Hamnet

High Speed Multi-Media MESH Network (HSMM-MESH)

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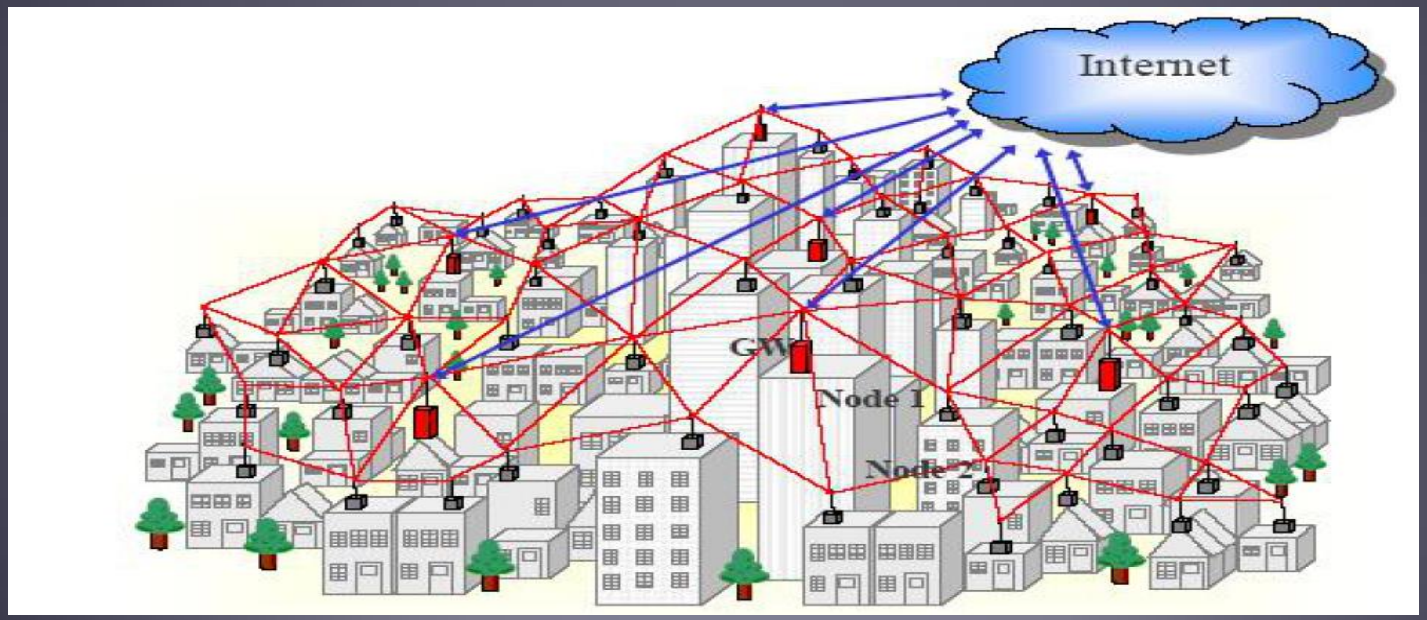
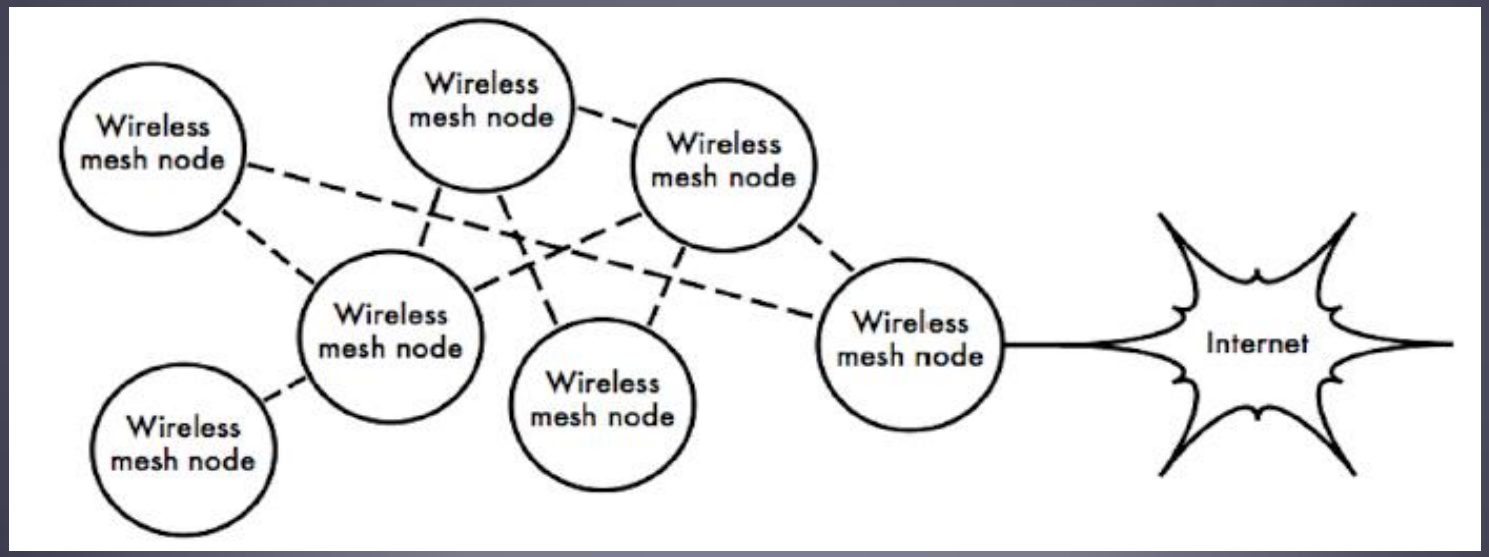


Hamnet Architecture

- A MESH network is a set of "nodes" that pass packets to each other. Each node can forward packets to other nodes.
- Every node can reach every other node directly or indirectly.
- There is no "central control;" all nodes are peers.
- If a node goes down, the network routes around it.



Hamnet Fundamentals

- Operates on three bands:
  900 MHz, 2.4 GHz and 5.6 GHz. Currently, only 2.4 GHz and 5.6 GHz are supported by Hamnet software.
- Higher frequency = More channels, less interference and smaller Fresnel radius but less ability to penetrate obstacles such as foliage.
- 2.4 GHz is the most popular band, because 802.11 Wi-Fi routers and antennas can be used.
- Speed depends on frequency and equipment, but 15 Mb/s is typical for each link using 2.4 GHz. Over 100 Mb/s is possible with Ubiquiti equipment.
- Capable of streaming real-time video, audio, file transfers, VoIP, web browsing, chat, e-mail, etc.

More Hamnet Fundamentals

- If one or more nodes have Internet connections, all other nodes can access the Internet. A network can operate with or without Internet connections.
- Hamnet radio signals are weak, and they have short range unless you use a high-gain antenna.
- Omni antennas are used around a location for the local mesh. 20+ dB antennas are used for long hops spanning up to 10 or more miles. 50 miles is possible.
- Line of sight is essential. Trees and hills block signals.
- This is *not* like putting a repeater on a tower to cover an area. Multiple nodes or gain antennas are needed.

Hamnet Use

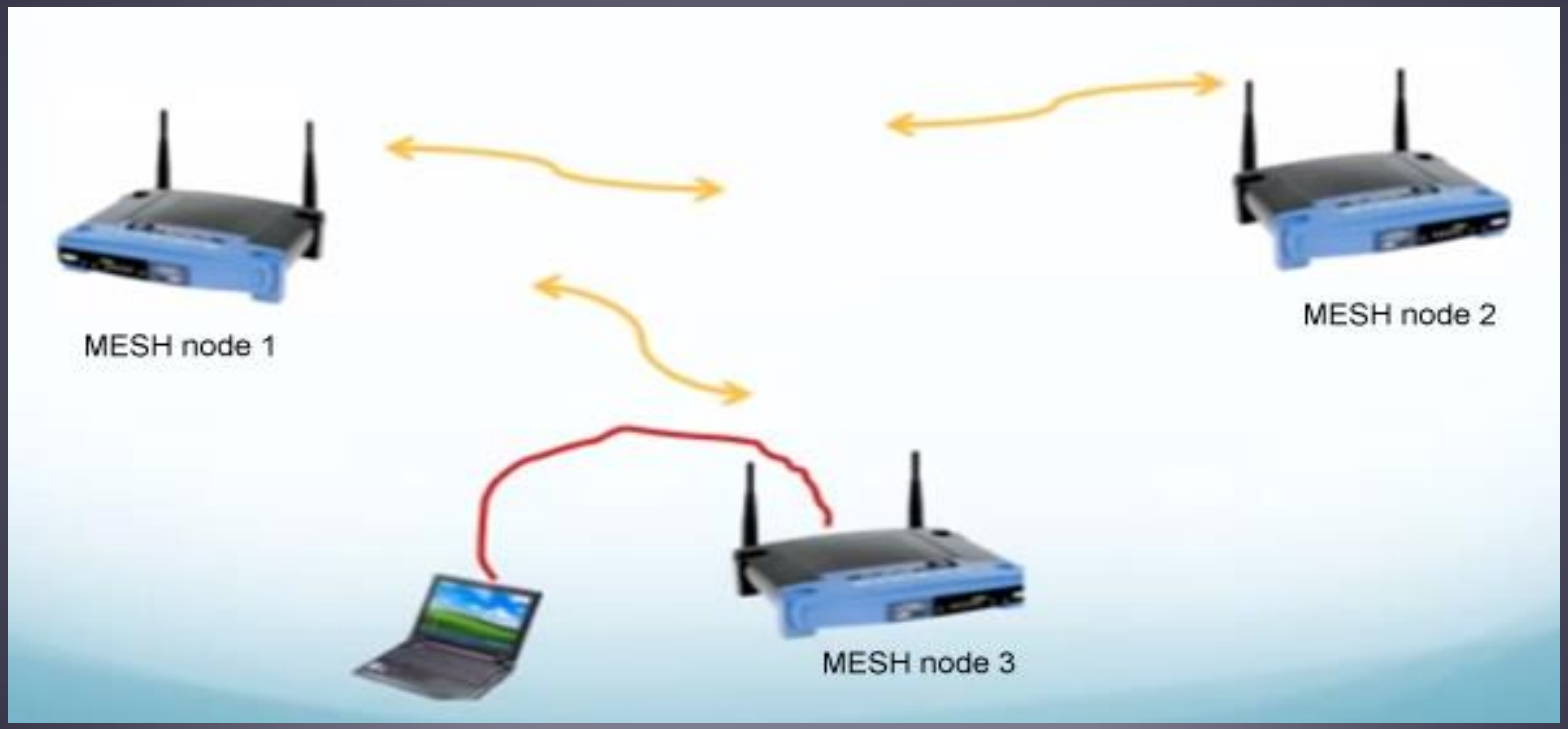
- Wi-Fi channels 1-6 can operate as ham channels under Part 97 (ham), *or* as unlicensed Wi-Fi connections under Part 15. Channels 7-14 operate under Part 15 only.
- Under Part 15 (unlicensed Wi-Fi):
  - Can carry commercial traffic.
  - Can broadcast music
  - Can use encryption
  - No restrictions on third-party traffic
- Part 97 (ham) operation allows higher power. However, amps usually are not needed.

Stations in North America

Hamnet – Eschweiler Germany

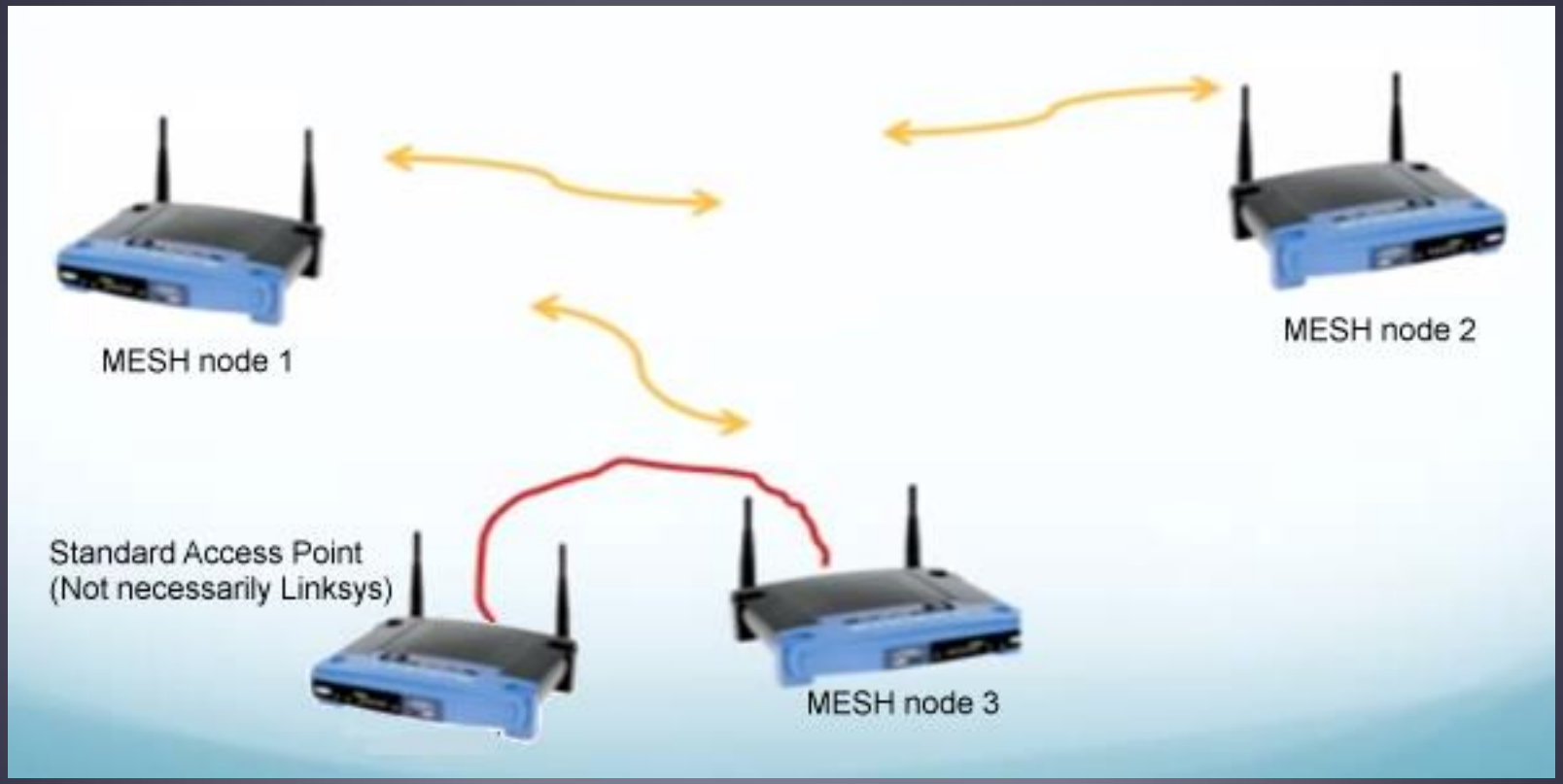
MESH Nodes are Not Access Points

- Wi-Fi devices cannot connect directly to MESH nodes.
- The Ethernet port on a MESH node is like a connection to a LAN switch.



Connect a Standard AP for Local Wi-Fi

- Use a standard access point (*not* flashed as a MESH node) to provide local Wi-Fi coverage.



Linksys Hamnet Hardware

- Linksys WRT54G versions 2–4 or current “L” model.
- A new WRT54GL costs about $48.
- Used WRT54G routers cost about $25 on eBay.
- Okay for short-range network around a facility.

Ubiquiti Hamnet Hardware

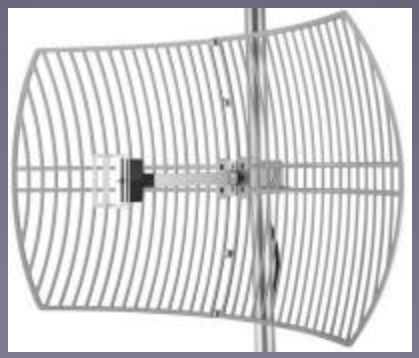
- Ubiquiti Bullet, NanoStation and NanoStation Loco.
- Rugged units for permanent outdoor installation.
- CAT5 cable provides network and power (PoE).
- Bullet $80, NanoStation $80, NanoStation Loco $49.

Hardware for Long Hops

- Ubiquiti AirGrid (27 dB gain): $70
- 100+ Mb/s transfer speed up to 30 km.

Antennas

- Use omni for short-range coverage around a site.
- Use patch, dish or Yagi for long-range hops.



Interference on 2.4 GHz 802.11

- 2.4 GHz is a crowded band.
- Fortunately, signals have a small footprint.
- 5.6 GHz has less interference. Use 5.6 GHz if 802.11 compatibility is not required such as for long links.

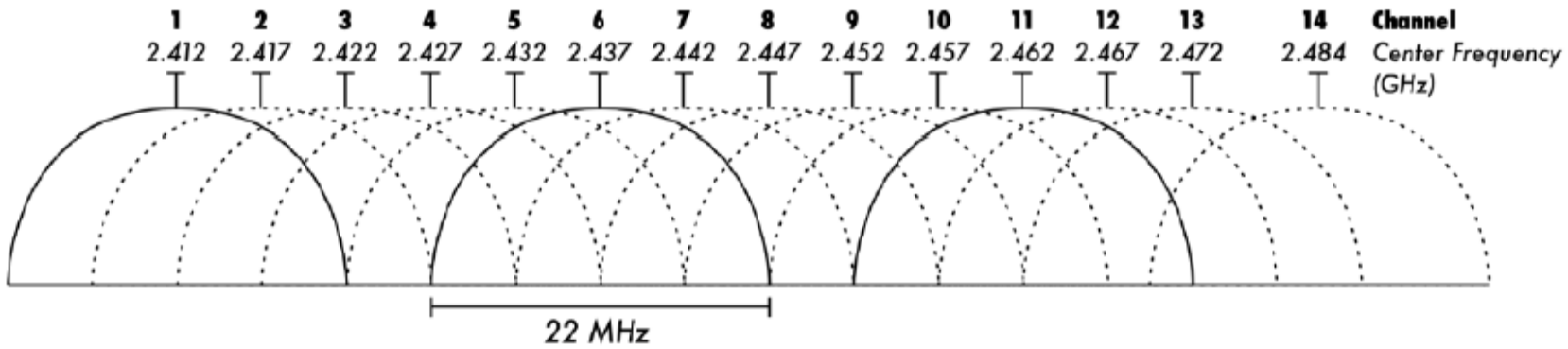
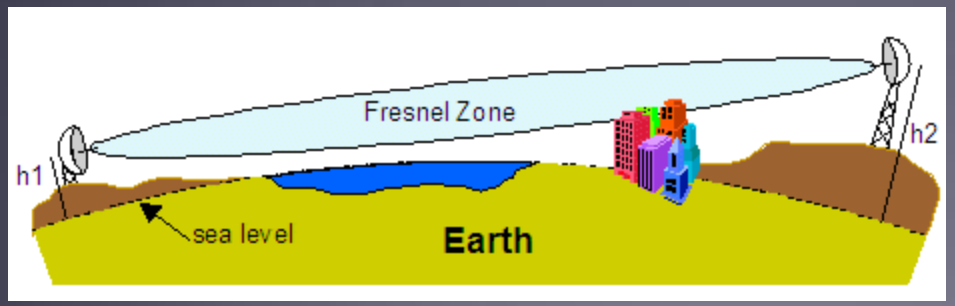
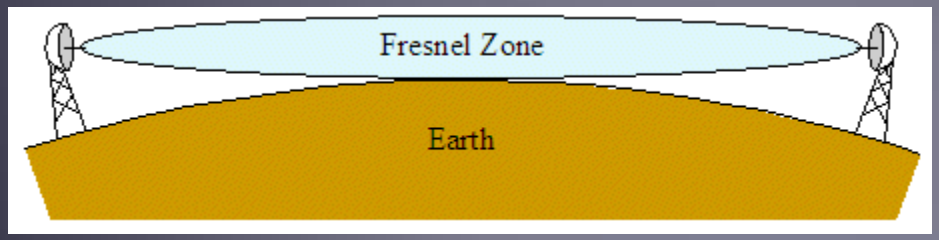


Figure RP 5: Channels and centre frequencies for 802.11b. Note that channels 1, 6, and 11 do not overlap.

Line of Site Considerations

- The signal is *not* laser-beam narrow.
- It has the shape of an ellipsoid with the "Fresnel radius" at the center.
- 5.6 GHz, 10 mile (16 km) link, 60% radius ≈ 30 feet (9 m).
- Anything within the Fresnel zone blocks some signal.





If tower is 50 feet (15 m) high, the distance to the horizon is about 8 miles (13 km).

Getting Started

- Find or purchase a suitable Linksys WRT54G (v.2-v.4 or "L" Linksys model) or Ubiquiti product.
- Register your callsign at: www.broadband-hamnet.org/component/user/register.html
- Watch these YouTube videos: https://www.youtube.com/watch?v=hUeW2ju-RZk https://www.youtube.com/watch?v=pryc8jIl6X0
- Download Hamnet firmware version 3.0.0 beta from: www.broadband-hamnet.org/documentation/68-firmware-installation-instructions.html
- Install and configure firmware with your node name. For example, W4PHS-01 or W4PHS-Nano-01.

Further Information…

- Main site: www.broadband-hamnet.org
- This presentation: www.dtreg.com/Hamnet.pdf
- Supported hardware: http://www.broadband-hamnet.org/section-blog/37-hardware-faqs/101-supported-hardware.html
- Ubiquiti products: www.ubnt.com/
- Node map: www.broadband-hamnet.org/googlemapped-mesh-nodes.html
- YouTube videos. Search YouTube for "Hamnet" or "HSMM."
  https://www.youtube.com/watch?v=hUeW2ju-RZk
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  https://www.youtube.com/watch?v=xpMr1VVUbQQ
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  https://www.youtube.com/watch?v=EltctYulqIk