



Embedded Maritime Broadband Radio - EMBR



KONGSBERG

WORLD CLASS – through people, technology and dedication

Existing broadband systems

- Ruggedized WiFi/WLAN 802.11x
 - Stability
 - Path Loss Margin: Up to 150 dB with multiple high gain sector antennas
 - Does not handle a combination of short/long ranges
 - Limited real time capability
- WiMax (802.16e)
 - Requires base station
- Radio link systems with parabolic antennas
 - Only point-to-point
 - Antennas need motor-control to maintain track



EMBR - Main features

- Embedded component in reference systems
- EMBR provides the user with one or more reliable broadband data links
- EMBR is easy to configure and operate
- EMBR has no moving parts
- An EMBR data link is able to transfer 5Mbps when the distance between the nodes are up to 10 km
- Realtime capability

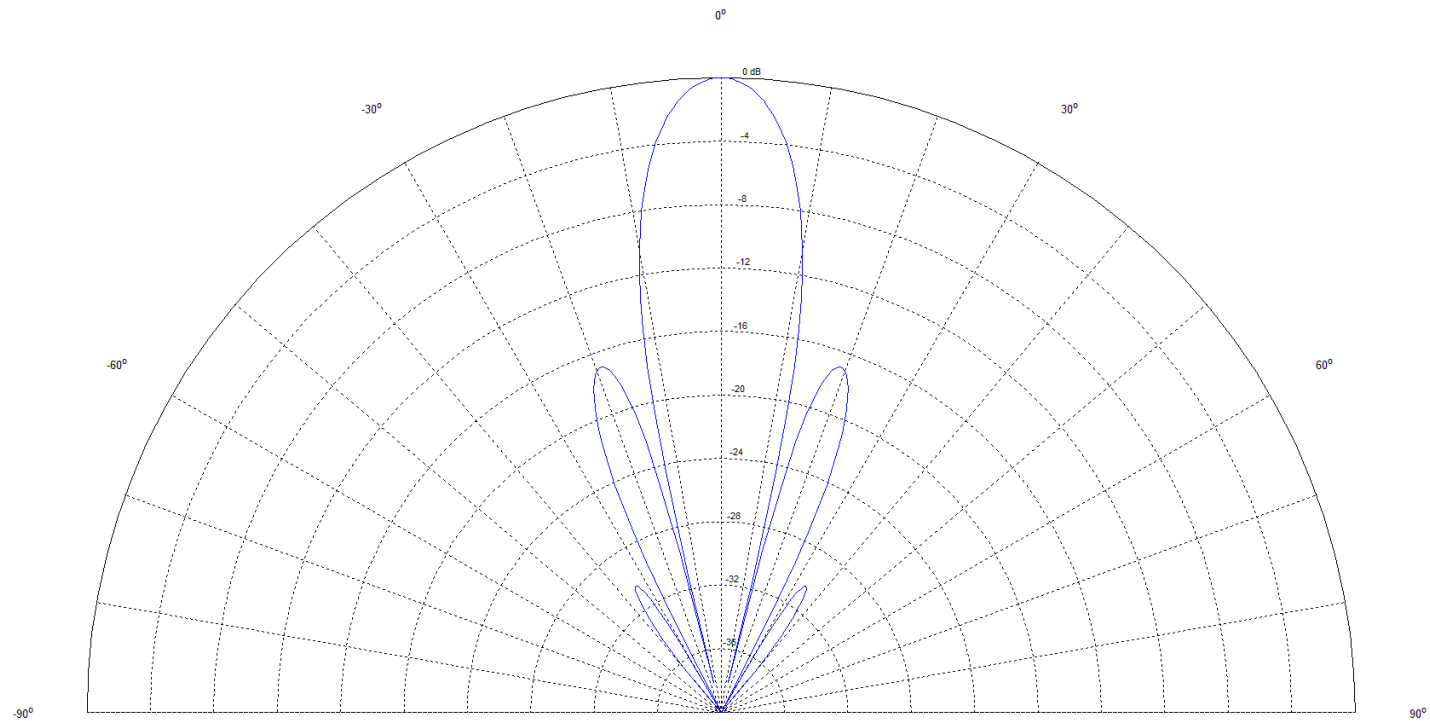
EMBR Design

- Frequency Band: 4.900 – 5.875 GHz
- Bandwidth: 20 MHz
- User Datarates: Up to 6Mbps
- Output power control

EMBR - Design

- Smart antenna based radio system with 60 antennas/transceivers in each unit
- Maximum Transmitted power:
 $60 \times 100\text{mW} = 6\text{W}$ (38 dBm)
- Antenna gain: 26 dBi (8 dBi + $10\log 60$)
- Gives maximum EIRP: 2.5 kW (64 dBm)
- Antenna 3 dB beam width: $\pm 4.5^\circ$ (H and V)
- Antenna beam can be controlled $\pm 45^\circ$
- All beam forming is performed in the signal processing domain

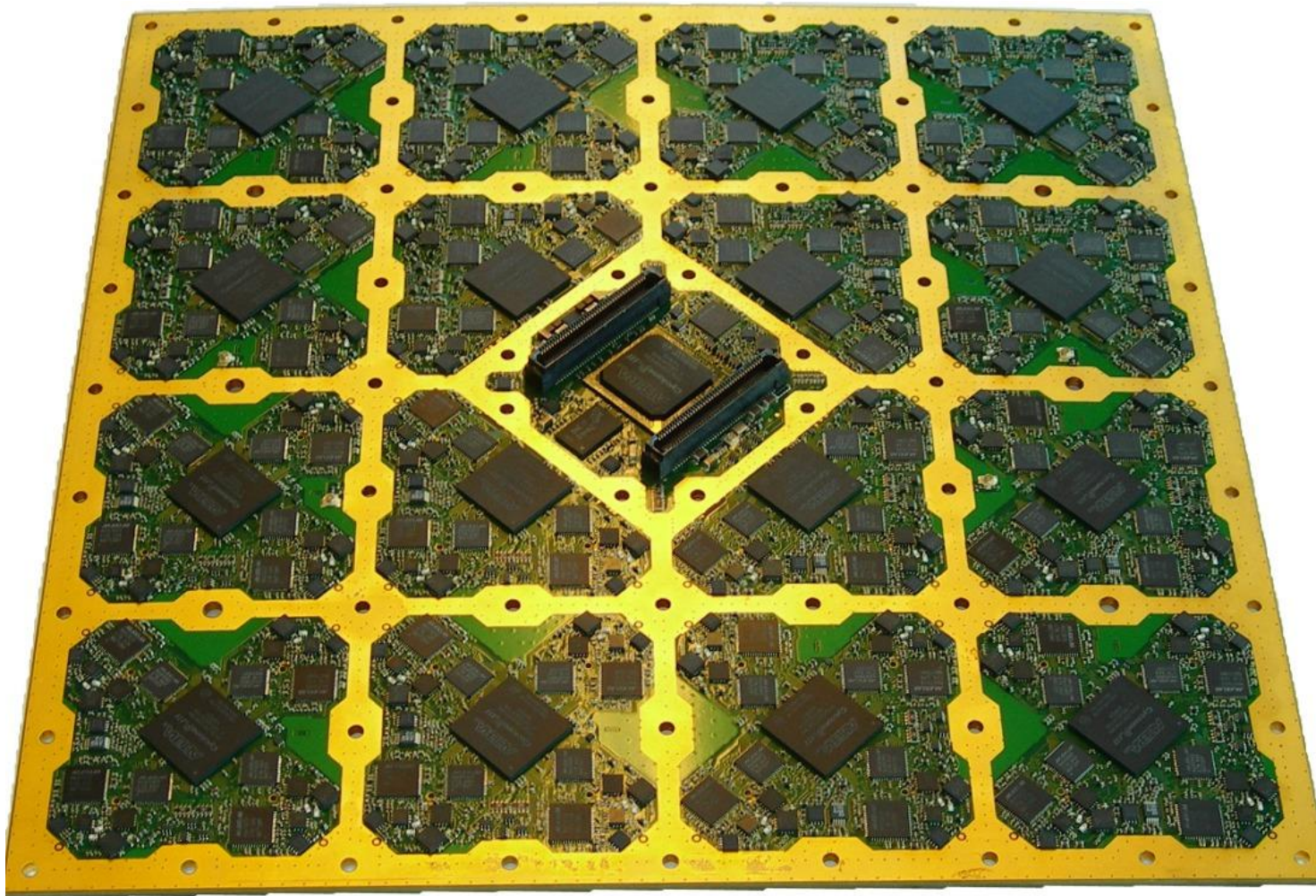
Antenna diagram



EMBR MAC/PHY

- Tailored Media Access Control (MAC) and Physical Layer (PHY)
- ACCM modulation (DSSS with rotating m-ary code book)
- Improved immunity versus multipath fading (reflections from sea surface and steel structures)
- Multi purpose functionality and capacity
- High priority channels – short latency channels

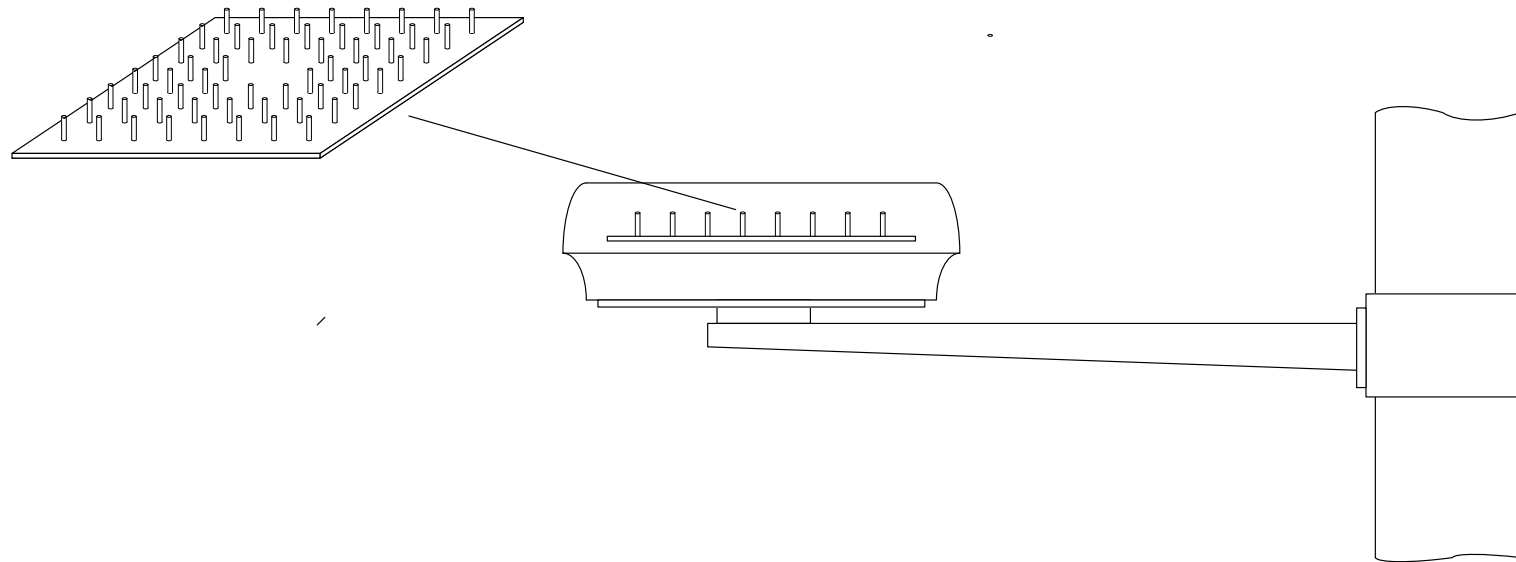
EMBR – Radio Board



EMBR – System Gain

- System gain: system parameter indicating how much Path Loss can be tolerated
- Three different antenna configurations:
 - EMBR-179 (monopole antennas)
 - EMBR-189 (helix antennas)
 - EMBR-201 (helix antennas)
- Line of Sight path loss at 10 km (5 GHz):
128 dB

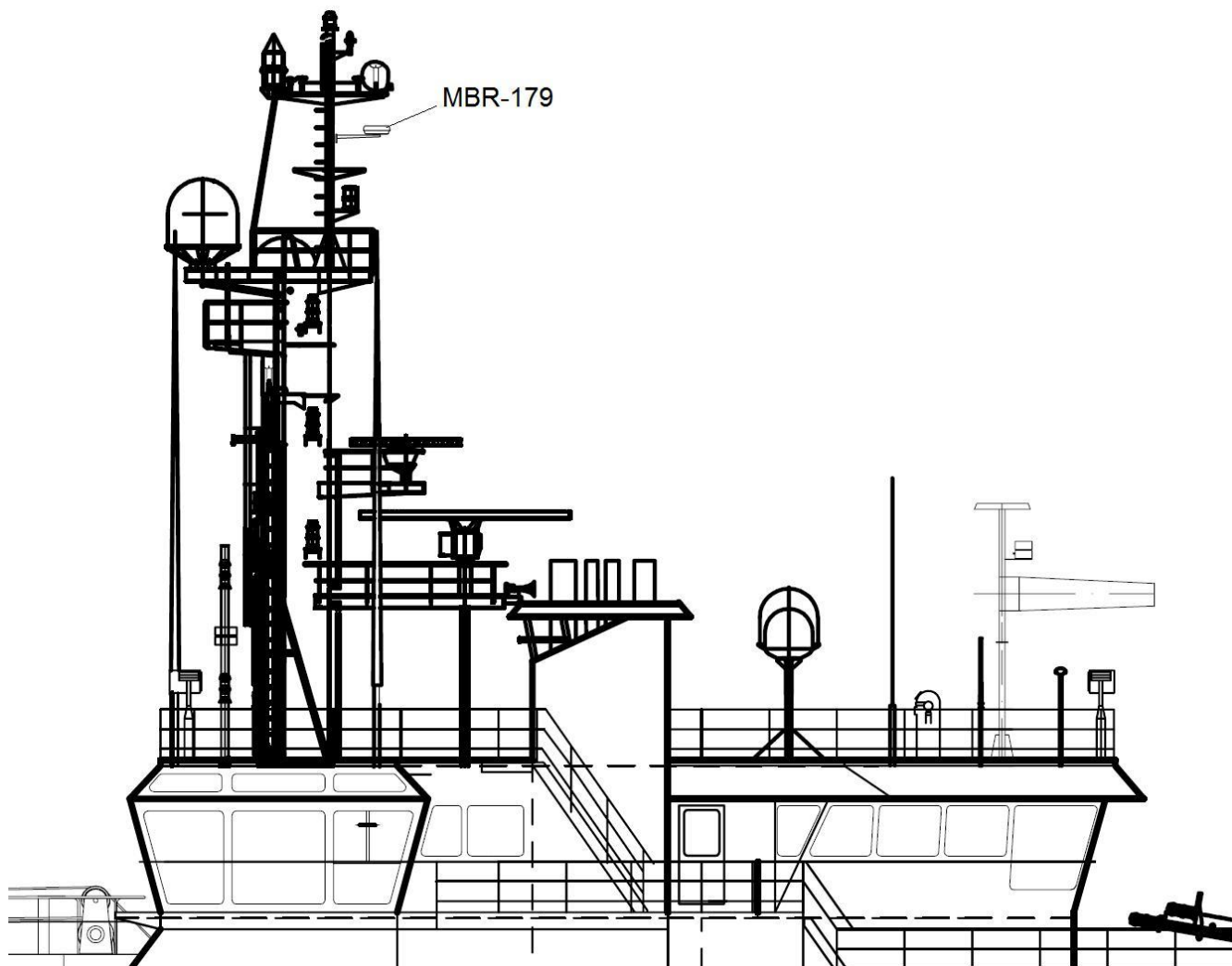
EMBR-179



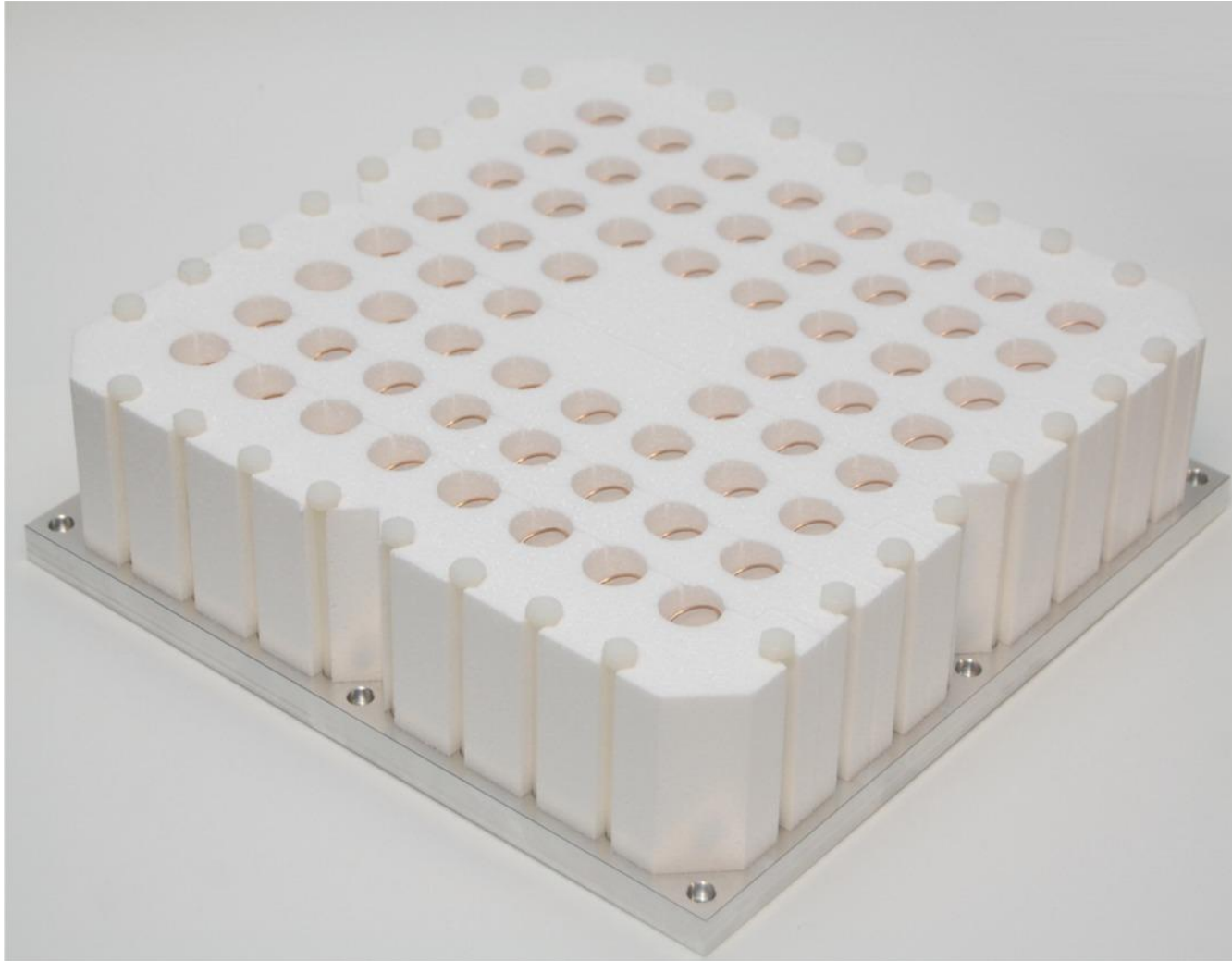
EMBR-179



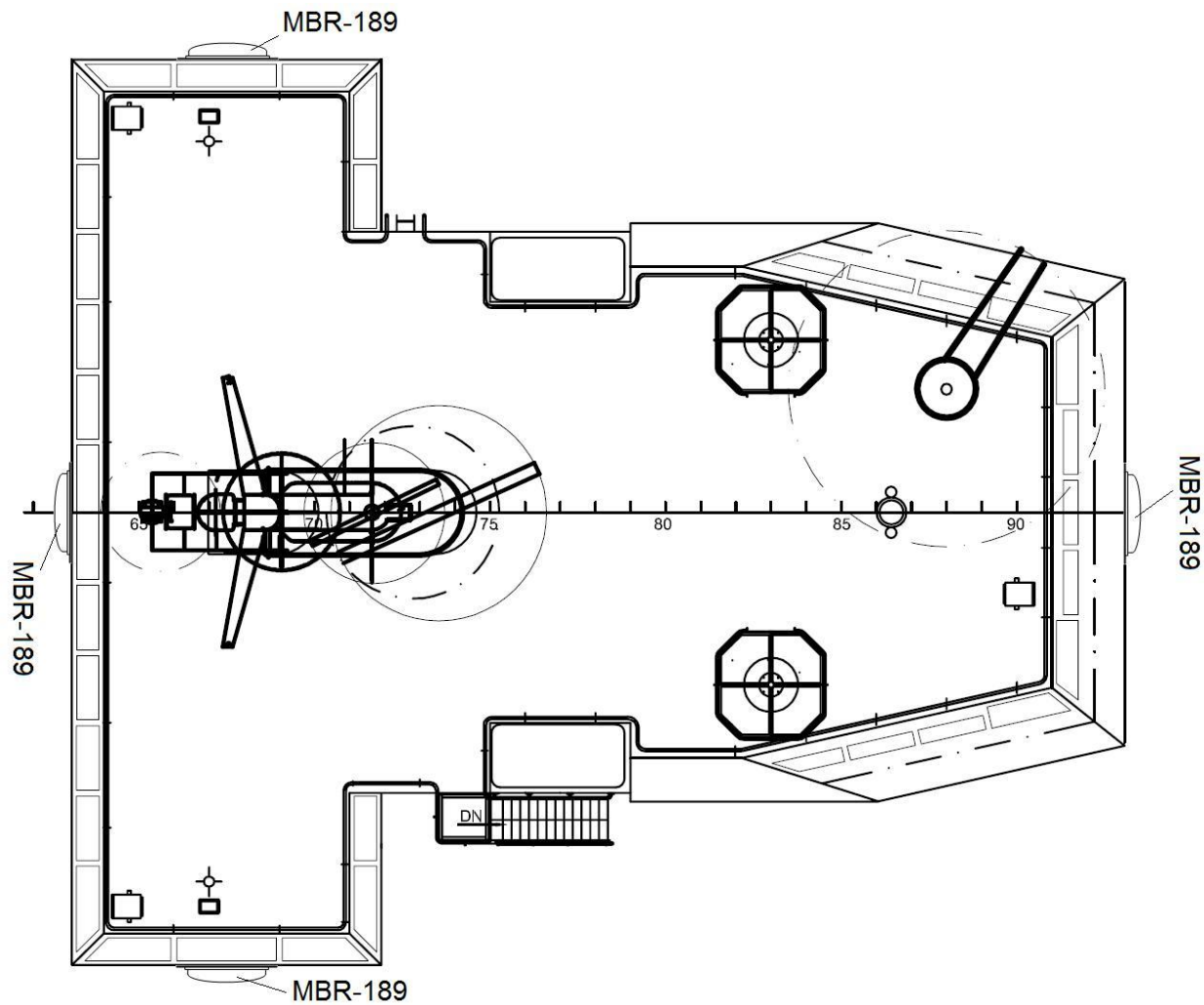
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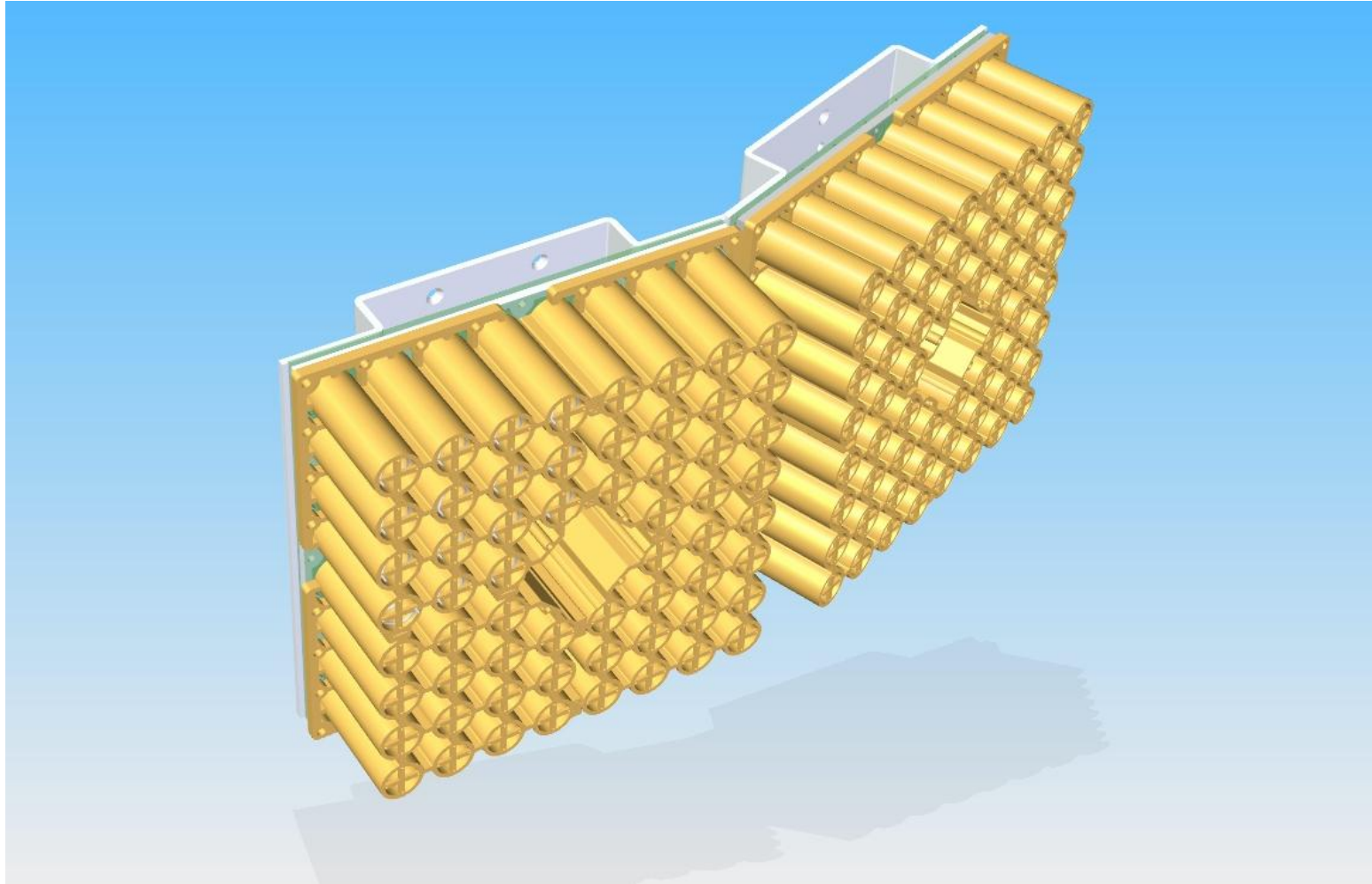
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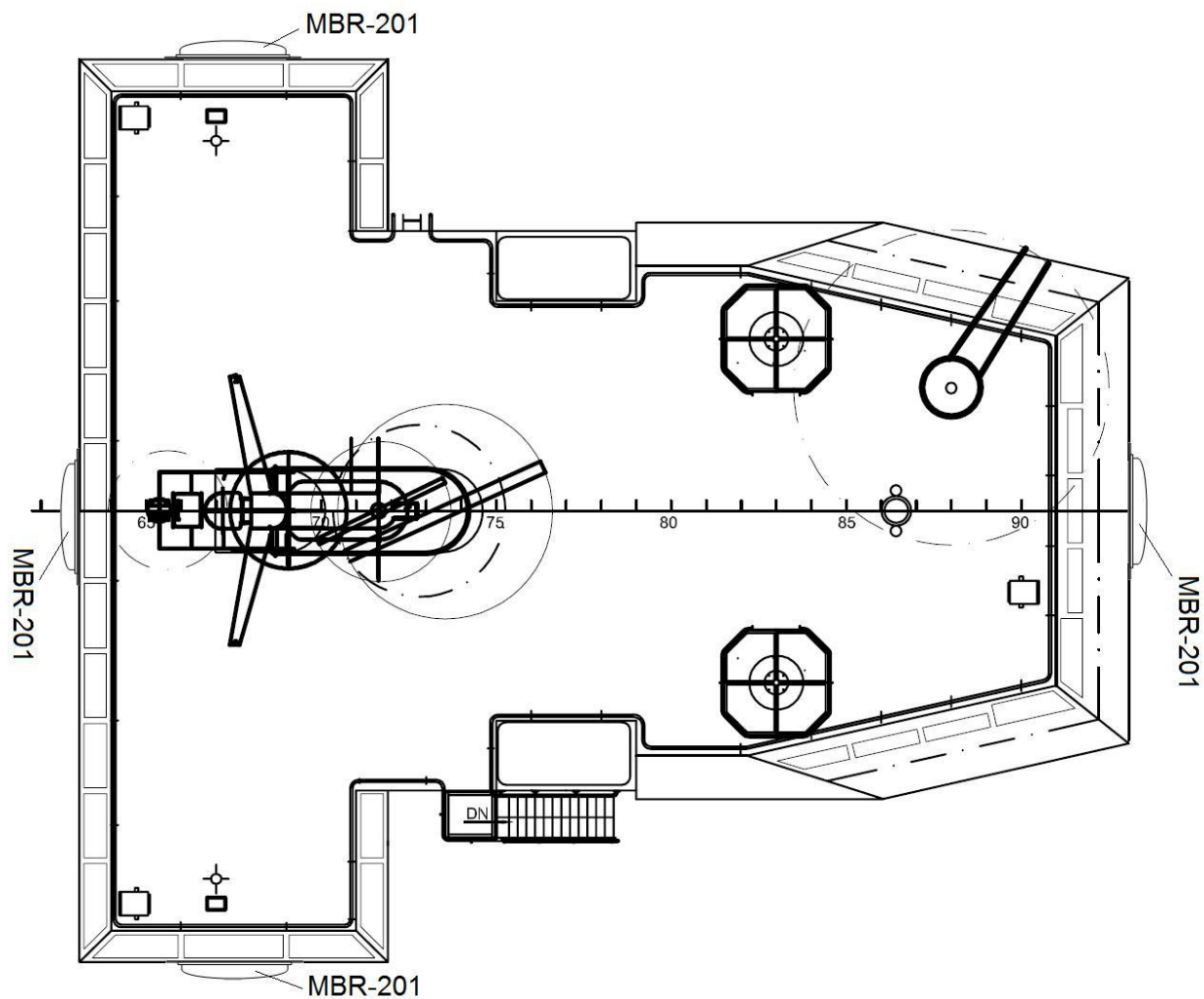
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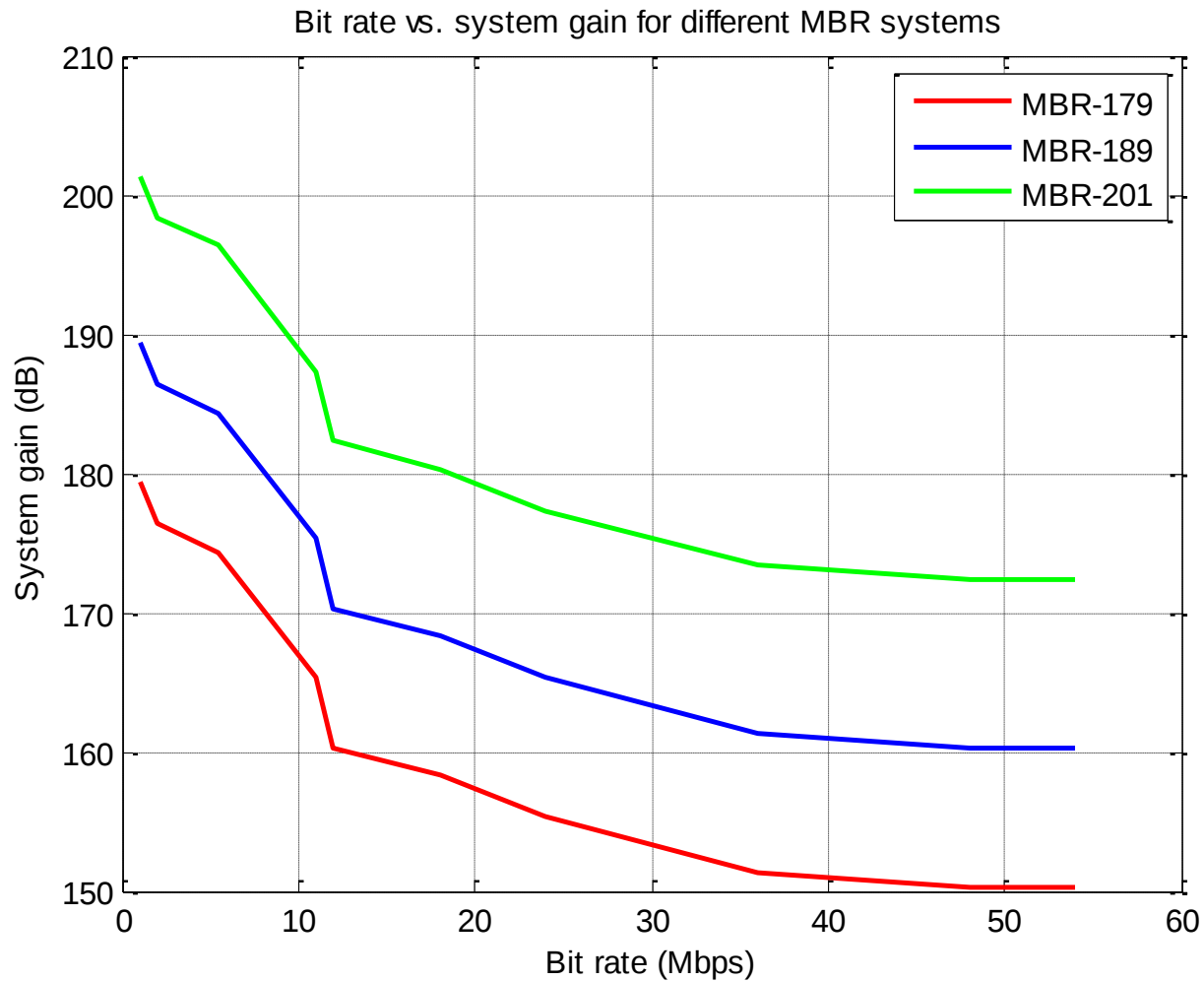
EMBR-201



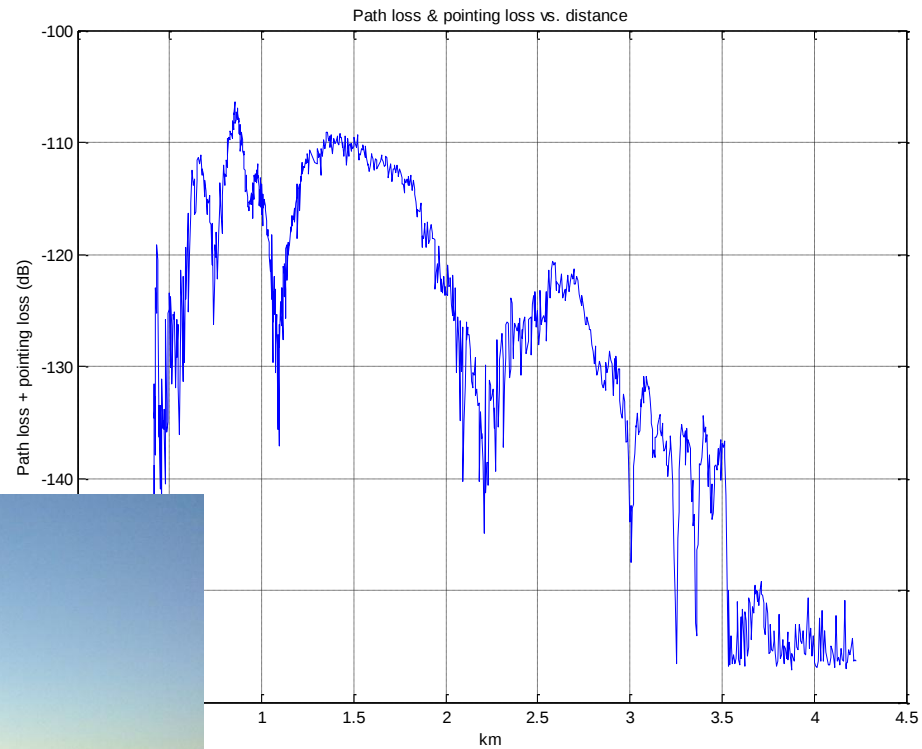
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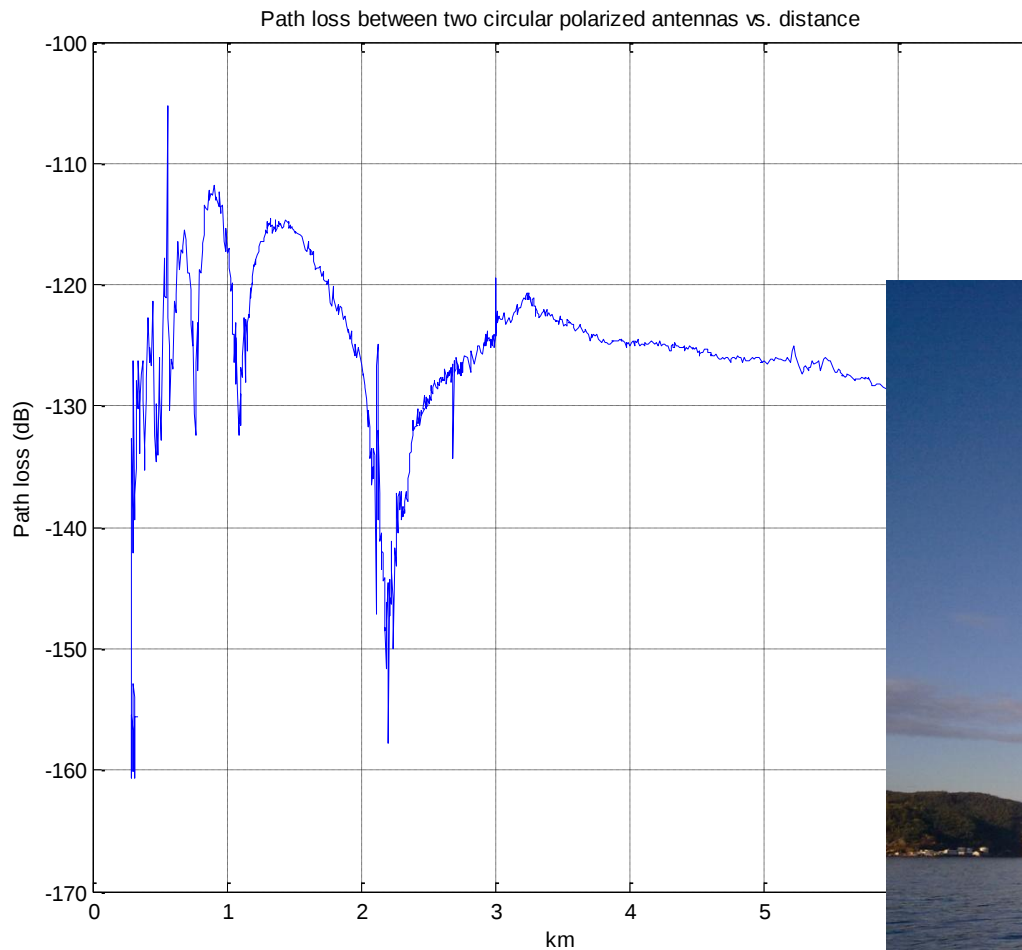
EMBR – System Gain



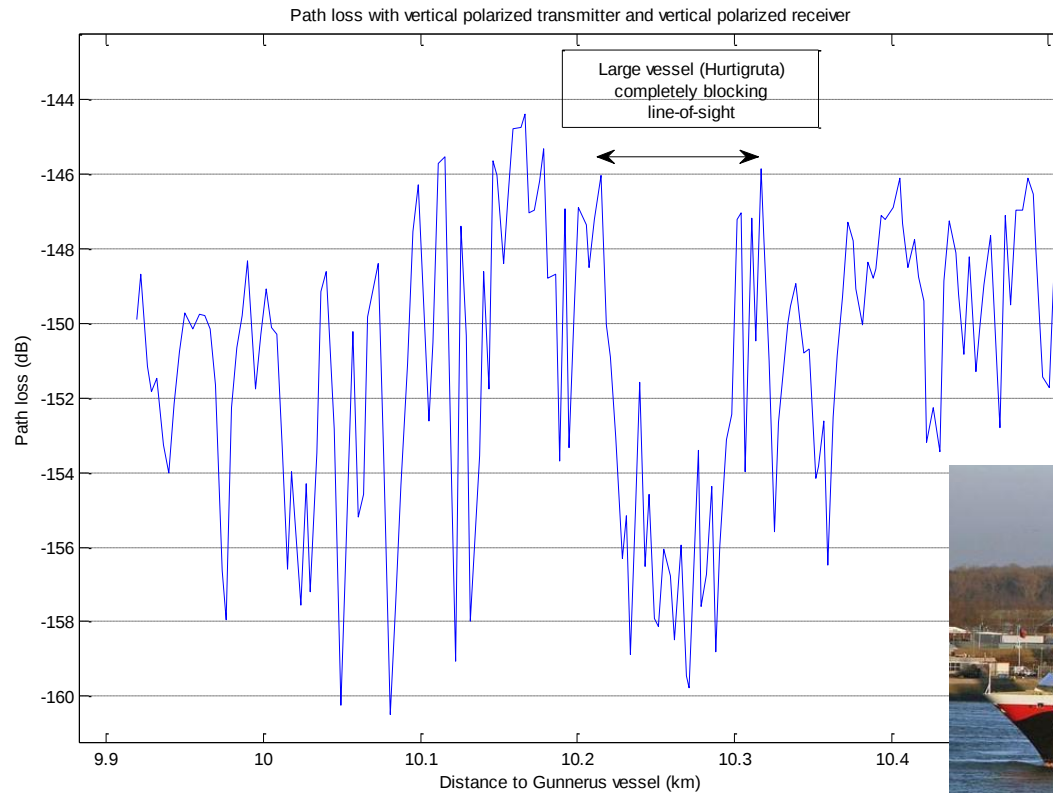
Measurements – path loss



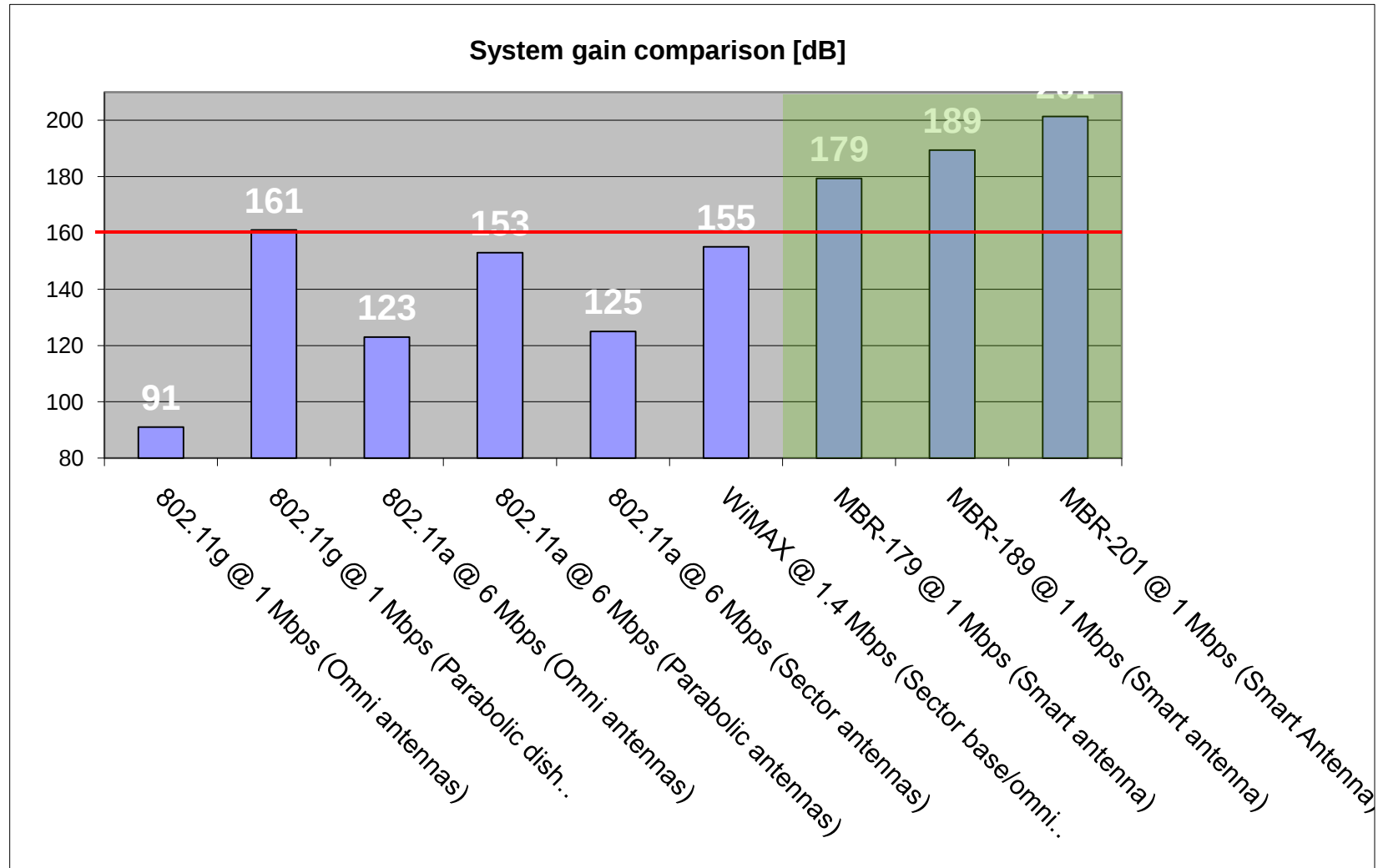
Measurements – path loss



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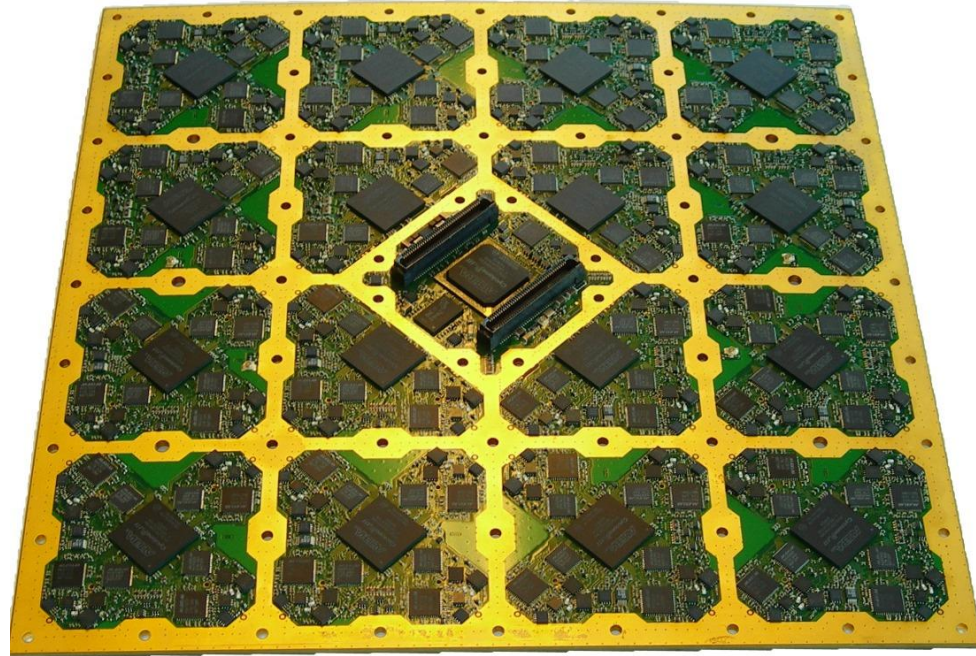


EMBR – System Gain



EMBR – key points

- Smart antenna technology
- Tailored MAC/PHY





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Raw Data rates & sensitivity

- 468 750 bits/sec -102 dBm
- 937 500 bits/sec -99 dBm
- 1 875 000 bits/sec -96 dBm
- 2 500 000 bits/sec -95 dBm
- 3 750 000 bits/sec -93 dBm
- 5 000 000 bits/sec -91 dBm
- 7 500 000 bits/sec -89 dBm
- 10 000 000 bits/sec -88 dBm