



# UWB Radio: Issues and Opportunities

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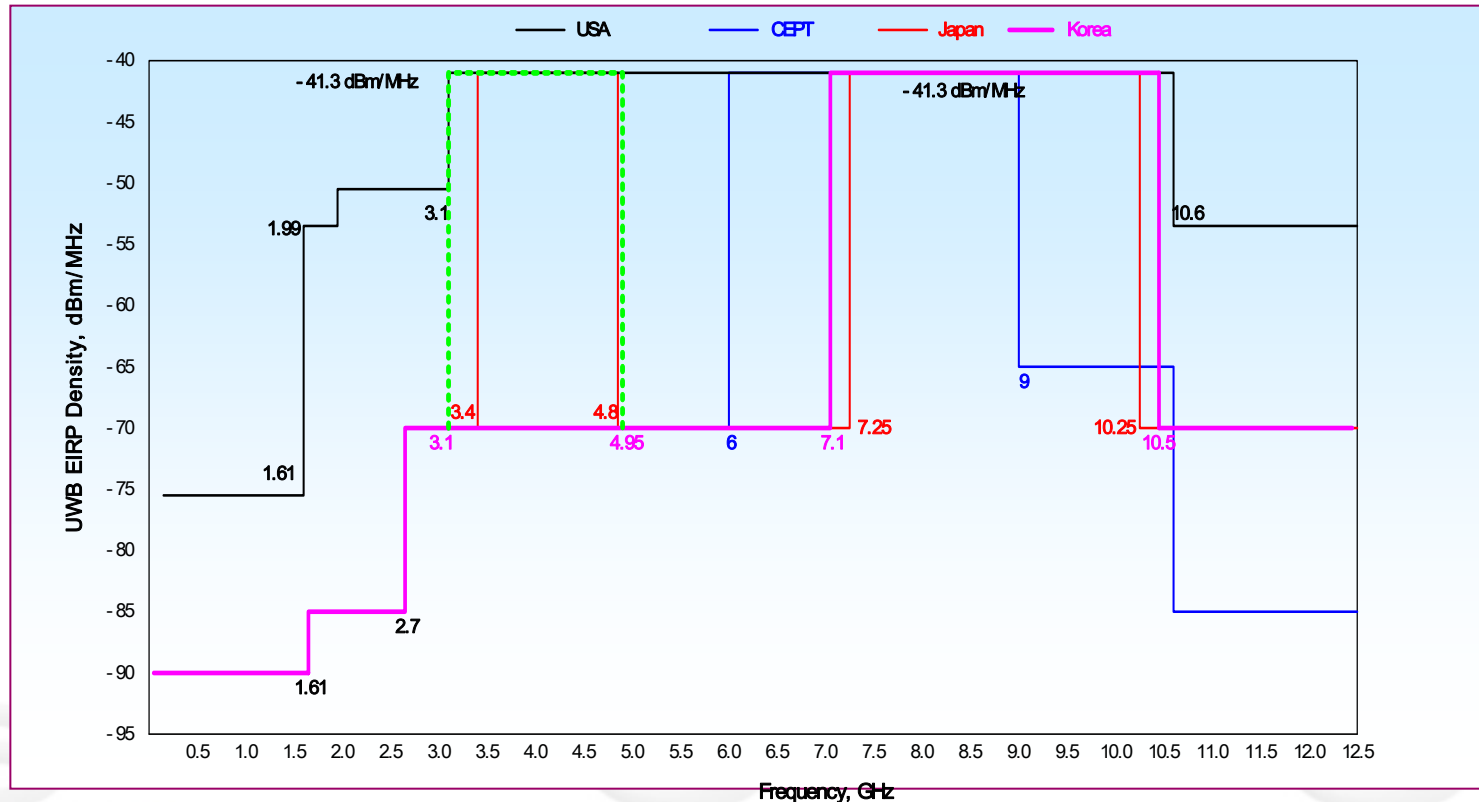
We're not going to talk about  
the Rose Bowl today!

# Agenda

- **Issues**
  - Is regulatory really solved?
  - What about standards?
  - What are the remaining design challenges?
  
- **Opportunities**
  - What are the research opportunities?
  - What about 60GHz?
  
- **Wrapup**

# Is regulatory really solved?

- We are getting closer –
  - US, Japan, and Korea are done...but DAA is an open issue
  - Europe is still a problem
  - China is in process
- Detect and Avoid (DAA) is required, but not defined!



# What about standards?



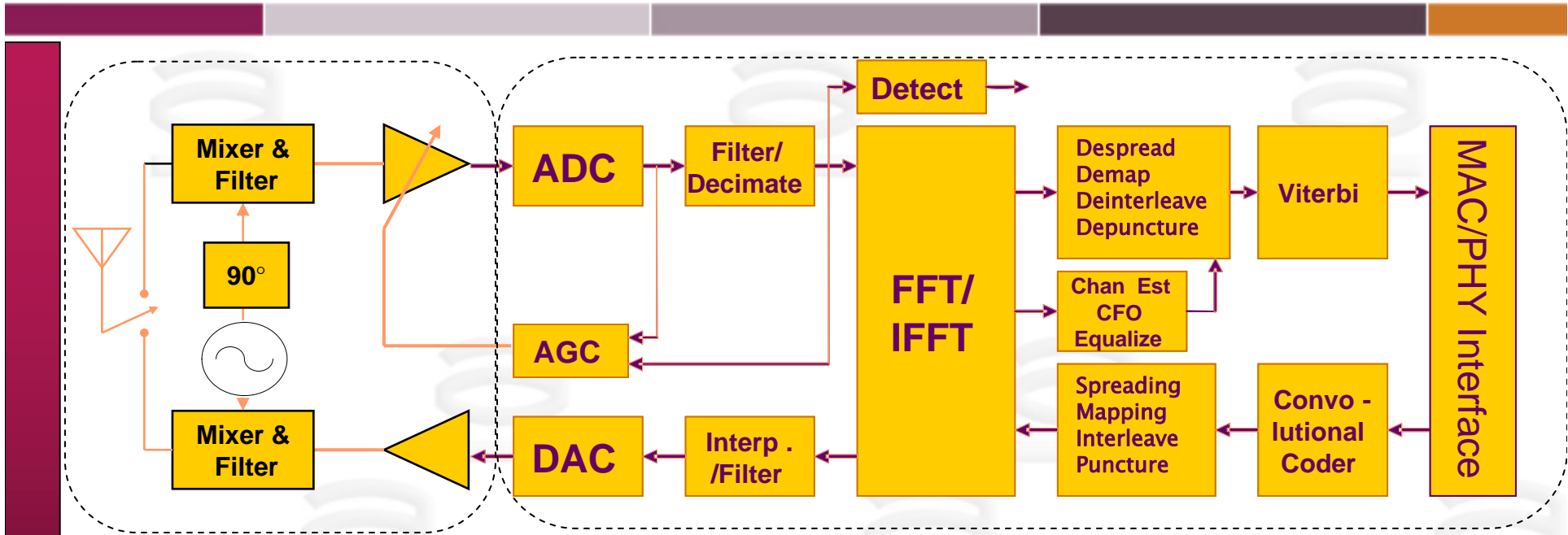
- IEEE is dead...
  - But it doesn't matter!
  - The race is essentially over...
- There is a standard – WiMedia's Multiband OFDM
  - WiMedia MB-OFDM was ratified as ECMA-368/369 in Dec 2005
  - ISO standard by the end of the summer
  - Recent WiMedia interop tests had six different interoperable chipsets – not FPGAs, not second source, but true independent solutions
- Certified Wireless USB uses ECMA-368/369
  - Products will go into production this summer
- Bluetooth has adopted WiMedia UWB
  - Above 6GHz bands only
  - Software layers above the WiMedia MAC
  - Will enter market in 2007

# What are the remaining design challenges?

Note: I'm only going to talk about WiMedia (MB-OFDM)

- This is a “race to the bottom”
  - Lowest power
  - Lowest cost (this does not imply single die – reasonable people may disagree)
- Hardware needs some evolution
  - Better ADCs – 6 –bits, low power >528MHz sampling
  - Optimized FFT and Viterbi engines – pretty straightforward
  - 90nm solutions have the potential to be pretty good!
- As usual, software is now important
  - Microsoft, Intel, etc. are engaged – Microsoft is way ahead of the curve in wUSB compared to wired USB...Vista support is coming!
- The DAA goals are still not clear, so we will continue to have to put lots of general hooks in place

# WiMedia/Certified Wireless USB/UWBoBT

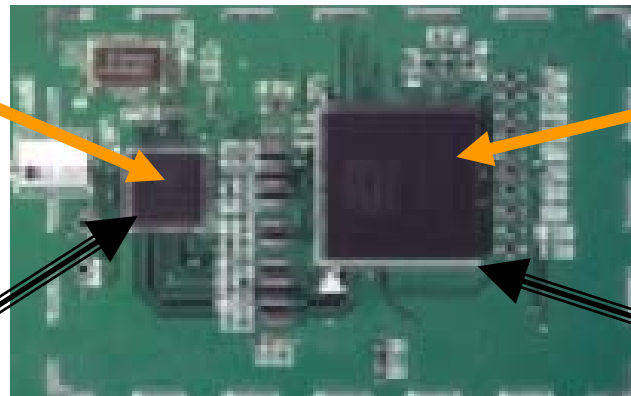


RF

Baseband/MAC

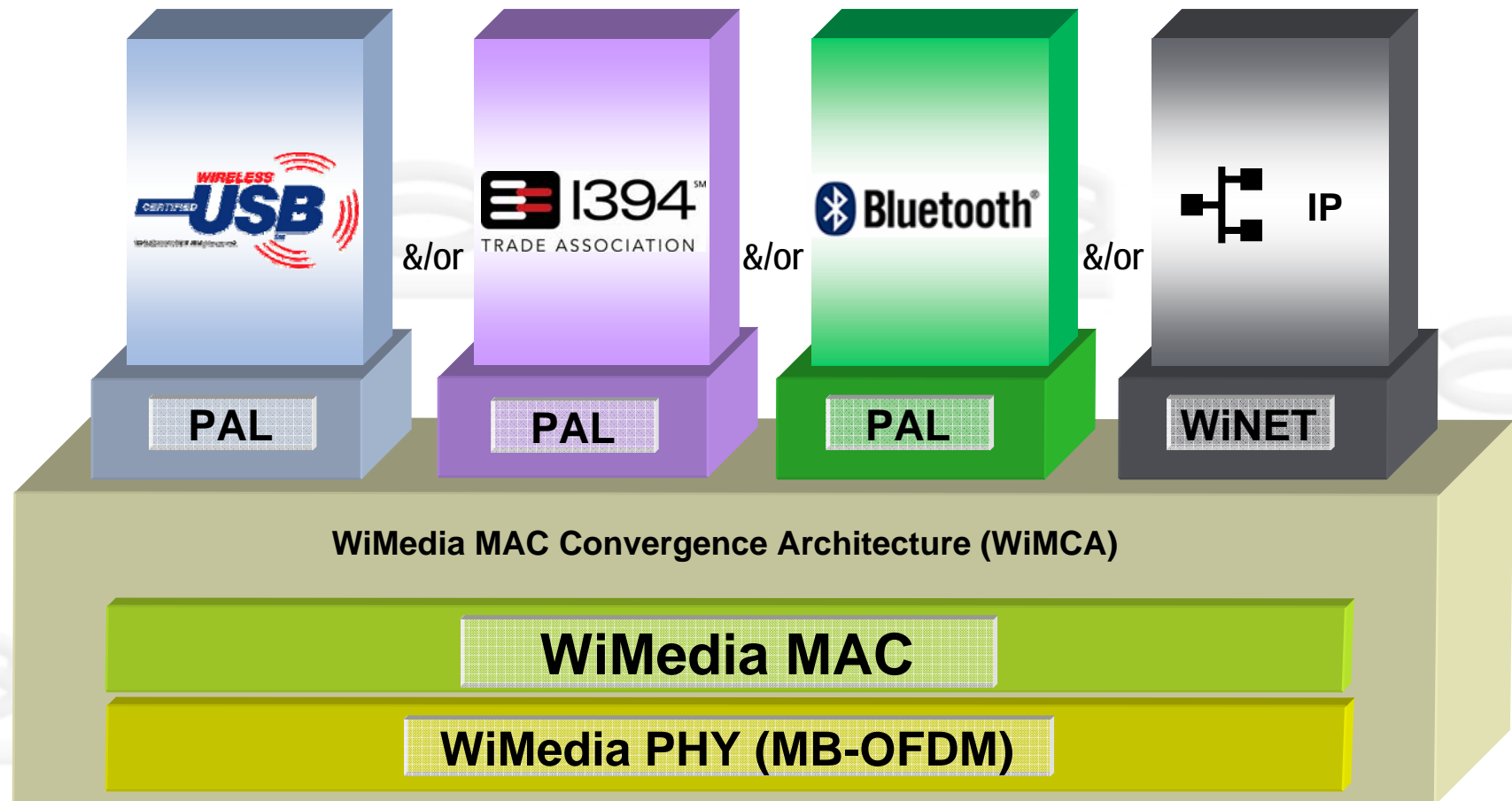
5mm x 5mm

10mm x 10mm



# WiMedia MAC is flexible

The WiMedia MAC can support many protocol stacks over the same radio



*PAL: Protocol Adaptation Layer*

# Here's where we're headed....

**Coming to a retail store  
near you this fall!**





# What are the research opportunities?

- **Detect and Avoid (DAA)**
  - Better power spectral shaping
  - Improved detection algorithms
- **Circuits**
  - Improved ADCs – higher speed, lower power, scalable
    - Future UWB may go to higher bandwidth
    - Converter power will always be critical issue
  - Variable bias point RF – low power for benign environments, higher power for interference
  - Optimal/scalable quantization for soft decision Viterbi
- **Antennas/filters**
  - WLAN, UMTS suppression
  - European 3–5GHz suppression to  $-85\text{dBm/MHz}$  (hope not!)

# DAA in a WiMedia TDMA MAC

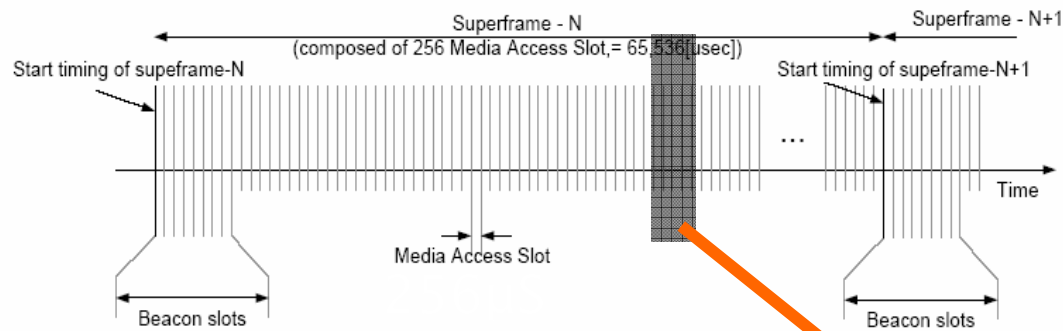
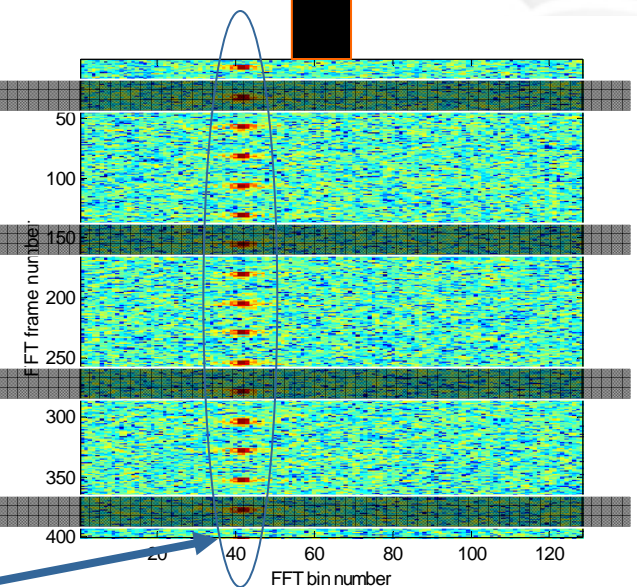
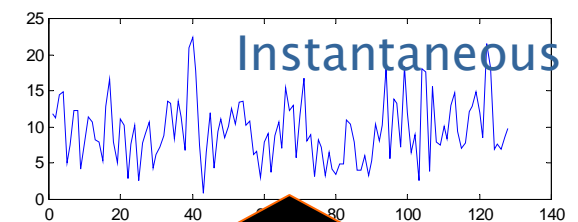
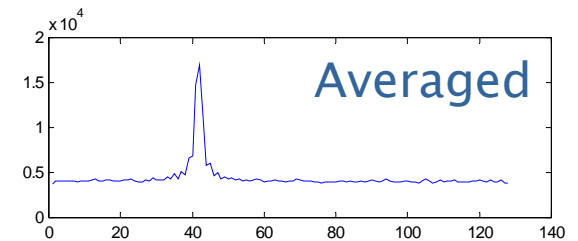


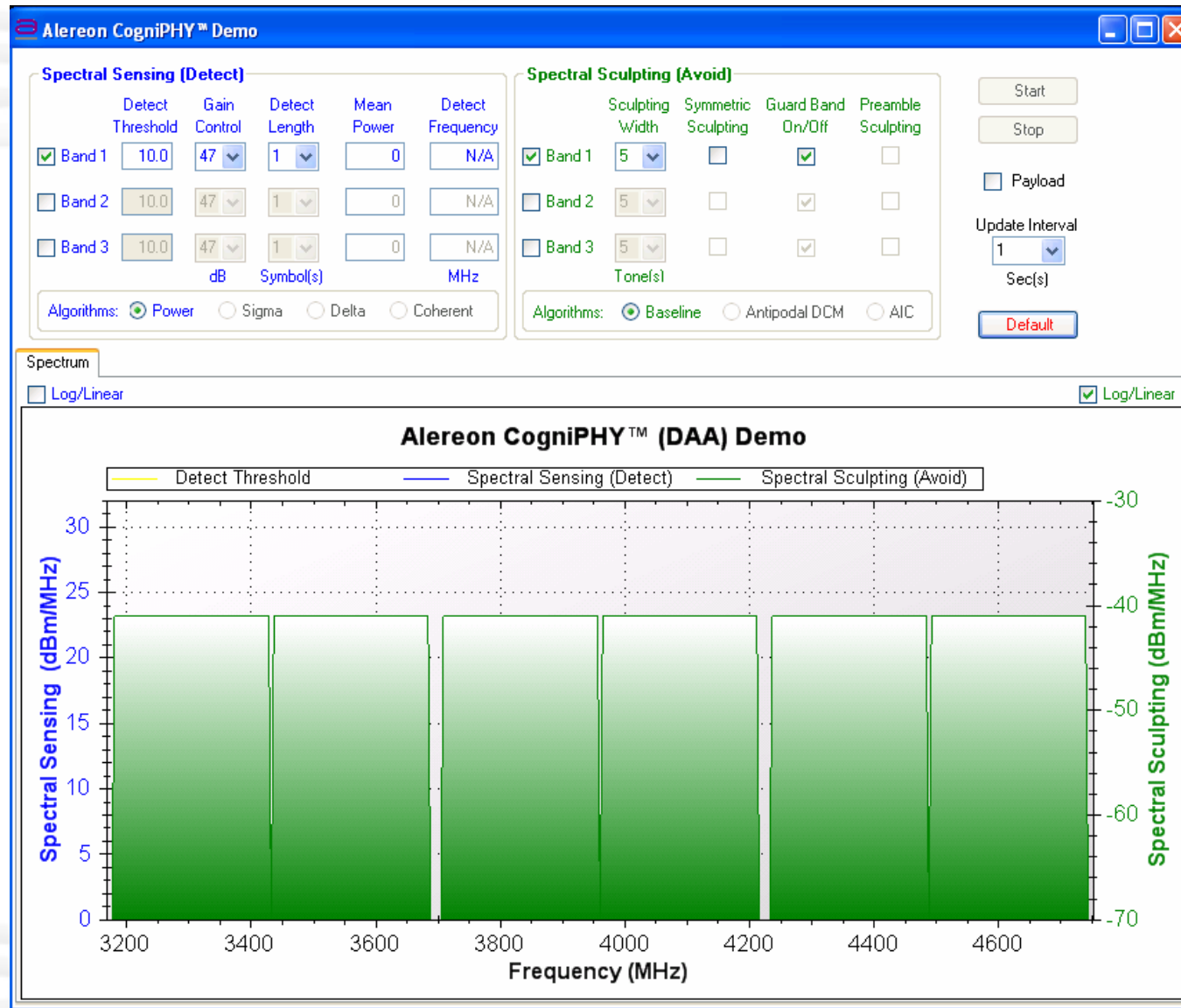
Figure 2 — MBOA MAC superframe structure

- WiMedia MAC is TDMA
- Slots can be reserved for spectrum sampling
  - All network Tx shut off
- Larger number of slots increases probability of detecting beacon
  - But reduces UWB data throughput
- Work continues to explore cyclostationary signals



WiMax beacons

# Preview of DAA demo upstairs



# What about 60GHz?

- **Complements existing UWB**
  - Higher speeds than practical with UWB
  - More power allows increased range
  - Excellent support for “point and shoot” file transfers
    - iPod, digital camera, other mobile devices
- **Will end up as part of the WPAN ecosystem over time**
- **Won't replace UWB, IMHO**
  - Some usage models (WPAN) aren't well suited to 60GHz physics
  - Dual radios will happen – someday

# Wrapup...

- Commercial deployment of UWB (MB-OFDM) is happening
  - Multiple interoperable sources of silicon rushing to market
  - ISO standards
  - USB-IF and Bluetooth support
- Regulatory will remain interesting
- Plenty of interesting research remains!
- Look for UWB products on the shelves this fall!