



# *High Performance in Mobile Wireless Applications*

## □ **Military mobility**

- High performance, automated network formation (and re-formation) at speed
  - ❖ Field-deployed in tactical video application
  - ❖ Combat-deployed in sensor networking application

## □ **Events/tactical networks**

- Fast set-up, interference avoidance, high performance for video, VLAN security, unpredictable mobility
  - ❖ Multiple Homeland Security deployments

## □ **Rail and transportation corridors**

- High-speed mobility, high performance over many hops
  - ❖ Multiple rail line trials -- both security video and commuter networking

## ❑ **Fixed configuration**

- Fixed locations, relationships between nodes relatively constant
  - ❖ “Mobility” features ease installation
  - ❖ Failures, failovers, interference

## ❑ **Temporary fixed networks**

- Hastily-formed networks, responsive networks
  - ❖ Minimizing set-up/optimization time
  - ❖ One or more “HQ” location may be permanent

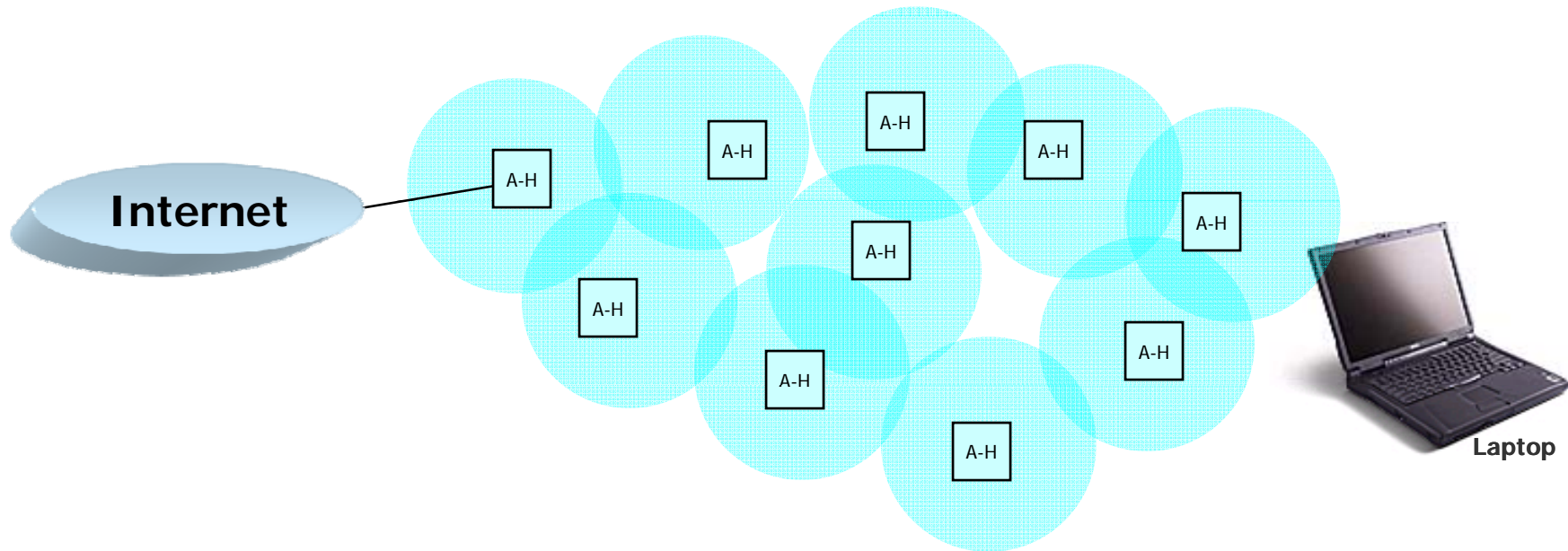
## ❑ **Corridors and perimeters**

- Generally fixed infrastructure, few moving nodes

## ❑ **Fully mobile networks**

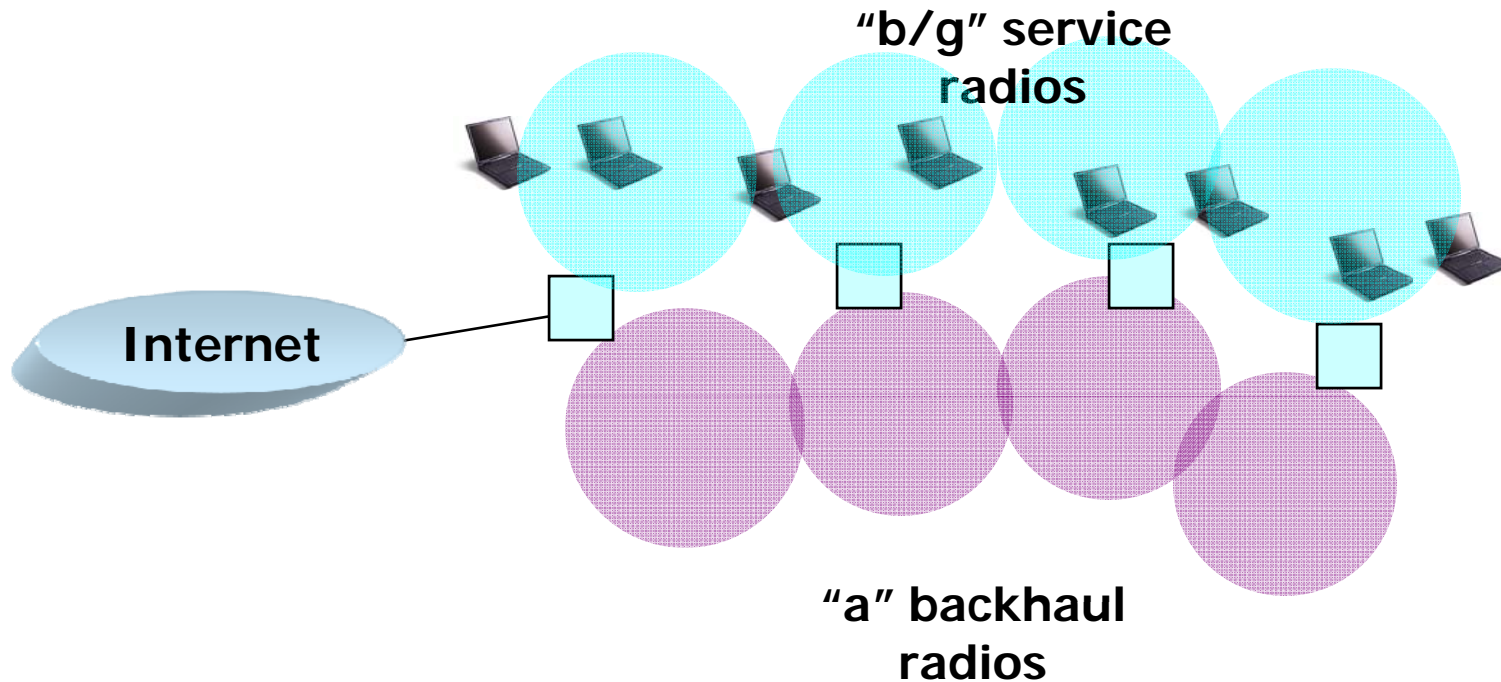
- All nodes may be in motion relative to one another

- Any node may talk to any node (ad hoc fashion).

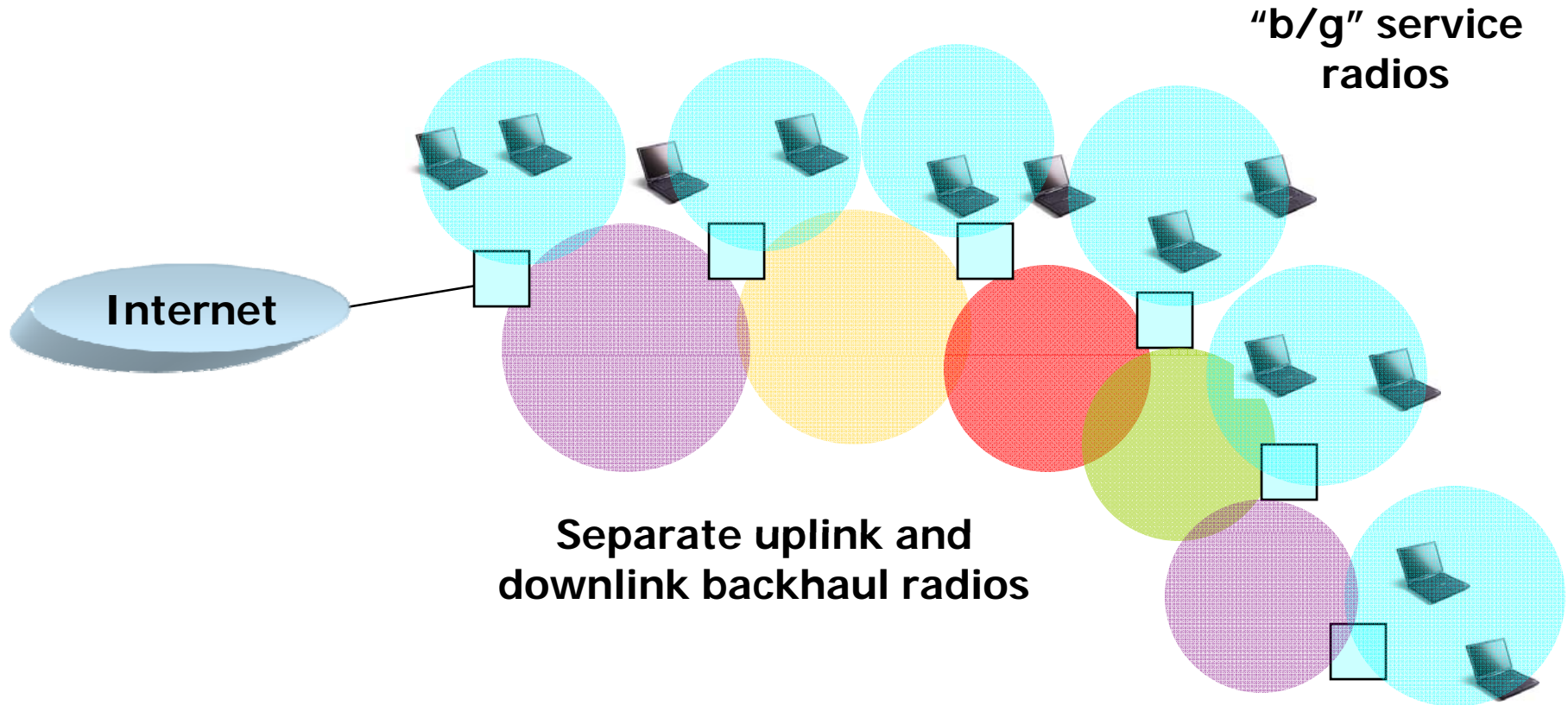


- Mobility is usually inherent -- same channel, omni antennas

## 2<sup>nd</sup> Gen. Adds Backhaul Radios ("1+1")



- Somewhat better performance, backhaul remains single channel, mobility usually inherent



- ❑ Radio spectrum flexibility creates switch-like performance
- ❑ Allows more hops, high quality voice and video, high speed mobility (software based)

## □ **Hardware-based**

- Often proprietary radios and/or RF switching
- Co-channel interference often avoided with sectored antennas
- Sectored antennas hamper (or eliminate) mobility

## □ **Software-based (MeshDynamics)**

- Dynamic distributed radio intelligence for channel and topology selection
- Nodes monitor environment at regular intervals for topology changes in motion (~30 mph or less)
- Dedicated "scanner" radio for coordinated "break" and "make" (to 250 mph +)

- ❑ **Distributed dynamic radio intelligence**
  - "Radio robots" in node automate set-up, mobile topologies
  - Network *reuses* channels for maximum performance
  - Automated interference avoidance
- ❑ **Exceptional mobility capabilities**
  - Network forms and reforms rapidly
  - Speeds up to 250 mph (400 kph), higher in future
- ❑ **High performance, many hops**
  - High bandwidth, minimal delay for video, data
  - Proven superior in extensive military testing

- ❑ **Structure of network based on multiple factors**
  - Signal strength
  - Hops to wired link (if present)
  - Data rate
- ❑ **Information exchanged between nodes regularly**
  - "Heartbeats" include adjacencies, performance information
  - Limits single logical network to <1000 nodes
- ❑ **Accurate decisions require RF awareness**
  - Fixed or low-speed (<30 mph) "listening" gaps
  - Dedicated scanning radio for high speed

- ❑ Assume radios are cheap, channels (spectrum) expensive
- ❑ Manage channels to insure 40db separation
- ❑ “Map coloring” exercise in fixed environments
- ❑ Partner selection exercise in mobile environment
- ❑ Can only scale if distributed decision

HIGH-SPEED PHYSICAL LAYER IN THE 5 GHz BAND

IEEE  
Std 802.11a-1999  
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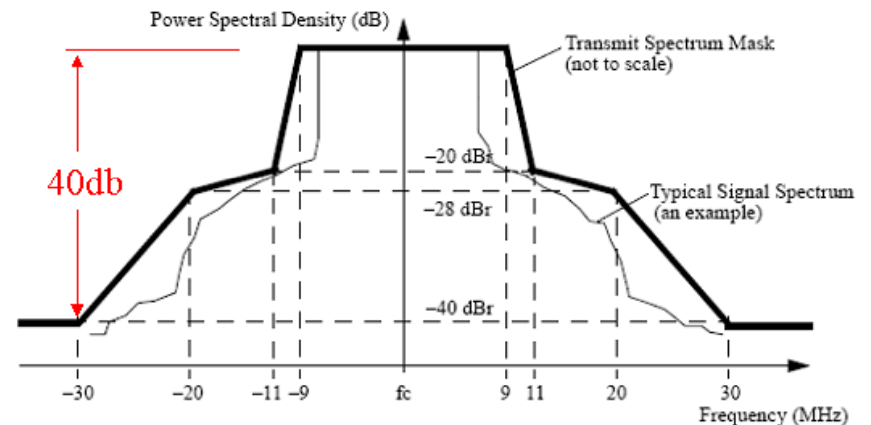
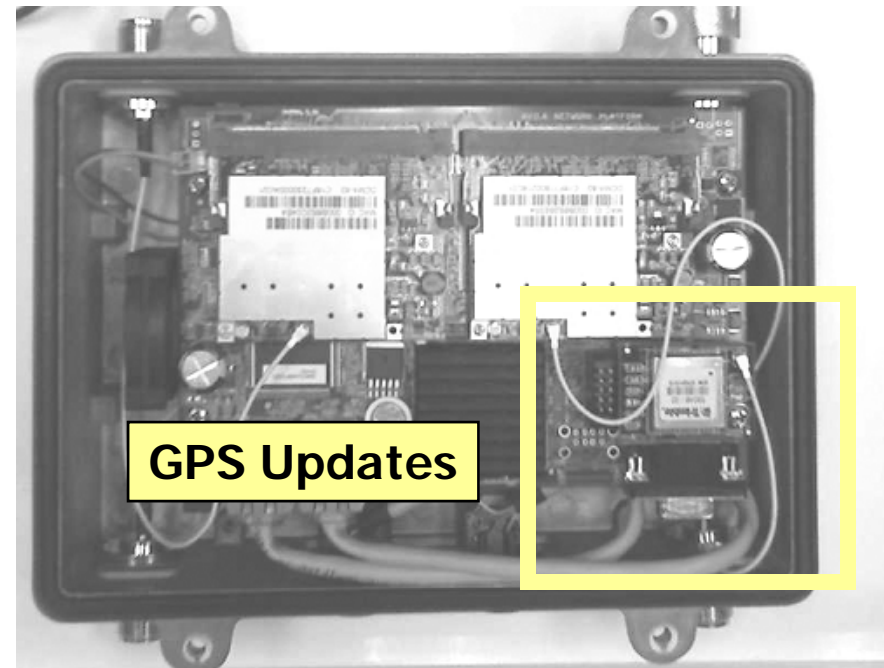
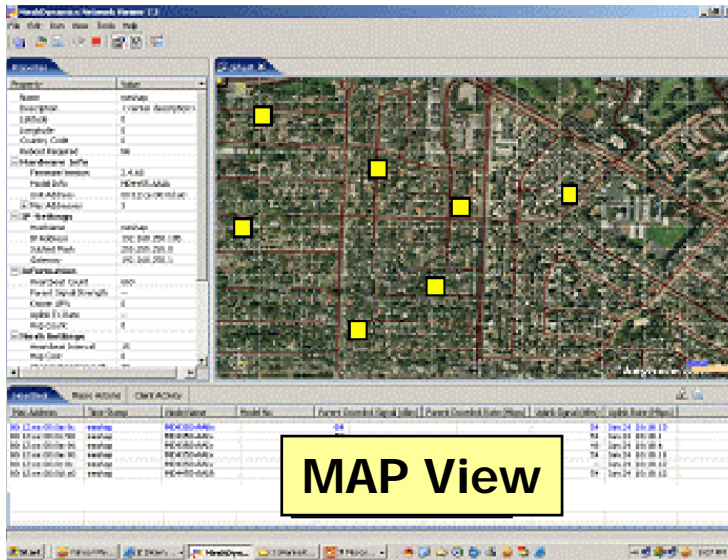


Figure 120—Transmit spectrum mask

The screenshot displays the MeshDynamics Network Viewer 7.0 interface. On the left, a 'Properties' window shows details for a mesh node named 'meshap'. The main window shows a network topology with nodes labeled '4220', '38 C', '4350', '4455', and 'HPC:2'. A table at the bottom shows 'Station Activity' with columns for No, MacAddress, TimeStamp, STA Address, and Status.

No	MacAddress	TimeStamp	STA Address	Status
1	00:12:ce:00:0a:52	Mon Oct 03 13:43:06 PDT 2005	00:12:f0:4d:76:e1	Disassociated
2	00:12:ce:00:08:06	Mon Oct 03 13:43:13 PDT 2005	00:12:ce:00:09:7a	Associated
3	00:12:ce:00:08:12	Mon Oct 03 13:43:15 PDT 2005	00:12:ce:00:08:a8	Associated
4	00:12:ce:00:08:12	Mon Oct 03 13:43:15 PDT 2005	00:12:ce:00:0a:52	Associated
5	00:12:ce:00:08:a8	Mon Oct 03 13:46:05 PDT 2005	00:12:ce:00:09:7a	Associated
6	00:12:ce:00:09:7a	Mon Oct 03 14:40:00 PDT 2005	00:12:ce:00:09:74	Associated
7	00:12:ce:00:09:74	Mon Oct 03 14:53:04 PDT 2005	00:12:ce:00:09:7a	Associated



- . Eclipse Based Open Framework.
- . Supports View Extensions for Customers
- . GPS not necessary for network function or mobility
  - . GPS Update Stream (via Serial Port)
  - . Sensor Data Stream (via Ethernet Port)
  - . Streams accessible within Region of Interest in network

- ❑ **Higher performance for video, voice, high-demand data requires structure**
- ❑ **Radios are cheap, use a lot of them**
- ❑ **Spectrum is scarce, use it wisely**
  - Unlicensed where possible, but optimize channels
- ❑ **Scale and high speeds demand nodes make independent topology decisions**
  - Distributed radio intelligence
- ❑ **Management without fixed connections**
  - Topology policy-based, not centralized
  - Add GPS if absolute locations necessary

- ❑ **Mesh development begun 2002**
  - Custom military solutions delivered beginning in 2004
  - Commercial multi-radio mesh demos shipped 2005
- ❑ **MeshDynamics established 2005**
  - IP from earlier developments incorporated
  - First products shipped 2005, production release 11/05
- ❑ **Approx. 110 networks, 1400+ nodes installed worldwide**
- ❑ **[www.meshdynamics.com](http://www.meshdynamics.com)**