ANTENNA PLACEMENT

WHY

DOES IT

MATTER???
ANTENNA FARMS
EM spectrum - how does it work?

- Photon Quanta
  - Energy carrier
  - Waves and particles
PHOTON GENERATOR

• diagram courtesy http://de.wikipedia.org/wiki/Datei:Felder_um_Dipol.jpg | Date=02.10.2006}
ENERGY WAVE OUTBOUND
RESONANCE

• How it is achieved
• Near field properties
• Resonance and photons
NEAR FIELD

- **E-VERTICAL** lines are the voltage functions, **B-HORIZ** are the magnetic functions presented to or received from the EM spectrum during resonance.

NEAR FIELD ACTIONS

NEAR FIELD

| NON-RADIATIVE (REACTIVE) | RADIATIVE (FRESNEL) |

FAR FIELD
SIZE OF NEAR FIELD

- **NEAR-FIELD REGION**
  - Reactive
  - Radiative
  - \( \lambda/2\pi \) = 0.159 wavelength

- **TRANSITION ZONE**

- **FAR-FIELD REGION**
  The maximum overall dimension of the source antenna "D" is a prime factor in determining this boundary. The far-field generally starts at a distance of \( 2D^2/\lambda \) out to infinity.
RADIATION PATTERNS

- Far Field
- Gain
- Polarization
- Aperture
- Available energy
- Natural effects of gain vs size vs polarization vs frequency vs time of year
GAIN AND PATTERN POSITIONING

3 dB Gain

6 dB Gain

10 dB Gain

Water

3 dB Gain

6 dB Gain

10 dB Gain

Typical VHF 5/8 wave radiation angle

Digital Antenna’s low radiation angle reduces ground for more range
SIGNAL POLARIZATION

Circular Polarized

Linear Polarized

Note the 90° phase difference.

If this wave were approaching an observer, its electric vector would appear to be rotating clockwise. This is called right-circular polarization.
APERTURE AND ENERGY

- Aperture refers to the effective area of an antenna that gathers energy
- Energy is measured in a quantity per square meter of area
- A larger aperture, or multiple phased apertures, captures more energy resulting in “gain”
MOTHER NATURE

- Curvature of earth (LOS)
- LOS loss function (Fresnel zone)
- Power dispersion
- Distance attenuation \[117 + (20 \log F \text{(in MHz)}) - (20 \log (h1 \cdot h2 \text{(in feet)}) + (40 \log d \text{(in miles)})\]
LINE OF SIGHT CONNECTION

Fresnel Zone

Earth
POWER DISPERSION
PLACEMENT AND OPERATION

• Height
• Vertical plumb
• Obstructions
• SWR
• Frequency
• Cabling
NEAR FIELD

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PLACEMENT AND OPERATION

- Height
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**Cabling**

D = Cable Diameter  
R = Bend Radius

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**Cable attenuation (loss) chart per 100’**

<table>
<thead>
<tr>
<th>Frequency</th>
<th>RG174</th>
<th>RG58</th>
<th>DA195</th>
<th>RG-8X</th>
<th>DA240</th>
<th>RG-8UP</th>
<th>DA340</th>
<th>DA440</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 MHz</td>
<td>10.7 dB</td>
<td>4.7 dB</td>
<td>5.3 dB</td>
<td>4.0 dB</td>
<td>3.0 dB</td>
<td>2.4 dB</td>
<td>2.5 dB</td>
<td>1.5 dB</td>
</tr>
<tr>
<td>300 MHz</td>
<td>16.0 dB</td>
<td>7.0 dB</td>
<td>7.5 dB</td>
<td>5.4 dB</td>
<td>4.3 dB</td>
<td>3.5 dB</td>
<td>3.4 dB</td>
<td>2.2 dB</td>
</tr>
<tr>
<td>800 MHz</td>
<td>29.2 dB</td>
<td>12.7 dB</td>
<td>12.4 dB</td>
<td>10.2 dB</td>
<td>7.1 dB</td>
<td>6.4 dB</td>
<td>5.7 dB</td>
<td>3.7 dB</td>
</tr>
<tr>
<td>1900 MHz</td>
<td>51.3 dB</td>
<td>22.0 dB</td>
<td>19.6 dB</td>
<td>20.6 dB</td>
<td>11.2 dB</td>
<td>11.2 dB</td>
<td>8.52 dB</td>
<td>5.8 dB</td>
</tr>
<tr>
<td>2400 MHz</td>
<td>60.2 dB</td>
<td>25.8 dB</td>
<td>22.1 dB</td>
<td>24.9 dB</td>
<td>12.6 dB</td>
<td>13.2 dB</td>
<td>10.2 dB</td>
<td>6.6 dB</td>
</tr>
<tr>
<td>Min. Bend Radius</td>
<td>1”</td>
<td>2”</td>
<td>2”</td>
<td>2.5”</td>
<td>2”</td>
<td>4”</td>
<td>3”</td>
<td>4”</td>
</tr>
</tbody>
</table>

1. RG174 should only be used for cellular frequencies in lengths less than 10’. For cable runs 100’ to 150’ on cellular frequencies, use Digital Antenna’s ULTRA low-loss DA440 cable. For cable runs greater than 150’, contact your installer.

2. Digital Antenna’s RG-8X with 98% tinned-braid & foil-shield – other manufacturers’ RG-8X has higher loss.

202 Antenna Placement
Intellian Tech Support

Presenter
Antenna Locations
Antenna Locations

• Objectives:
  – Preserve Antenna Aperture
  – Avoid Shadowing Potential Services
  – Avoid half and quarter wave spacing
  – Avoid Damage from High-power Transmitters
## Antenna Spacing Guidelines (Feet)

<table>
<thead>
<tr>
<th></th>
<th>VHF</th>
<th>GPS</th>
<th>SSB</th>
<th>Radar</th>
<th>Cell</th>
<th>Sat TV</th>
</tr>
</thead>
<tbody>
<tr>
<td>VHF</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>GPS</td>
<td>3</td>
<td>1/2</td>
<td>4</td>
<td>(b)</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>SSB*</td>
<td>3</td>
<td>4</td>
<td>10</td>
<td>4</td>
<td>2</td>
<td>4</td>
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<tr>
<td>Radar</td>
<td>2</td>
<td>(b)</td>
<td>2</td>
<td>(a)</td>
<td>1</td>
<td>4(b)</td>
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<tr>
<td>Cell</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Sat TV</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4(b)</td>
<td>4</td>
<td>6</td>
</tr>
</tbody>
</table>

- a) 2 Radars require minimum 18” vertical separation
- b) Must be outside of radar beam
Satellite Television

• C-Band TVRO Broadcasts From 4 To 8 GHz
• Ku-Band TVRO Broadcasts From 12 To 18 GHz
  – DirecTV, Dish Network
• Satellite Signals Are “Folded” To A Lower Frequency By The Low Noise Block Amplifier (LNB) At The Receiving Dish
  – Superheterodyne A Wide Block Of Relatively High Frequencies, Amplify And Convert Them To Similar Signals Carried At A Much Lower Frequency (Called Intermediate Frequency Or IF
• Satellite IF Frequencies Operate From 950 To 1450 MHz
  – Can Be Piggybacked In The Same Coaxial Cable That Carries Lower-Frequency Terrestrial Television From An Outdoor Antenna
# Types Of RF Coaxial Cable

<table>
<thead>
<tr>
<th>Characteristic Impedance</th>
<th>RG-59u</th>
<th>RG-6u</th>
<th>RG-11u</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impedance</td>
<td>75Ω</td>
<td>75Ω</td>
<td>75Ω</td>
</tr>
<tr>
<td>Propagation Velocity</td>
<td>0.66</td>
<td>0.75</td>
<td>0.66</td>
</tr>
<tr>
<td>Diameter</td>
<td>0.242 in</td>
<td>0.270 in</td>
<td>0.412 in</td>
</tr>
<tr>
<td>1GHz Loss @ 100 Feet</td>
<td>-8.09dB</td>
<td>-6.54dB</td>
<td>-4.23dB</td>
</tr>
<tr>
<td>1GHz Loss @ 100 Meters</td>
<td>-26.54dB</td>
<td>-21.46dB</td>
<td>-17.22dB</td>
</tr>
<tr>
<td>3GHz Loss @ 100 Feet</td>
<td>-14.29dB</td>
<td>-11.45dB</td>
<td>-7.8dB</td>
</tr>
<tr>
<td>3GHz Loss @ 100 Meters</td>
<td>-46.88dB</td>
<td>-37.57dB</td>
<td>-25.29dB</td>
</tr>
</tbody>
</table>

- **RG-59/U**
  - Coaxial Cable With 20 AWG Center Conductor And 75Ω Characteristic Impedance
  - Used For Low-power Video And RF Signal Connections At Short Distance, High-Frequency Losses Are Too High To Allow Its Use Over Longer Runs

- **RG-6/U**
  - Coaxial Cables With An 18 AWG Center Conductor And 75Ω Characteristic Impedance
  - CATV Distribution Coax Typically Has A Copper-Coated Steel Center Conductor And A Combination Aluminum Foil/Aluminum Braid Shield

- **RG-11/U**
  - Coaxial Cable With A 14 AWG Center Conductor And 75 Ω Characteristic Impedance
  - The Correct Choice For Runs Over 300 Feet
Types Of Multiswitches

- There are basically 2 different types of Multi Switch available:
  * Passive (un-powered) and
  * Active (powered).

- If cable runs are longer than 100 feet for any receiver, a powered Multi-Switch is highly recommended.

- The long run can degrade the signal level to the DTH receiver. A powered Multi

- Switch compensates the signal loss.
What is SWiM or SWM?

- Single Wire Multiswitch products are designed to provide DIRECTV® programming from all current and future Ka/Ku satellites via a single RG-6 coaxial cable home/boat run to a set of multiple IRD's connected using one or more Splitters within a customer’s home.
- SWM products allocate channels (frequency blocks) for viewer selected programming to the SWM compatible IRD's.
- These channels (frequencies) contain the programming guide data and user selected programming channels.
Satellite Communications

• Wide Variety of Marine Communication Needs
• Receive Only
  – GPS, Weather, TV, Internet, Other Entertainment
• Transmit/Receive
  – Voice
  – Video
  – Data/Fax
  – Internet
• Motion Compensated Systems
Typical Satellite System

Radome

Control Unit

Power Supply

Vessel Motion Sensor

Monitor

Computer
Satellite Constellation Geometry

- **Geostationary** – Always in Same Relative Position in Sky. 
  *TV, Communications, Weather 22,000 miles*

- **Non-stationary** – Cross from Horizon to Horizon while in use. 
  *Height varies with purpose.*

- **Low Earth Orbit (LEO)** 
  *400-1200 miles*

- **Medium Earth Orbit (MEO)** 
  *12,000 miles (GPS)*

- **Some Systems Must Maintain a Minimum of 2-3 Satellites in View at All Times**
Radome Location

- Physically Secure Location
- Clear View of as Much Sky as Practical
- Follow Antenna Spacing Requirements
- Outside Any Radar Array within 6 Feet
Satellite Dish

- When the signal reaches the viewer's vessel, it is captured by the satellite dish. A satellite dish is just a special kind of antenna designed to focus on a specific broadcast source. The standard dish consists of a parabolic (bowl-shaped) surface and a central feed horn. To transmit a signal, a controller sends it through the horn, and the dish focuses the signal into a relatively narrow beam.
Line-of-Sight

-15° to +85°

Blocked From View!

Mast or Cabin Structure
Radar Clearance

-15° to +15°

Diagram showing the angle range for radar clearance.
Below-Deck Equipment

• Control Unit – Not Normally Used for Vessel Navigation; Install in Convenient Location
• Vessel Motion Sensor – Position as Close as Practical to the Vessel Pitch-and-Roll Center
• Be Aware of Potential Magnetic Interference When Fluxgate Compass Included with Package
Connections

• Coax Cables in Accordance with Manufacturer Recommended Signal Loss
• Multi-conductor Cables – Use Manufacturer Provided Cables
• Splice Cables Using Ring Lugs and Suitably Sized Terminal Strips
• Protect All Connections from Weather