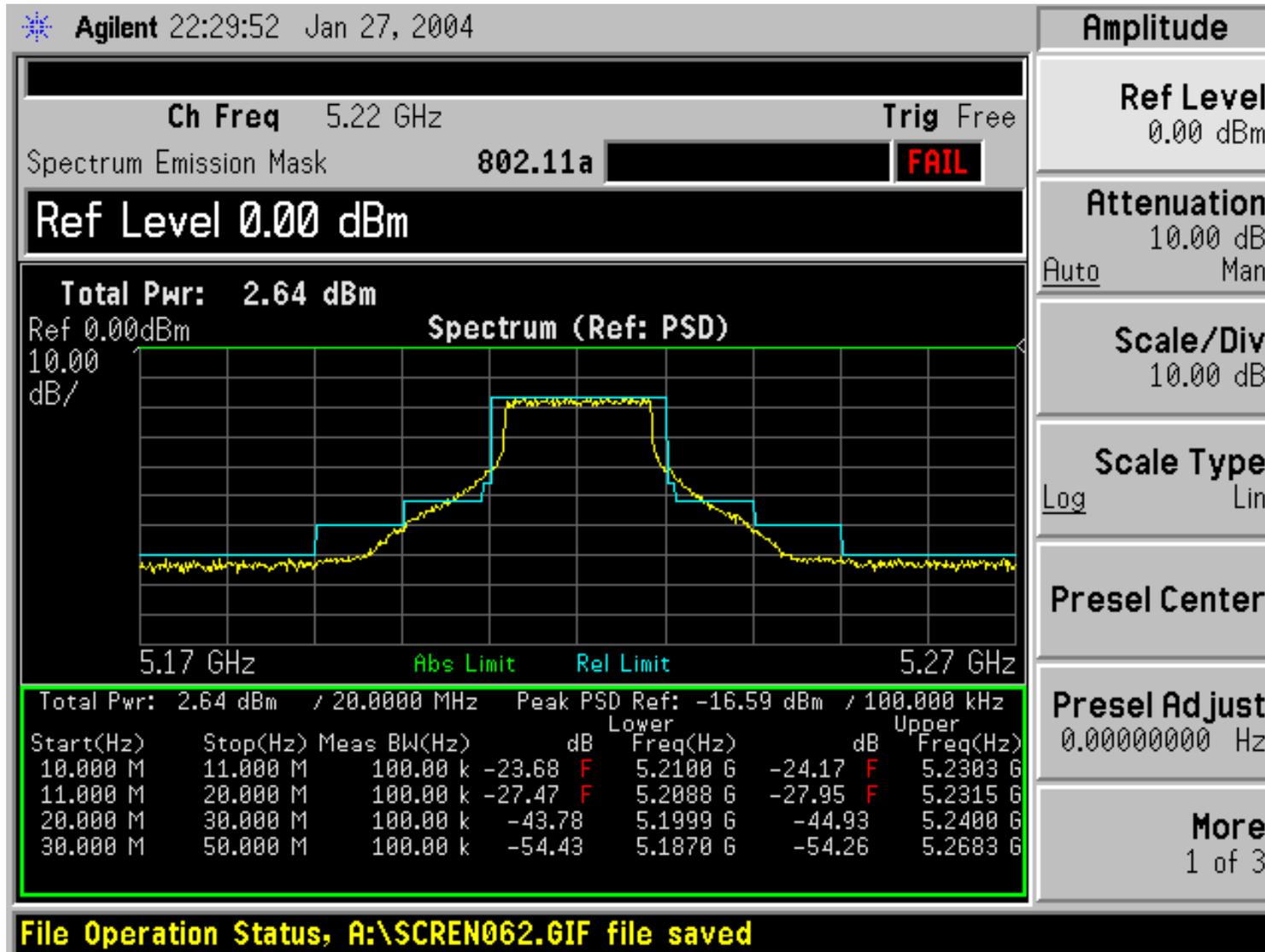
Prototype Filter Added

- Meets DSRC-C for 5,10 & 20 MHz channels
- No Change to Chips
- Adds < \$3.00 in parts
- Any mfr. can build it
- Actual production filter size can be reduced
- Both PS & DSRC volume will exist



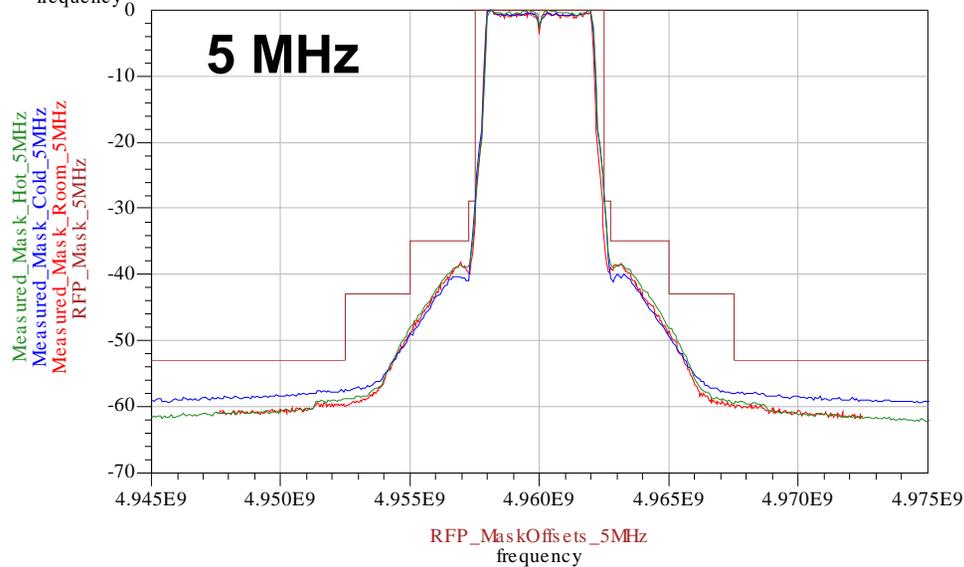
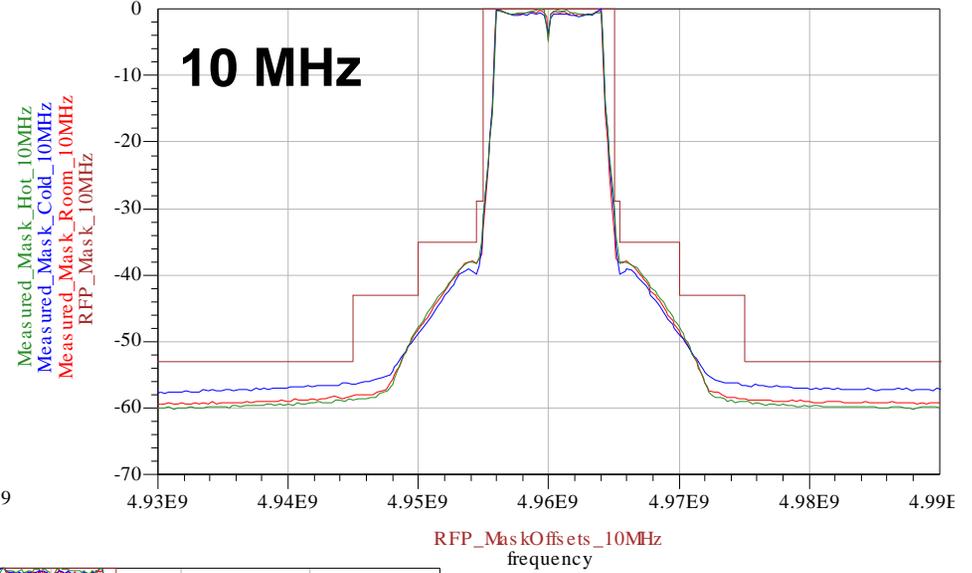
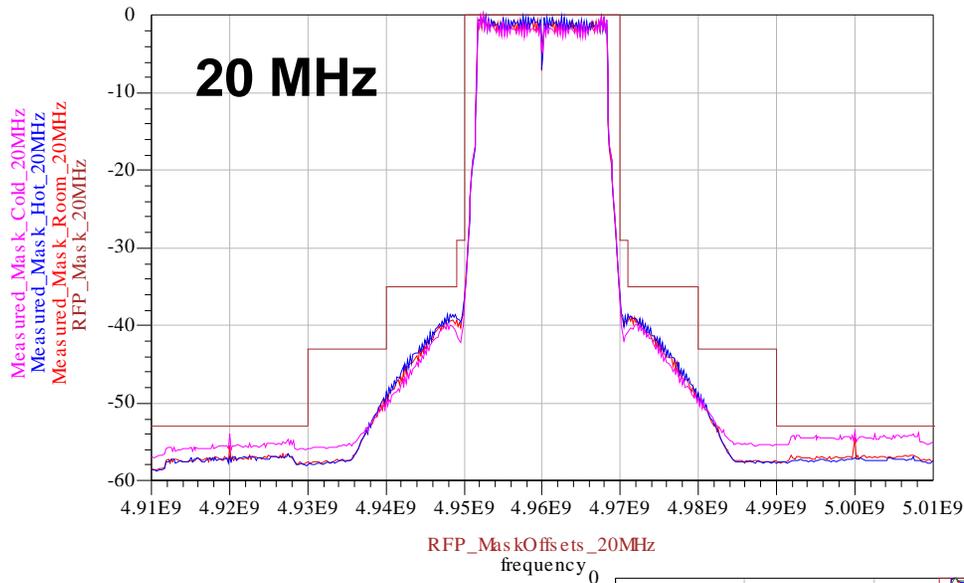
802.11 COTS Access Point Board

Unfiltered Access Point Transmit Spectrum



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COTS Access Point With \$3.00 in Filter Parts Added Meets the DSRC-C Mask with 20,10 & 5 MHz Channels



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Conclusions

- **Retain current rules allowing transmitter power up to 2 watts under Part 90 licenses to help minimize user deployment costs**
- **Keep the 50 MHz at 4.9 GHz mission critical; administrative traffic can use the 600 MHz of unlicensed spectrum at 5 GHz**
- **Deploy a two tier mask structure using 802.11a mask below 8 dBm and DSRC-C mask above that level (ref: 20 MHz BW channels)**
- **COTS technology can be meet the DSRC-C mask by addition of simple inexpensive filter; no change to chips are required**
- **Meeting the tighter mask is a business decision, not a barrier to entry for COTS manufacturers**
- **Motorola will also be leveraging COTS technology**
- **Don't create another "800 MHz interference problem"**

