High Speed Multi Media – Mesh Networking Using Commercial Off the Shelf Equipment

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Digital Radio ?

- Original - CW
- Packet – 600 baud, can saturate network
- Other Digital modes, example PSK31
- We've become spoiled to Internet speed
- High speed modes – higher bandwidth
- Amateur radio gaining members

What is High Speed Radio ?

- Digital
- ‘High Speed’
- By Bandwidth, 50 MHz +

HSMM

- HSMM been a technology looking for a reason to exist in ham radio since at least 2003.
- Technology not especially difficult with commercial equipment
- Usually spread spectrum to achieve high data rates
- Why use?

Why Use ?

- Emergency communications
- Point to point – Backbone Networks
- Mobile Access – Ad-Hoc Networks
- Text
- Voice
- Video
- Portable, emergency power

Amateur Bands

- 50 MHz
- 440 MHz
- 900 MHz
- 1.2 GHz
- 2.4 GHz (with 802.11b/g channel overlap)
- 3.5 GHz
- 5.8 GHz (with 802.11a channel overlap)

Amateur Applications at 2.4 GHz

- Able to establish high speed line of sight microwave communications using ~$150 nodes.
- Bandwidth in excess of 1 Mbps
- Commercially proven equipment
- In development/use in Austin and Dallas in public service network
- Able to modify radios so that it cannot be easily detected by commercial networks

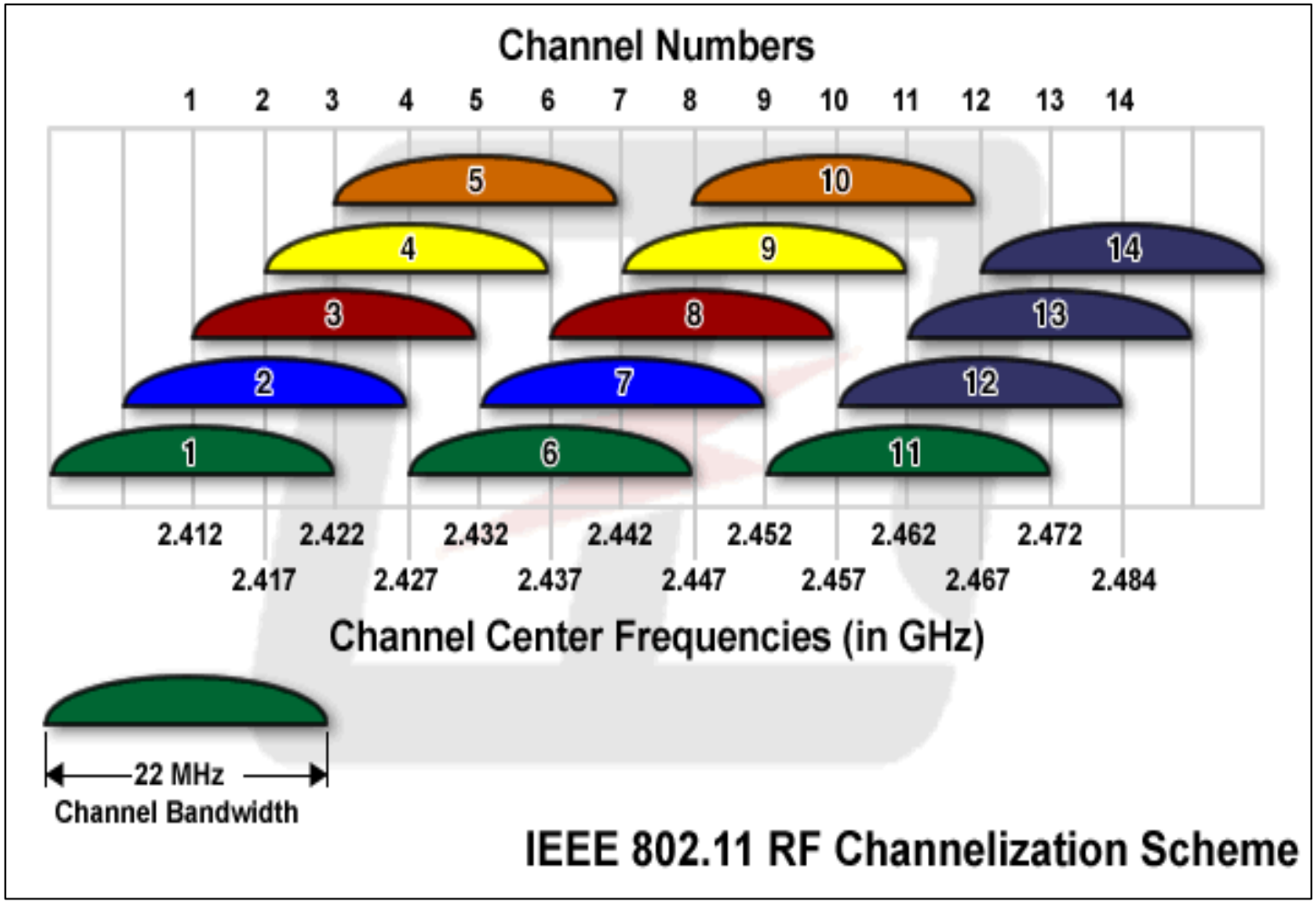
Equipment

- Linksys WRT54G wireless routers, versions 1-4, WRT54GL
- Directional antenna, MFJ 1800 has 15 dBi gain in 18 inch by 3 inch size, ~$30
- Linksys router available surplus or new as WRT54GL. Cost $25 to $85
- Antennas ~Homebrew to $100
- Power over Ethernet, $10 to $50 or homebrew
- Fixed, mobile or portable

Amateur

- Not 802.11b/g part 15 radios !!
- Amateur band 2.39 - 2.45 GHz part 97 !!
- Amplifiers, 1 watt under $100, 3 watts under $300
- Best amplifier is a good antenna!

Channels 1-6 Are in the Ham Band



Frequency and Range

- WRT54 router operates on 2.4 GHz, 802.11b/g
- Channels 1-6 in ham band 12 cm 2.39 to 2.45
- Can change crystal to offset channels and make not detectable to commercial 802.11b/g
- Reported range from rooftops with yagis 5 - 10 miles
- Load new software in router to yield more functions – for example: OpenWRT

Power

- Router uses 'rubber duck' antenna and runs about 50 mW output
- Omnidirectional antennas: 8 dB at $80 yields 300 mW erp
- Yagi at 12 dB at $30 yields 800 mW erp
- Dish at 24 dB at $80 yields 12 watts erp
- Mobile antennas are less than 12 inches long and yield 2 dB for 80 mW erp

Amateur Issues

- Power Limits – Not limited to commercial part 15, part 97 is Amateur, limit is 100 watts, above 1 watt automatic power control.
- Equipment modifications OK
- High Gain antennas.
- Ensure no non-hams and no commercial traffic – directional antennas and non-commercial channels.

Amateur Issues

- Interference from commercial – Implemented systems show little interference from commercial using highly directional antennas
- Interference to commercial - Amateurs are primary in band, part 15 must accept interference – in theory
- In practice - use directional antennas, polarization, low power and non-commercial channels

Amateur Issues

- How to detect a new node – HSMM – Mesh [tm] uses Optimized Link State Routing Protocol written for Linksys router, detects new node in 5 seconds and joins to mesh
- Amateur identification – router broadcasts station ID

Something for Everyone?

- New technology !!
- Emergency communications
- Public service
- Software developers
- Network specialists
- Computer specialists
- Antenna gurus
- Backup links

Possible Applications in the Coastal Bend

- Field Day contacts
- Public events between stations
- Base at a tall building with omni directional antenna
- Future links to hospitals and regional emergency communication center, weather service, etc

What Others Have Done

Public Events – Wild Ride in Dallas Area
2004/2005 - 20 mile network with live cameras - www.n5oom.org/hsmm

Interested ?

- Join the local working group
  - Web: http://groups.yahoo.com/group/cc-hsmm
  - Email: cc-hsmm@yahoogroups.com
- Resources:
- General - www.arrl.org/HSMM
- Austin Group - www.hsmm-mesh.org
- Linysys router - www.wikipedia.com

Resources

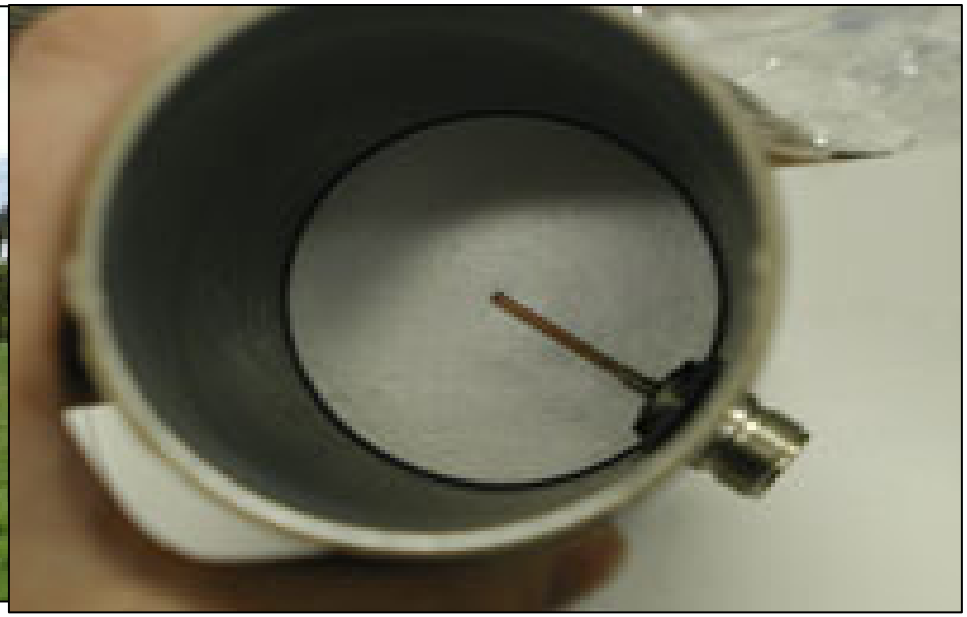
- Book – Wireless Networking for the Developing World - http://wndw.net/
- Web - www.seattlewireless.net
  - www.olsr.org
- CQ-VHF Magazine HSMM Column
- QST

Equipment

- Linksys Router

Patch Antenna and Enclosure

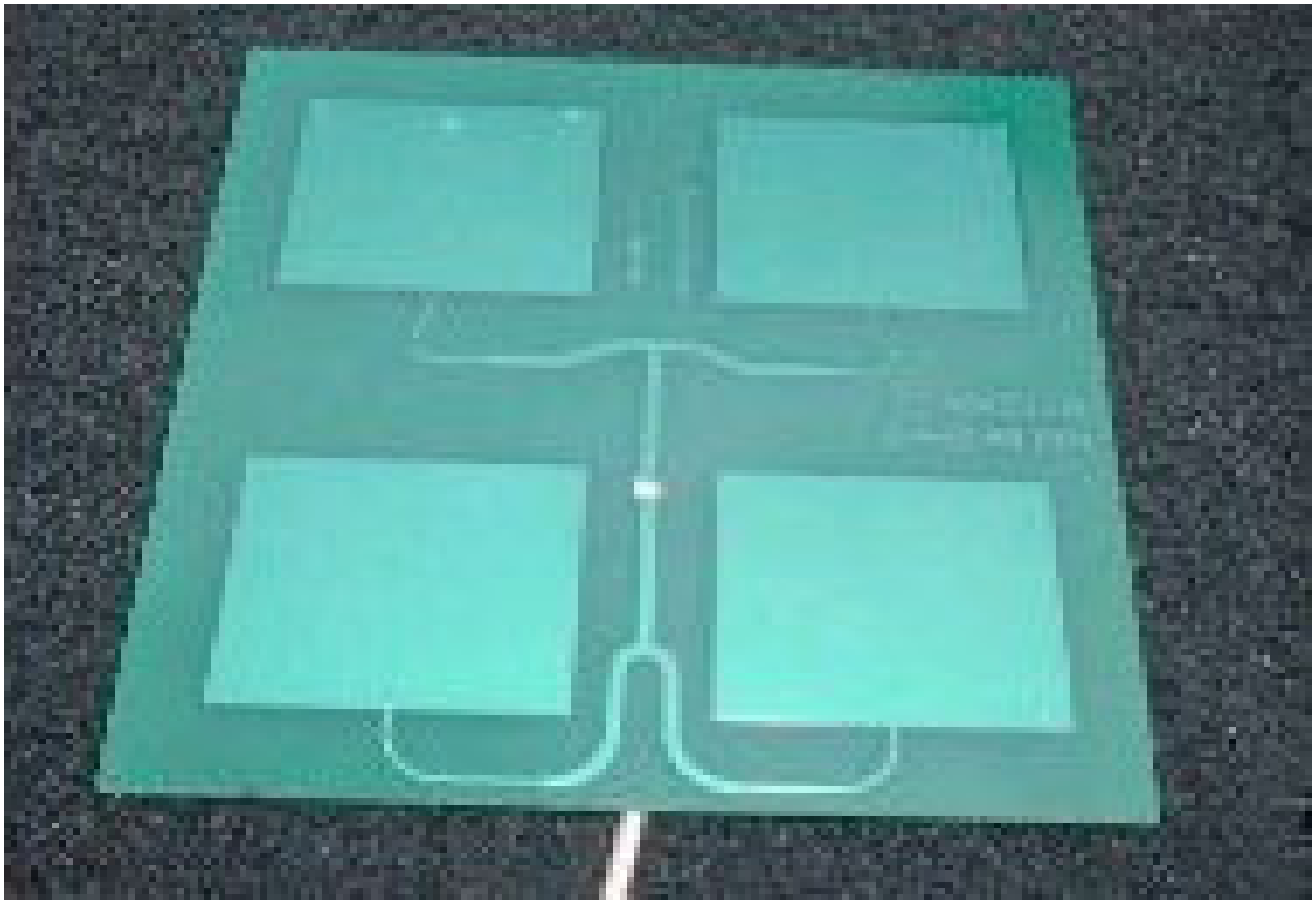
Can Antenna



Collinear

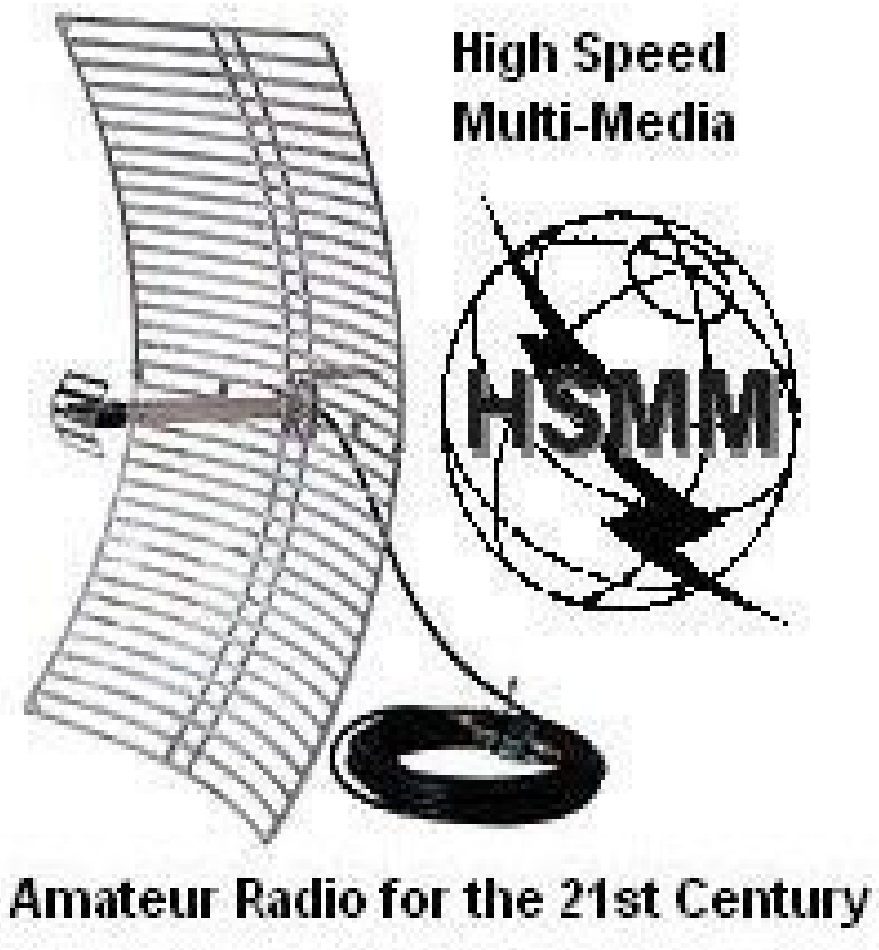
Yagi

Patch Antenna



Portable

Questions ?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HSMM
Amateur Radio for the 21st Century