Watery Wireless

An interesting problem and some things that were learned about wireless links across water

- I am Brendan Minish CTO of Westnet
- Westnet is a Wireless ISP based in Mayo
- We have deployed many Cross water links

The problem

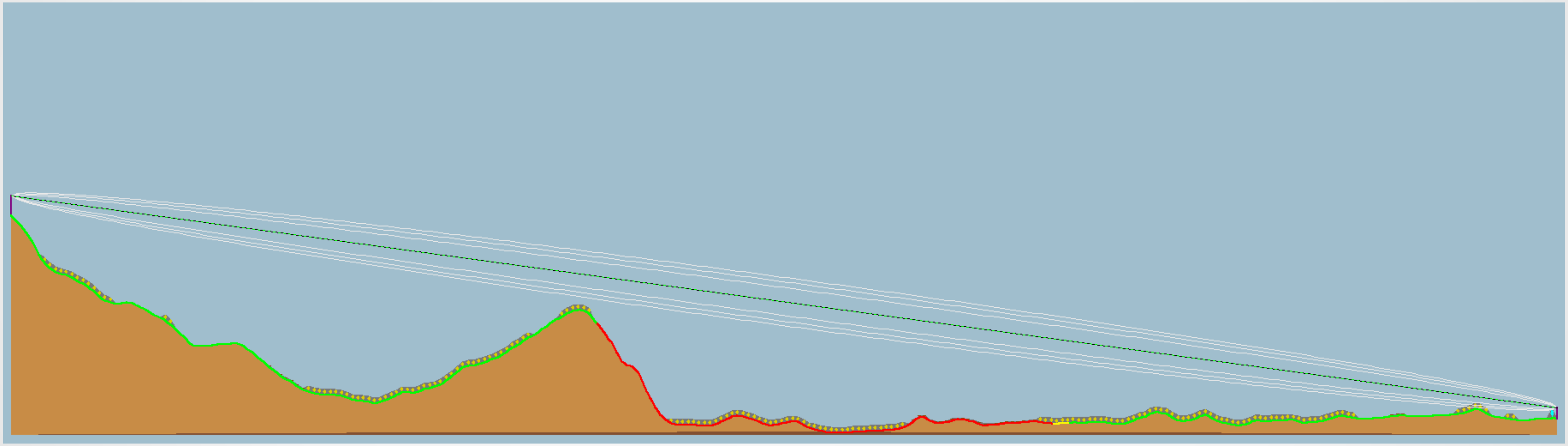
Requirements

- 5Km Link across water
- Average throughput of 15Mb/sec or better
- High Link availability (*)
- DC Power Budget (<200W)
- Within Licence rules for 5.8Ghz

Analysis

- There are two problems to solve
  - Cross water link with Fresnel incursion
  - Antenna aiming

Path Profiles



Path Profiles

- Wireless free space path loss.
  - Inverse square law
  - @ 5.8Ghz 123 dB path-loss on 5.5Km clear path
  - May be larger on paths with obstructed Fresnel zone
  - Water is highly reflective to RF
- Single mode Fibre ~0.5dB per Km.

Cross water

- Link Stability
  - Very poor due to strong reflections from water
  - Worse in stable sea conditions
  - Use Spatial diversity

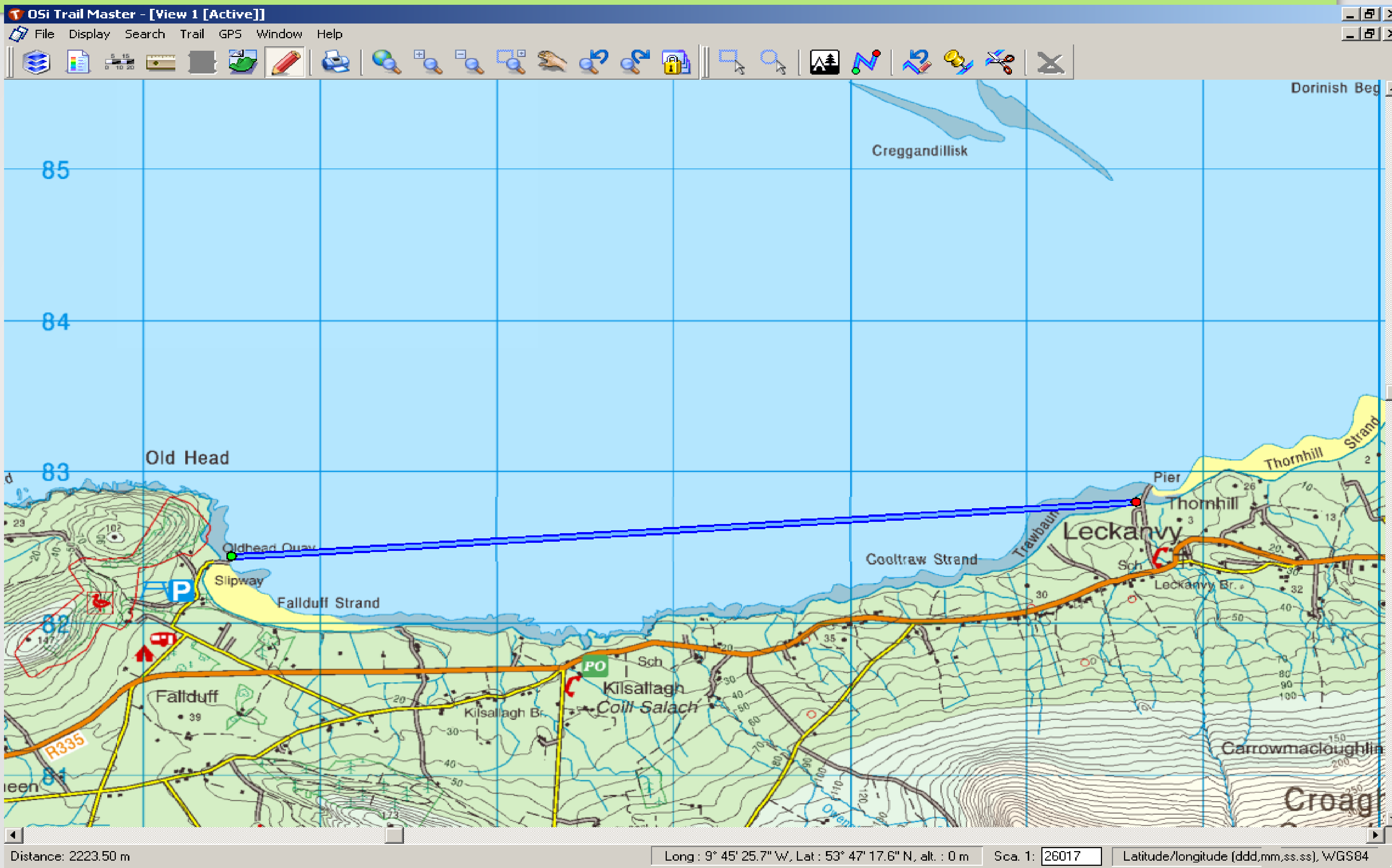
Cross water

- Testing
  - Need a cross water path that we can test
    - Under differing sea conditions
    - Without mucking about in boats
    - For extended test periods.
  - 2 paths Identified across Clewbay
    - 5.5 Km Old Head Pier – Lecanvy
    - 13.25 Km   Old Head Pier - Mulranny

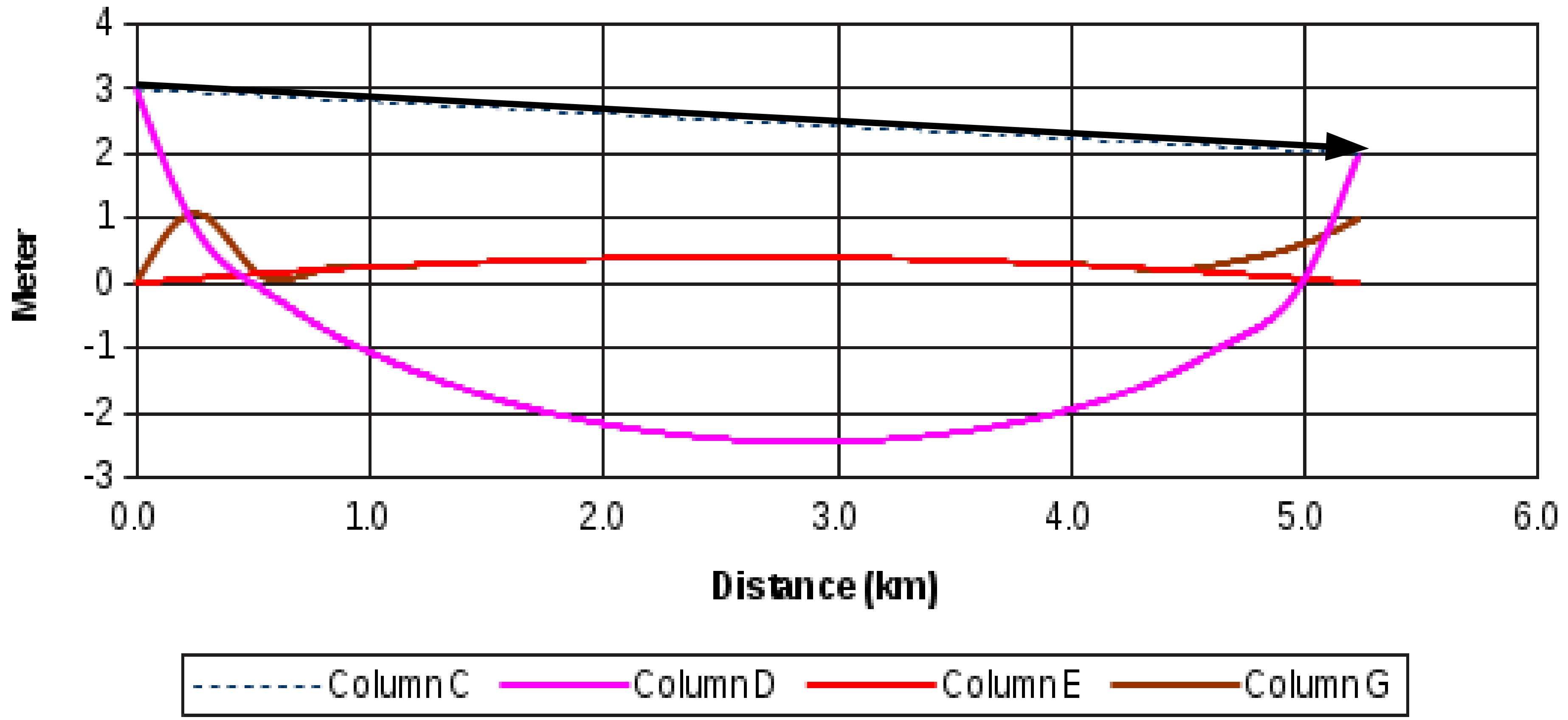
Testing

- Need to log data
  - Virtual linux server running Centos(*)
    - Zenoss (SNMP graph parameters)
    - Splunk (collect system logs from devices)
  - Linux laptops both ends
    - Iperf for throughput testing

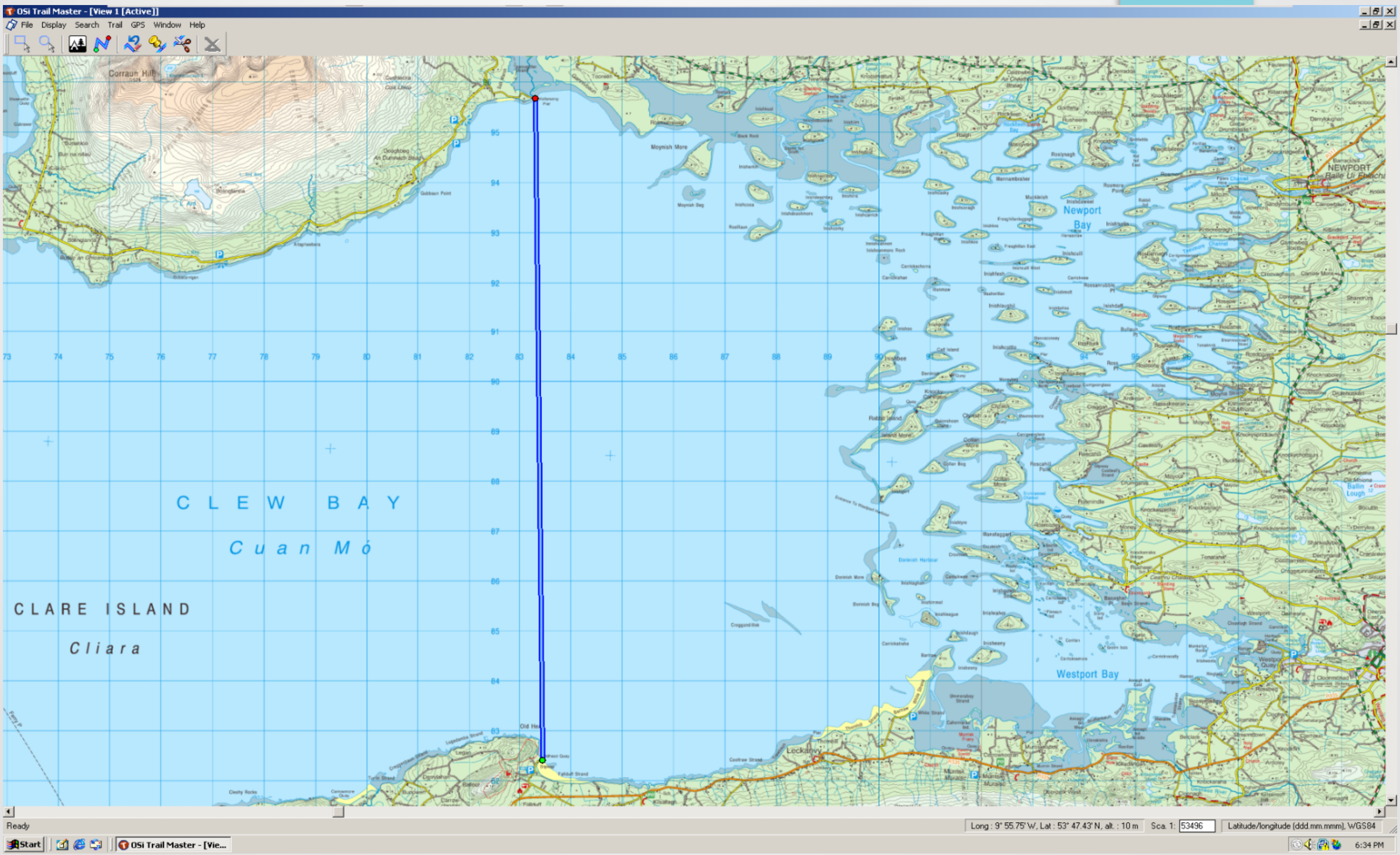
Old Head - Lecanvy



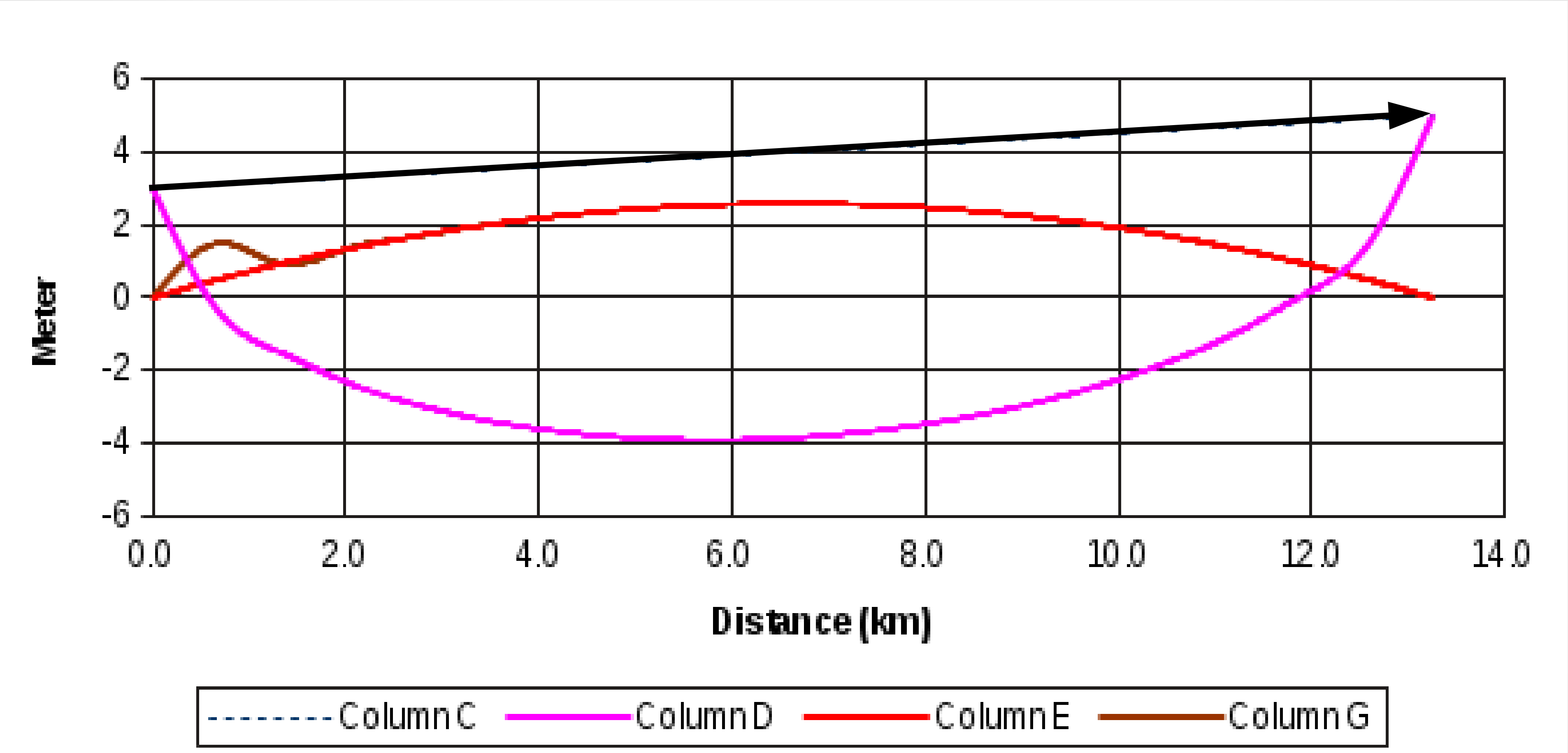
Old Head - Lecanvy



Old Head - Mulranny



Old Head - Mulranny

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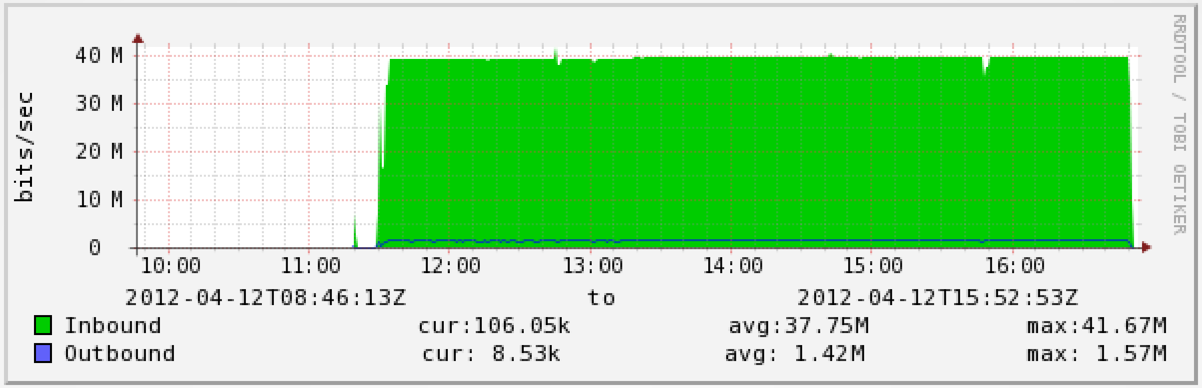
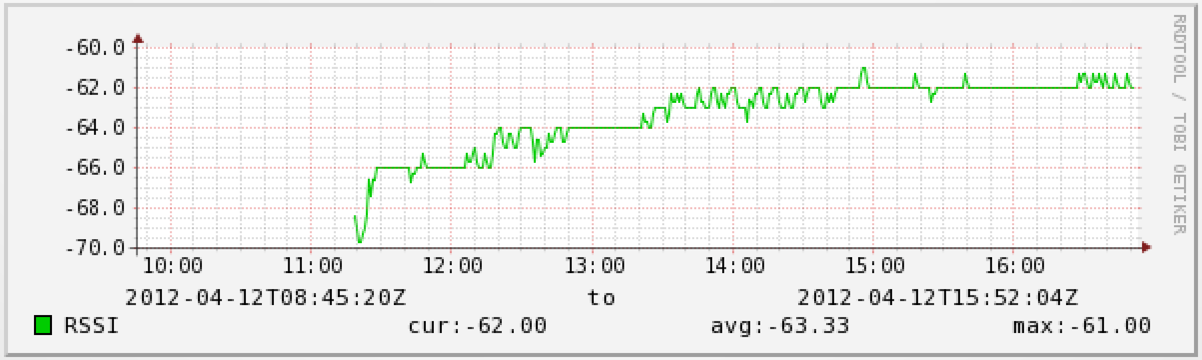
5.5 Km Link

Throughput

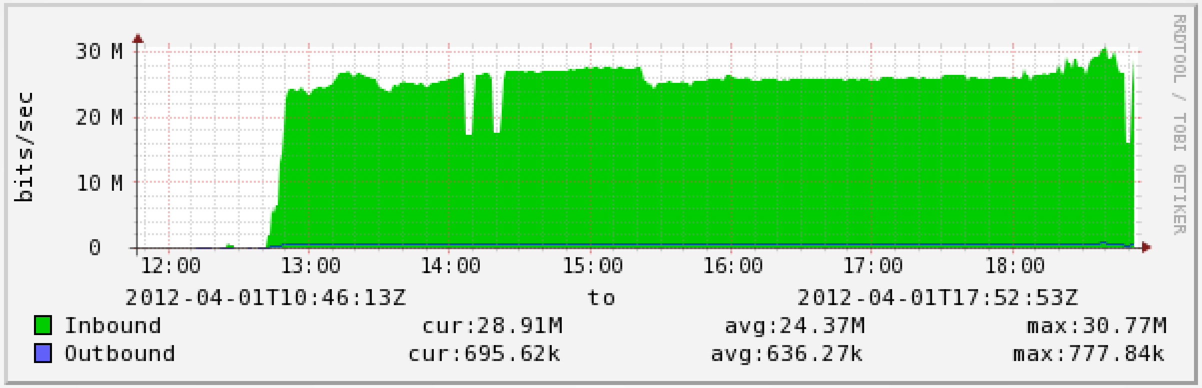


RSSI

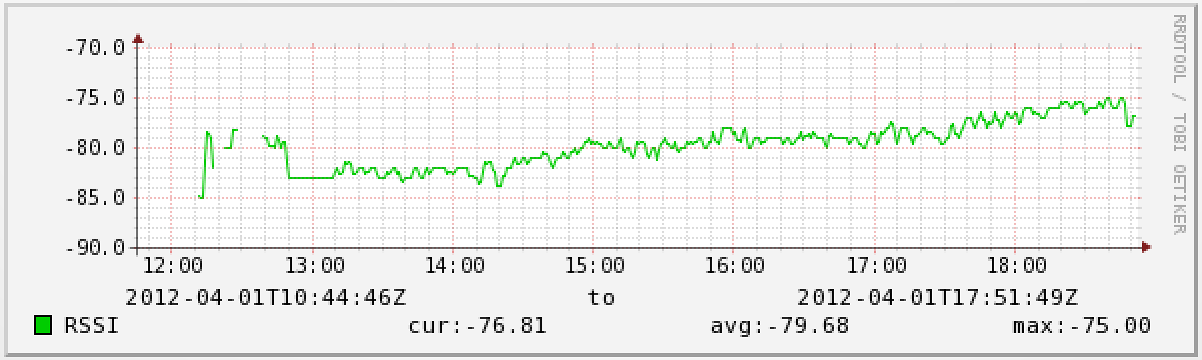


13.25 Km Link

Throughput



RSSI



Cross water links

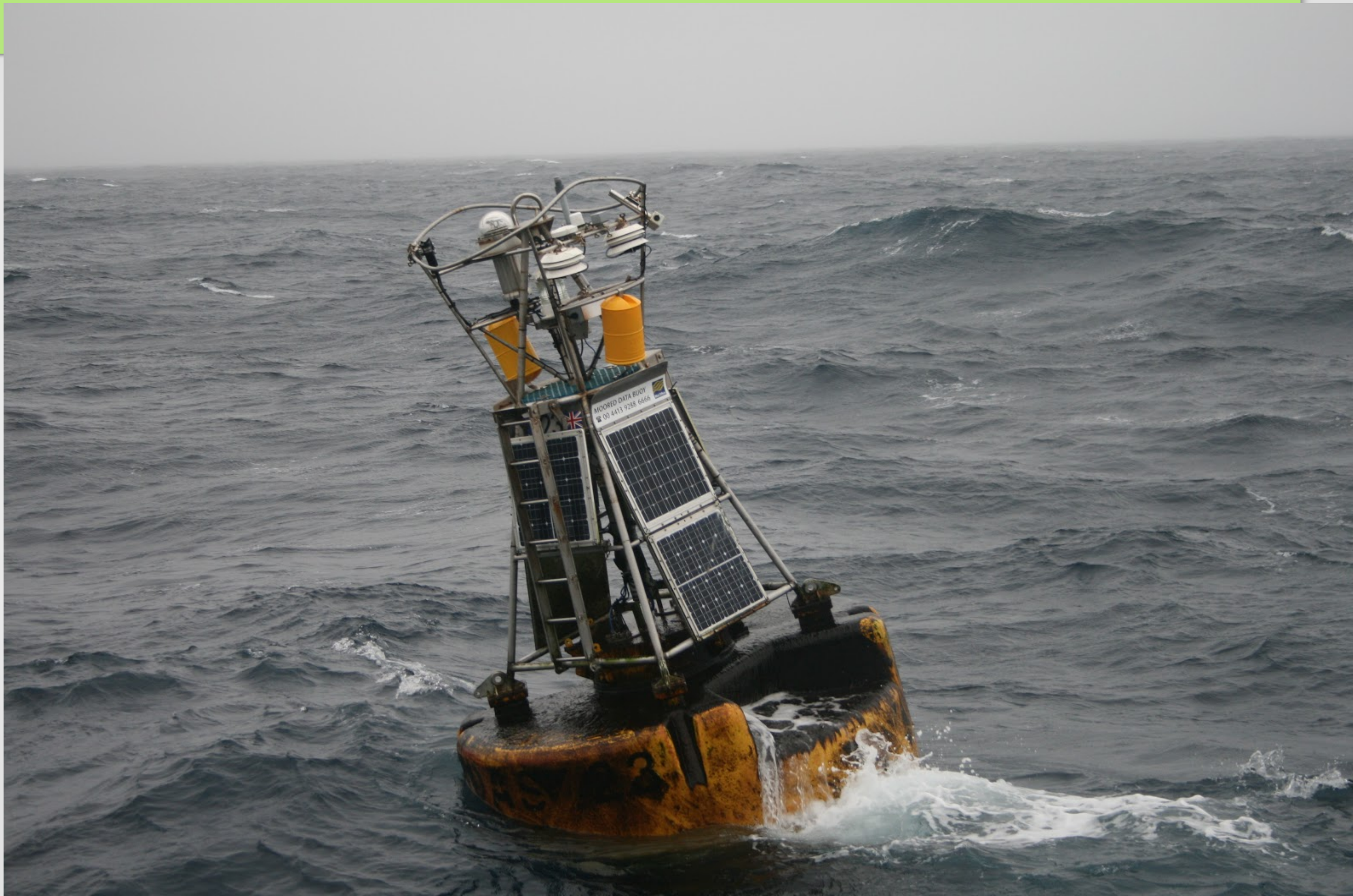
- Spatial diversity required
  - 4X spacing if only done at one end
- Atheros 802.11N chipsets
  - Restrict to 802.11A mode
  - Enable both chains
  - Spacings of several M
  - Vertical better than Horizontal
  - Local Terrain can help

The 'Other problem'

- Antenna positioning
  - On the land side this is relatively easy.
  - The Buoy end presents some difficulties


YAMAHA
FOUR STROKE

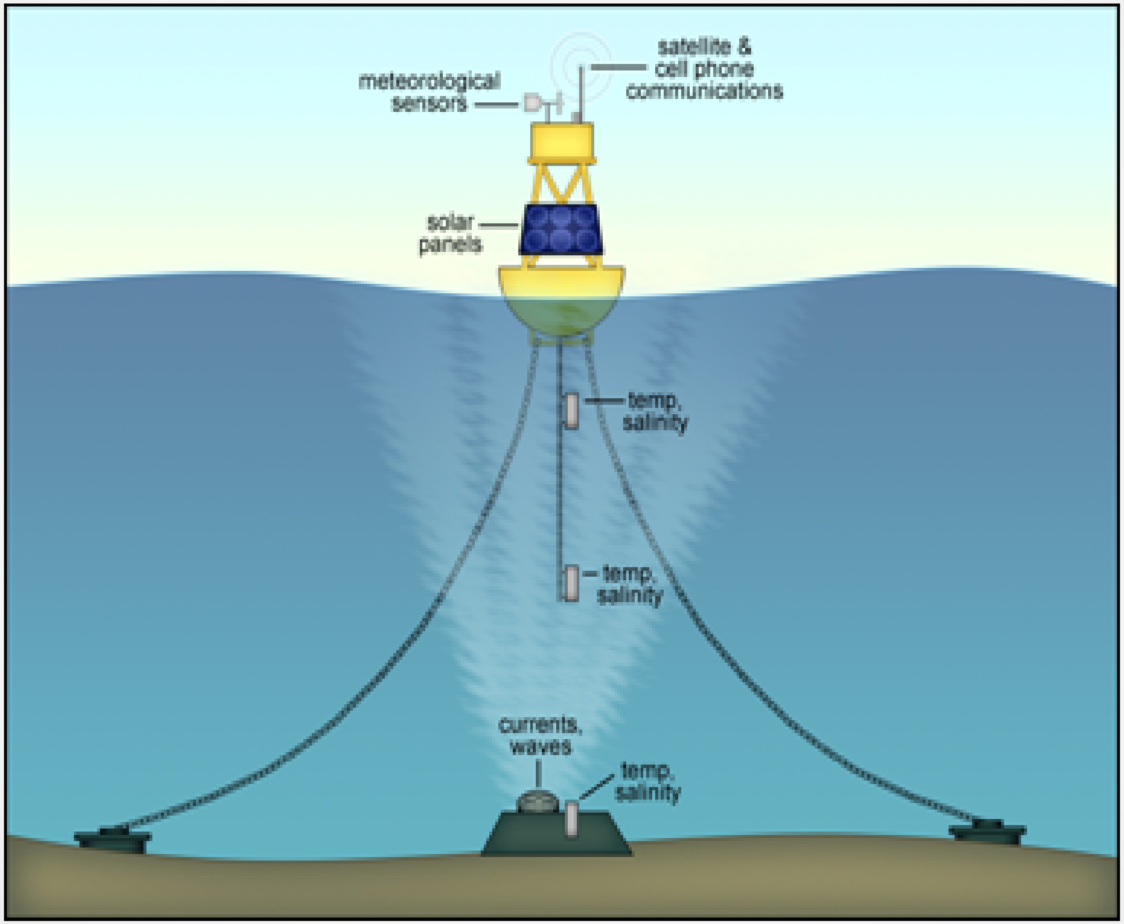

NOAA


MOORED DATA BUOY
00 4413 9288 6666

Antenna positioning

- Buoy Moves
  - It Rolls
  - It Tips
  - It does not rotate a whole lot

Antenna Positioning

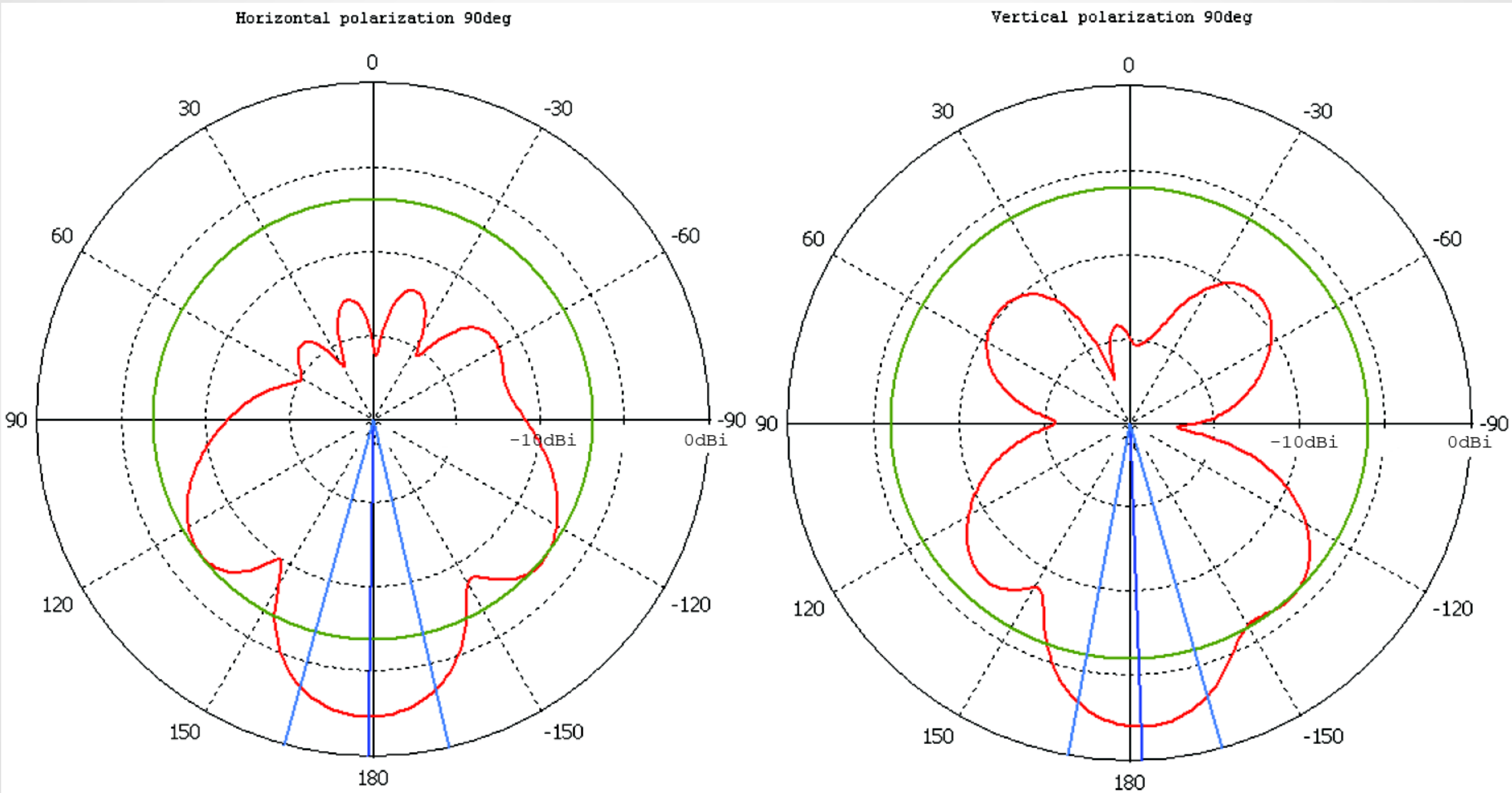


Electronic Antenna positioning

- BATS System

Antenna Properties

- Low gain CPE
  - Quite wide tolerance for aiming
    - More than 150 Degrees of Arc measured @ 5.5Km
  - Small size
  - Lightweight
  - Low Power consumption



Horizontal polarization 90deg
0
30
-30
60
-60
90
-90
-10dBi
0dBi
120
-120
150
-150
180
Vertical polarization 90deg
0
30
-30
60
-60
90
-90
-10dBi
0dBi
120
-120
150
-150
180

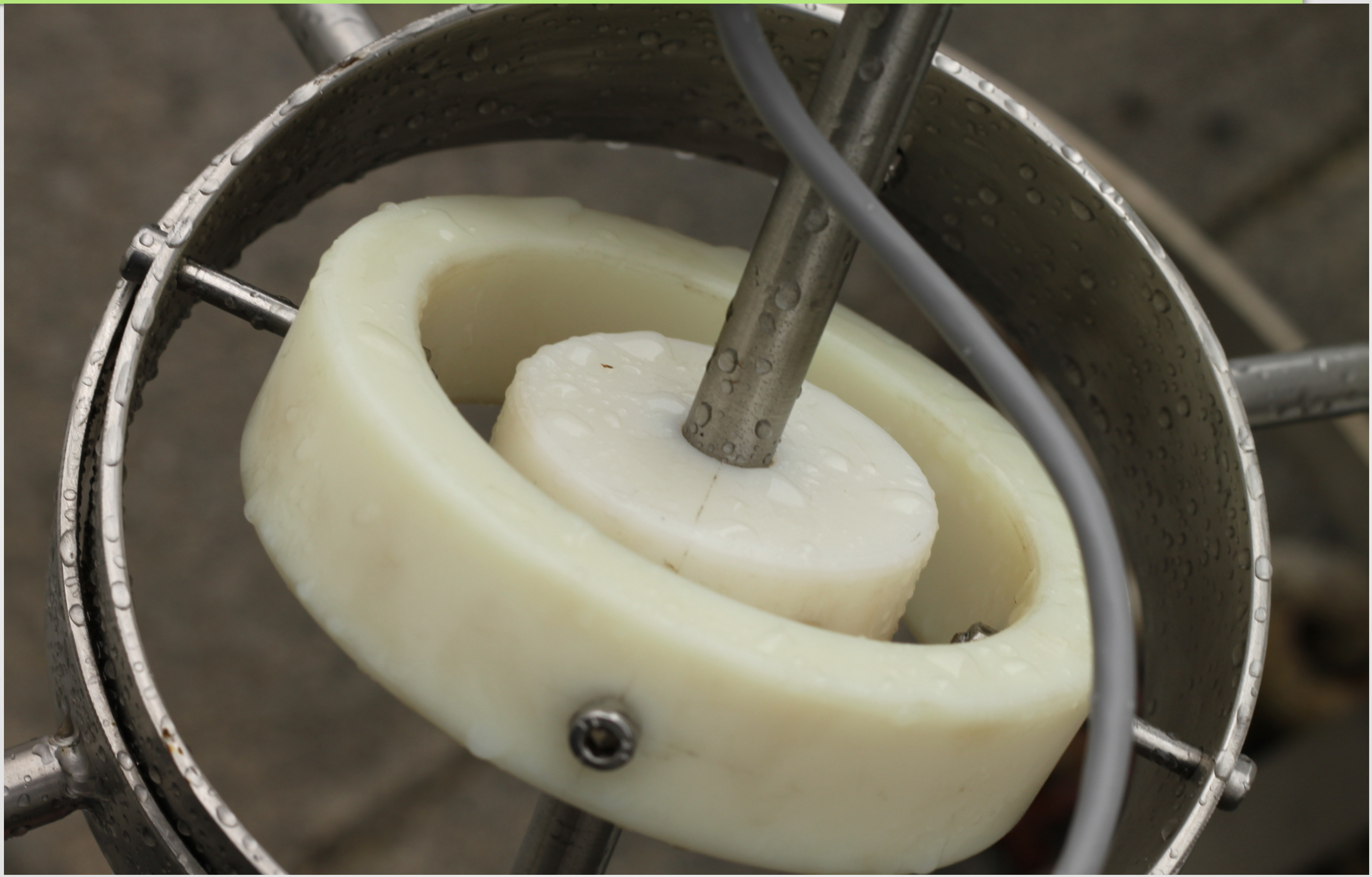
Antenna Properties

- High Gain on the Shore side
  - Maintains required system gain
  - Larger antenna
  - Much tighter pattern
  - Two antennas vertically spaced required
  - 3M spacing adequate for 5.5Km path

Antenna Positioning

- Low gain CPE, High gain shore-side
  - Required system gain maintained
  - Quite wide tolerance for aiming
    - More than 150 Degrees of Arc measured @ 5.5Km
- Buoy rotation a lot less than this
  - Use a Gimbal
    - Takes care of pitch and roll
    - Completely passive
    - Cheap

Gimbal Prototype



Phase Two

- System trialled on a buoy in Galway bay
- Gimbal provided adequate stability
- Live data streamed back
  - From Galway Bay to IBM in Dublin
- Project Handover to marine Institute

Acknowledgements

- Marine Institute
- P&O Marine services (Buoy deployment)
- IBM
- Rory Casey (Fibrepulse, Intro to MI, assistance with trials)
- Mark McNicholas (assistance with trials & reports)
- John Geraghty (Mechanical Engineering, Gimbal prototype)