

## Presentation-Maritime Broadband Radio

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## KONGSBERG has a long and unique history

Our history spans over two centuries





#### Kongsberg Group Technology is our common core



#### **KONGSBERG DIGITAL**

Maritime simulation Industrial digitalization



#### **KONGSBERG MARITIME**

Seaborne transportation Robotics and Sensors Offshore, Oil & Gas



#### **KONGSBERG DEFENCE & AEROSPACE**

Defence Space and Surveillance



Throughout the entire maritime industry



## MARITIME BROADBAND RADIO

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The Revolution in Marine Interconnectivity

PHASED ARRAY FOCUSED RADIO BEAM

**23(90)**2019



#### Maritime Communication Requirements

A communication solution must...

... be reliable with a minimum loss of data packets

... be designed to work well in a maritime environment

... be able to communicate simultaneously over short and long distances

... work even when signal path is obstructed

... be easy to operate, maintain and install







#### Challenges in maritime communication





• Network topology – Near/far communication

• Flat-sea fading – destructive interference





• Moving vessels – Obstructions

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### Beam forming by antenna arrays

- With a phased array antenna the radio beam can be shaped to increase gain in specific directions
- The beam can be focused instantaneously by software both for transmission and reception



Example of phased array radar antenna found on the Internet



Beam forming radiation patterns



# A smart antenna

- · Combining up to 60 antenna elements in one antenna panel
- · Simulations and experiments used to find optimal geometry
- Enables instantaneous beam forming and spatial addressing
- Compact size
- High gain

Smart antennas are antenna arrays with signal processing used to identify spatial signal signatures such as the direction of arrival of the signal, and use it to calculate beam-forming vectors, to track and locate the antenna beam on the target.





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#### Parallel signal processing

- Massive parallel processing by use of up to 17 FPGAs handling a real-time data stream of 40 Gbps
- Operating in 5 GHz frequency band
- Real-time signal processing
- Up to 60 independent transceivers
- Fail tolerant design





#### Phased array advantage







Conventional radio systems. Radiates in all directions. Limited range, limited bandwidth and easy to monitor and jam.

Phased array radio system. Fast moving directed beam without any moving parts. Long range, high bandwidth, difficult to monitor and jam.

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Phased array advandages



A very high link margin allows for non-line-of-sight communication even in the microwave band because of the refraction effect of radio waves.







#### Facts and numbers





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#### Kongsberg Seatex Radio Product Line





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#### Portable MBR 189/179









#### Dual boarding team pack, MBR 144







#### PERFORMANCE.

**Operational Excellence Through Communication Performance** 

Same and the sam

PHASED ARRAY FOCUSED RADIO BEAM



#### Communication beyond line of sight What determin the range?



#### Communication beyond line-of-sight









#### Communication beyond line-of-sight, vessel to vessel





#### Long range air to ground link performance





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### Long range air to ground link performance







#### Test vessel-vessel and vessel-land



#### 6.3 Test 1 - Vessel to Vessel

The graph below shows the signal strength in db (blue, left axis) and data bandwidth in Mbps (orange, right axis) plotted against range between the two vessels in metres.



From the initial starting range of around 700m the data bandwidth remained fairly constant at around 14.5Mbps until just after 21km when it started to drop significantly. It should be noted that the calculated line-of-sight between the two radios was 12.5km and the full data rate continued well beyond this range.

The signal strength was shown to be reducing in a near-linear fashion down to around 10.5dB which is close to the point where the link becomes unstable. It was estimated that a link could be maintained until around 24km albeit at a lower data rate.

Repeated tests at this limit gave improved data rate results but the signs of instability would suggest that the useable limit had been reached.



#### 6.4 Test 2 - Land to Vessel

This graph shows the results of the second test, between the vessel and the land station at 100m.



Starting at a range of just over 30km with full data rate (14.7 Mbps) the data rate remained above 14Mbps until the trial was terminated at 46km with a data rate still at 14.5Mbps) the signal strength had fallen but only to 23.5dB. This indicates that the calculated range of 48km appears achievable with full data rate or even beyond.





18

16

14

12

10

76\*W

#### MBR – Silvus comparison



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### Worlds first fully autonomus pipeline inspection.



#### Assets



Hugin UUV





Simrad Echo used as «USV». MBR 179 installed together with HIPAP for coms with Hugin MBR 189 installed on the mountain Ulriken. (640 meter antenna height)

#### Area of operation.





Coverage of the MBR marked with green.

Distance for operation marked in red.

Operation conducted twice.

MBR at Ulriken connected to internet/VPN to operation room.

Whole operation monitored in real time

## MBR IN SOME OPERATION.

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Sales and a

PHASED ARRAY FOCUSED RADIO BEAM

## Norwegian Coast Guard





#### Coast Guard set up Norway

Air craft, land, vessels, Inspection kits and drones.











#### Boarding team to mother vessel (first test in 2012)





#### Ground installations



#### Reinsfjell

#### Ulriken

#### Gaustadtoppen



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# Ground installations, air to ground coverage







#### Coverage at 15 000 feet AGL



## Coverage at 4 000 feet AGL (Standard mission altitude)

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## NAVSEA – NSCW Carderock – Stilletto



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#### Live Stream from Stiletto and RHIB – recorded in T.O.C.







#### **Offshore Patrol & Surveillance**



NATO Counter- Piracy Mission: **Operation Ocean Shield, Aden.** 

Real time video, boarding-team, frigate

- Safety
- Effectiveness
- Report/documentation















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#### Tested MBR on Valiant Shield (Guam) and swarm excersice. MARTAC will use MBR as primary comms on their vessels

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#### **Military Operations – Common Operating Picture**





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#### Demonstrated ranges.

- 40-70 km from vessel to vessel
- 130-150 km from aircraft to vessel at 2000-4000 feet aircraft altitude
- 210 km from aircraft to vessel at 10 000 feet aircraft altitude
- 200-275 km from aircraft to ground stations at 10000-15000 feet aircraft altitude

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• 60 km from aircraft to portable equipment



"The wireless network tested in the pilot project has demonstrated outstanding range, stability and bandwidth. The positive operational effects from sharing sensor data in coordinated operations have been significant."

Commander Ole Thorsen, The Norwegian Coast Guard

#### Conclustion



- Reliable, robust and highly dynamic communication system
- Long range and high throughput
- IP oriented
- Small and compact, easy to install

.

- For all type of applications
- You own the system and data

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## IF YOU ONLY FOCUS ON THE PROBLEM









#### Thank You, Questions?

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