



# Wideband FH NPRM Discussion

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# Discussion Points

- **Motivation for proposed rule change**
  - HomeRF Mission
  - Current Usage Scenarios
  - Expanded Usage Scenarios
- **The Requested Rule Change**
  - Objectives
  - Proposed Change
- **Responding to IEEE objections**
- **Call to Action**



# HomeRF™ Working Group Mission Statement

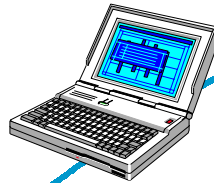
To enable the existence of a broad range of interoperable consumer devices, by establishing an open industry specification for unlicensed RF digital communications for PCs and consumer devices anywhere, in and around the home.

**94 Members as of 9/1/99**

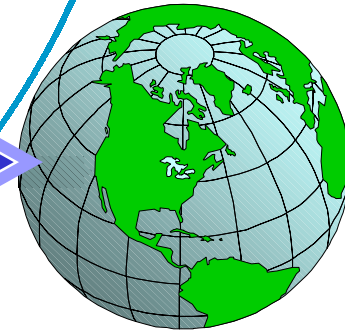
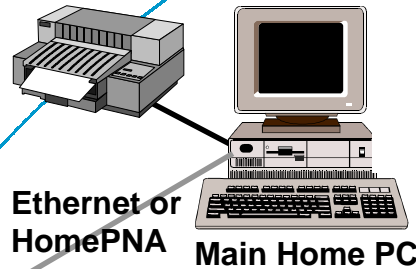


# Connects Broadband Pipes to Home network

**Office Laptop**  
 Connect to office LAN  
 Email  
 Home Printer access  
 Surf from anywhere  
 Share files



**Mobile display pad**  
 Electronic Program guide  
 Read & set security system  
 Home Theater control  
 Display News headlines



**Additional PC(s)**



**Cordless Phone**  
 Remote Speech recognition  
 Call by name  
 Build shopping lists  
 Home PBX

**Fridge Pad**  
 Family Calendar  
 Recipe Display  
 Build shopping lists  
 Voice messaging  
 Intercom



**Kids Room PC**  
 Printer access  
 Internet access  
 File access



# WBFH Benefits & Expanded Usage

- **Benefits:**

- Backwards compatible with first generation SWAP devices
- Take advantage of HomePNA R2.0 performance
- Increase telecommuting productivity for Laptop users
- Increase the number of DECT handsets from 4 to 8
- Improve compressed video transmissions quality
- Take advantage of future Broadband speed increases
- Increase number of MP3 audio streams

- **Usage scenarios**

- Whole house wireless CD quality audio speakers
- Video intercoms
- Remoting PC screen/keyboard to TV
- SOHO PBX with the expanded DECT channels



# Requested Change Objectives

- **Aligned with purpose of Part 15**

to enable the “introduction of new services and devices and the enhancement of existing services and devices...[which] will create new jobs, foster economic growth, and improve access to communications by industry and the American public.”
- **Proposal does not cause additional interference to existing users of the 2.4 GHz band**
  - The increases in bandwidth are accompanied by proportionate reductions in maximum allowable power
- **Allows a similar degree of range/performance flexibility for FH systems as recently allowed for DS systems**
  - Will foster greater offerings at lower costs for consumers
- **Harmonizes Part 15 FH regulations with most of Europe & Far East**



# Requested Change

- **Maximum 1 MHz channels**
  - unchanged
- **Maximum 3 MHz channels**
  - Maximum power +25 dBm EIRP
  - Maximum channel bandwidth 3 MHz
  - Maximum channel occupancy 50 mSec
  - Minimum number of hops 75
- **Maximum 5 MHz channels**
  - Maximum power +23 dBm EIRP
  - Maximum channel bandwidth 5 MHz
  - Maximum channel occupancy 20 mSec
  - Minimum number of hops 75
- **Definition of channel bandwidth remains unchanged**
  - -20 dBc energy or less out of channel bandwidth
  - Two new categories will result in overlapping channels



# Response to IEEE's Objections

- Four points were raised in the letter:
  - a) Overlapped channels cause “increased interference”
  - b) WBFH rules will require faster hopping, which “represents a more severe interference threat”
  - c) The proportional reduction in maximum allowed transmitted RF power will not “effectively offset the impact of wider occupied channels”
  - d) Changing the 15.247 rules to allow WBFH is not necessary, since there is “already...a standard for high speed wireless networking” that will meet all of HomeRF's objectives.

**HomeRF would like to clarify our position - we believe there are sound technical and marketing reasons for WBFH**





# First-some key points

- **1: WBFH Home RF systems will be required to fall back to 1MHz channels in the presence of interference or channel impairments**
  - Will be in the 2.0 spec and required for compliance/logo
  - Just like 802.11b, fallback modes increase robustness and provides legacy support
  - Unlike 802.11b, fallback modes decrease spectral occupancy, so probability of co- and adjacent channel interference decreases for WBFH---especially significant for Bluetooth interference
    - In 802.11b, fallback modes are especially bad for Bluetooth interference, since spectral occupancy remains constant, but packet length increases significantly.



## Key points (2)

- **2: We believe the FCC's role is to foster competition when it is in the consumer's best interest**
  - The intent of WBFH is to allow FH systems to move to higher speeds just like rule wavers have allowed DS systems to move to higher speeds
    - §15.247 has always allowed both DS and FH to operate in the 2.4GHz ISM band, and our belief is that the FCC should allow both technologies to compete and drive down prices.
  - IEEE 802.11 has both FH and DS standards - both types of systems have advantages and disadvantages and 802.11 has historically recognized that fact
  - By favoring an imbalance in §15.247, IEEE 802.11 is abandoning its traditional impartiality

**HomeRF believes FH technology is best for home use, and should be allowed to expand to higher speeds, like DS technology**



# Response to letter (a-1)

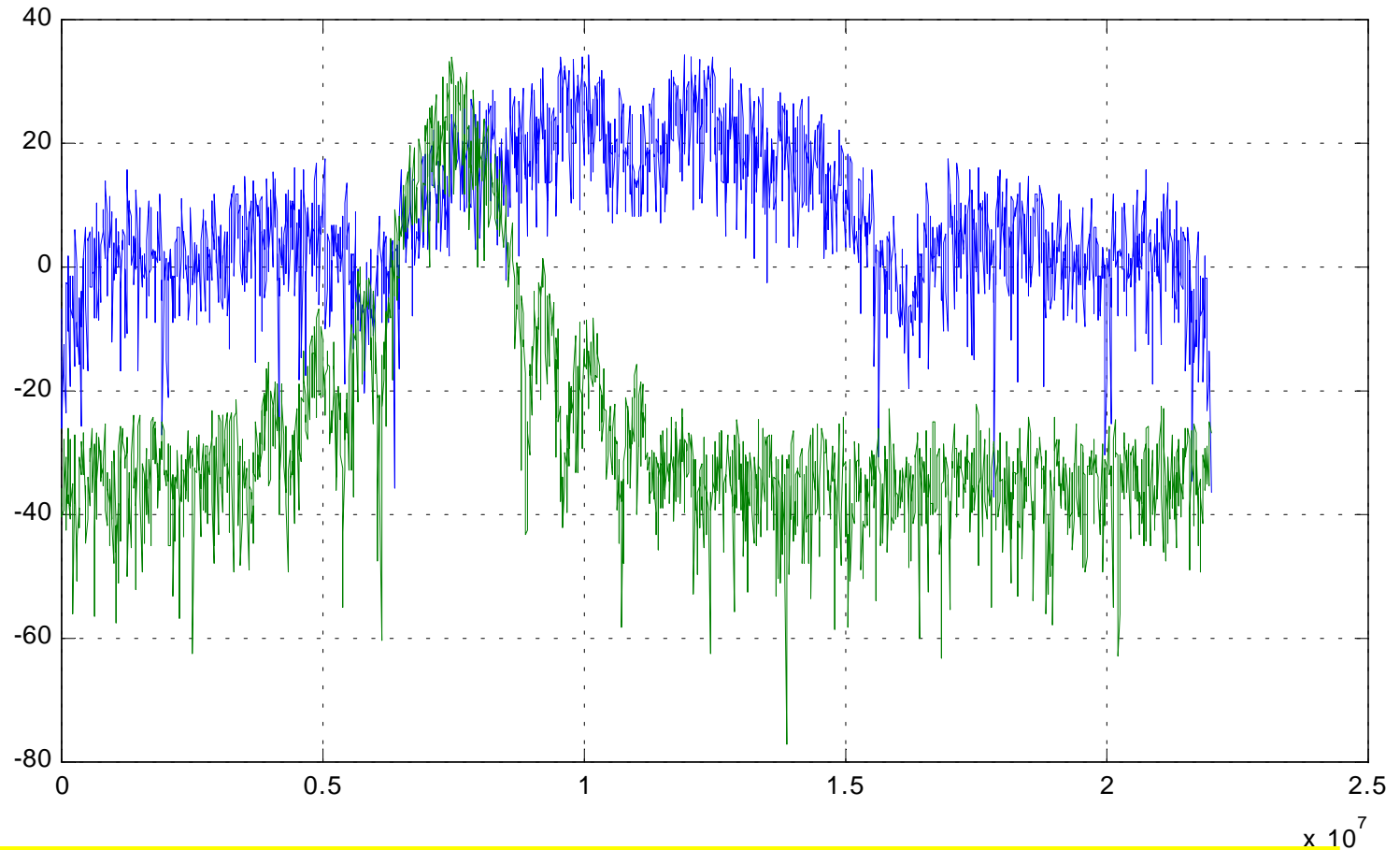
- Overlapped channels cause “increased interference”
  - WBFH will likely use GMSK, which has most of its energy concentrated near the middle of the channel
    - For 5Mb/s w/5MHz channels, WBFH will be -20dB@4MHz
    - For 10Mb/s w/5MHz channels, WBFH will be -20dB@5MHz, and -10dB at 3MHz
  - Simulation results show that DS systems can operate at 0dB C/I, as long as it has 10dB of processing gain (next slide)
  - FH systems such as Bluetooth use limiter/discriminators, and capture effect effectively blocks interference for  $C/I > 11$  dB (BT)
  - WBFH is 5MHz hopping over the entire 83.5MHz band; 802.11b occupies 22MHz continuously per subnet

**Interference from WBFH is only significant when C/I is poor - not unique**



# Response (a-2)

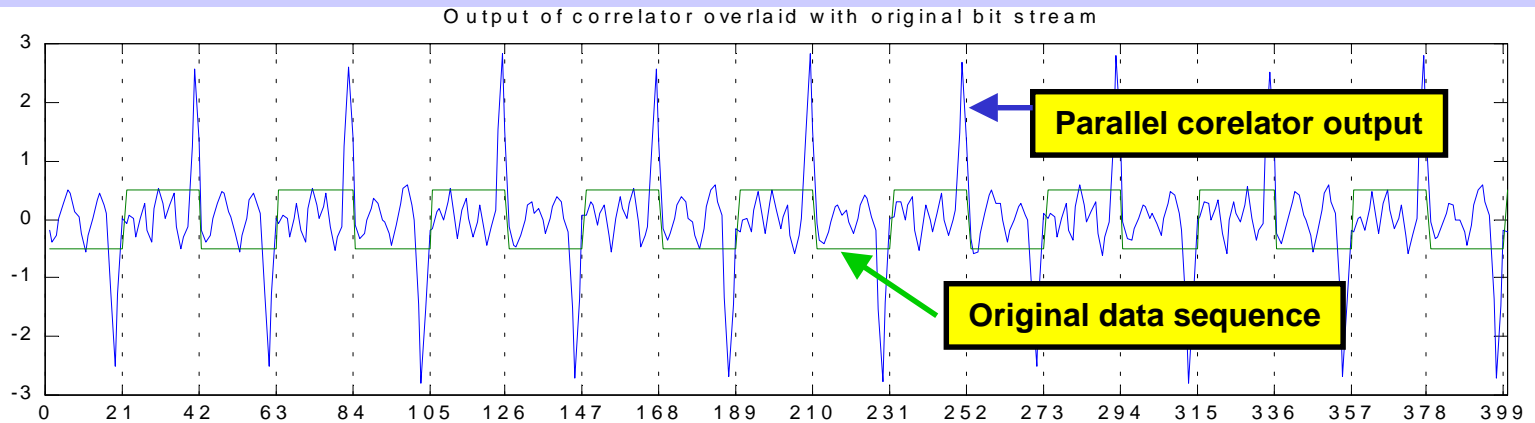
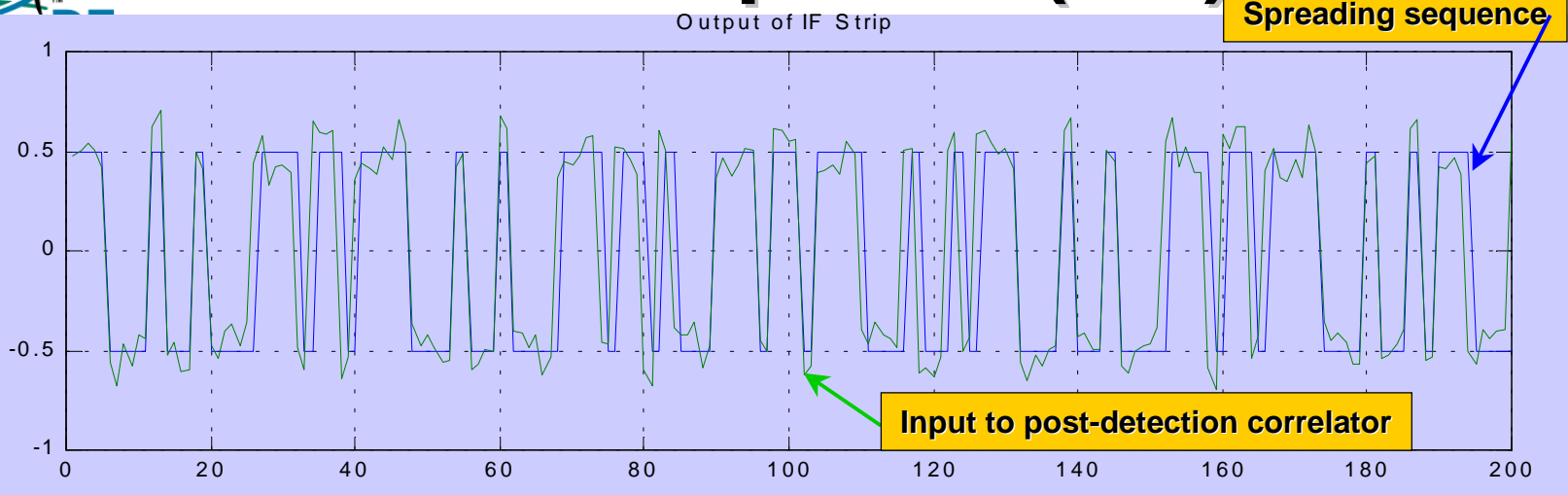
22MHz DS system w/5MHz FH system



**Pathological case: Matlab simulation of 22MHz DS signal with 5MHz WBFH signal, equal power in DS IF**



# Response (a-3)



**Even at 0dB C/I, a DS system with 10dB processing gain can recover the bit stream**



# Response (a-4)

- WBFH does not pose a significant interference threat to other FH systems
  - Limiter/discriminator systems capture at  $C/I > 10\text{dB}$  or so
  - **ANY** interferer will cause problems at  $C/I$  below capture
  - HomeRF systems must revert to 1MHz channels under interference or impairments, so situation will be same as today
    - Spectral density of WBFH will be lower since power is spread over as much as 5MHz



# Response (a-5)

- CCA issues are only relevant for 802.11 systems
  - 802.11 can only do energy detection for today's SWAP or BT systems
  - Issues in CCA between 802.11FH and DS
  - BT doesn't even do CCA of any type
- Self interference of WBFH is not an issue for 802.11 or FCC
  - HomeRF hopping sequences are a minimum of 10MHz between adjacent hops
  - SWAP devices must negotiate between themselves, like 802.11
    - HomeRF doesn't consider self interference (802.11 with itself or WBFH with itself) as an FCC issue



# Response (b-1)

- “In general, a faster hop rate for FHSS systems represents a more severe interference threat than does an FHSS system employing a slower hop rate.”
  - Given this statement, Bluetooth would seem to be the worst case, since it hops much faster than WBFH, BUT, according to a study by an 802.11 company:
    - “IEEE 802.11 DSSS systems show graceful degradation in the presence of significant levels of BT interference”
    - “IEEE 802.11 High Speed WLANs show good reliability even in an environment of fairly dense BT piconet usage”
  - If these statements are true, then the slower hop rate of WBFH should make it more benign to 802.11b





# Response (c-1)

- c) The proportional reduction in maximum allowed transmitted RF power will not “effectively offset the impact of wider occupied channels”
  - The claimed detrimental impact of wider channels has not been substantiated
  - Many WLAN vendors DO ship products with RF power >100mW
  - If a WBFH system at 200mW over 5MHz but hopping 50 times per second is bad, consider that FCC rules currently allow DS systems to transmit at a single frequency with an RF bandwidth of 5MHz (500kb/s w/10dB of processing gain) at up to 1 Watt, which would appear to be much worse for interference
  - **A 200mW WBFH system would have the same overall power spectral density over the 83.5MHz as allowed under today’s rules**

**WBFH offers many advantages - and doesn't increase PSD over today's rules**



# Response (d-1)

- d) Changing the 15.247 rules to allow WBFH is not necessary, since there is “already...a standard for high speed wireless networking” that will meet all of HomeRF’s objectives.
  - HomeRF chose FH for SWAP because, compared to DS, FH offers:
    - Lower power consumption
    - Lower cost
    - More graceful degradation in capacity with increasing network density, including multi-family dwellings
  - In addition, the HomeRF MRD requires a complete cordless telephony solution, which SWAP gets from DECT
- **802.11b does not meet the HomeRF MRD, or we would have chosen it**
- If SWAP and 802.11b are competitive, that’s OK...competition is good!

**HomeRF/SWAP was designed for its target market - the home.  
802.11b was designed for the enterprise.**



# Call To Action

- **Vote to recall first letter and send in a letter of support for the rule change**
  - Is aligned with IEEE 802 goals of supporting regulations that permit greatest selection of best technology to meet specific market needs
  - It does not impact the performance of existing Part 15 compliant products over current regulations
  - It enable US consumers to benefit from new wireless devices that are currently allowed in most other countries but not in the US
- **Vote to recall first letter and remain neutral**
  - Let individual companies comment on rule change