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Telemetry Using IEEE802.11g for Monitoring Target Ships

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Outline

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Motivation

- The genesis of this project was the interest of the Portuguese Navy (PON) in measuring physical parameters over long distances.

- These parameters were the result of a missile impact on a naval platform (decommissioned ship).

Objectives

- **Understand** and **define** which **physical parameters** should be **measured**;
- **Design** and **assemble** a **low cost system** capable of performing telemetry over long distances;
- **Test** the **system** in close to real conditions.

System's Layout

The system can be divided into two parts:

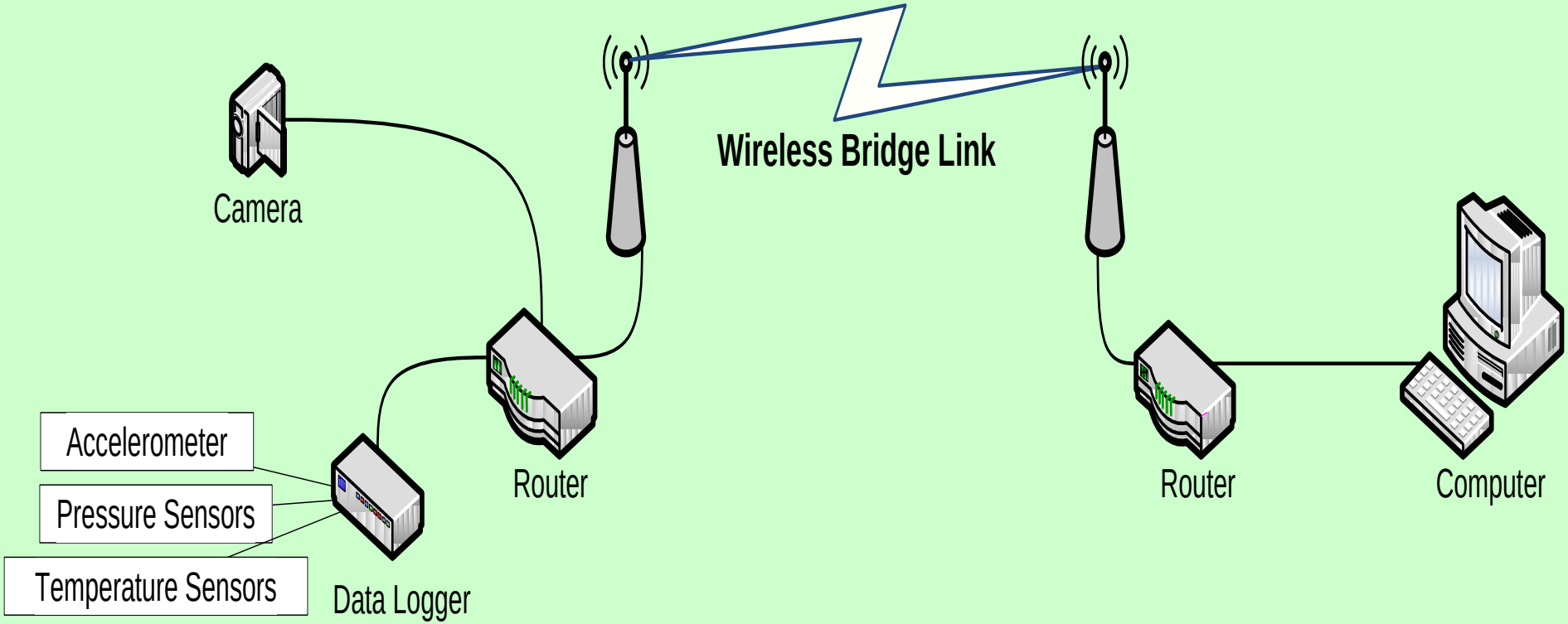
1. Wireless communication;
2. Data gathering.

1. Wireless communication → IEEE802.11g standard (compatible with LAN's, common routers with wireless, amplifiers and antennas).

2. Data gathering → Dataloggers (associated with sensors) with LAN interface, high resolution and high sample rate.

System's Layout

A **video camera** was **added** to **record** some **images** from the **impact** (in the measuring station).



System's Layout

Based on "Off-the-shelf" equipment:

Routers: Linksys model WRT54GS V7

Amplifiers: Hyperlink Technologies model DS HA2402GX-NF

Antennas: Ferimex model OMNI H

Data loggers: Data Instrument model DI-710-EL

Digital camera: Trendnet model TV-IP 100

Tests

In order to prove the measurement concept, two tests were made:

- Laboratory tests to all equipment in order to verify their own specific characteristics;

- Some tests were made to validate the system in similar conditions to real situations.

Laboratory Tests

- **Routers' output power**
  - Using a Spectrum Analyzer

To confirm the output power

- **Amplifiers' output power**
  - Using a Spectrum Analyzer

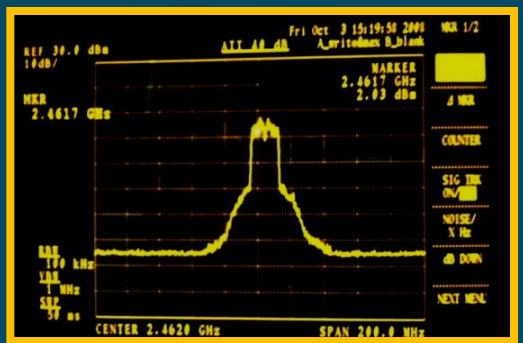
To confirm the amplifier´s output power

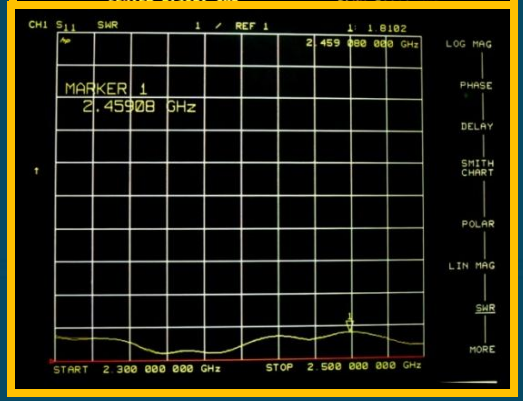
- **Antenna's frequency response**
  - Using a Network Analyzer

To select the best IEEE802.11g channel to work with

Laboratory Tests

- **20dBm** of output power
- **13dB** of amplification
- Best channel was number **11**





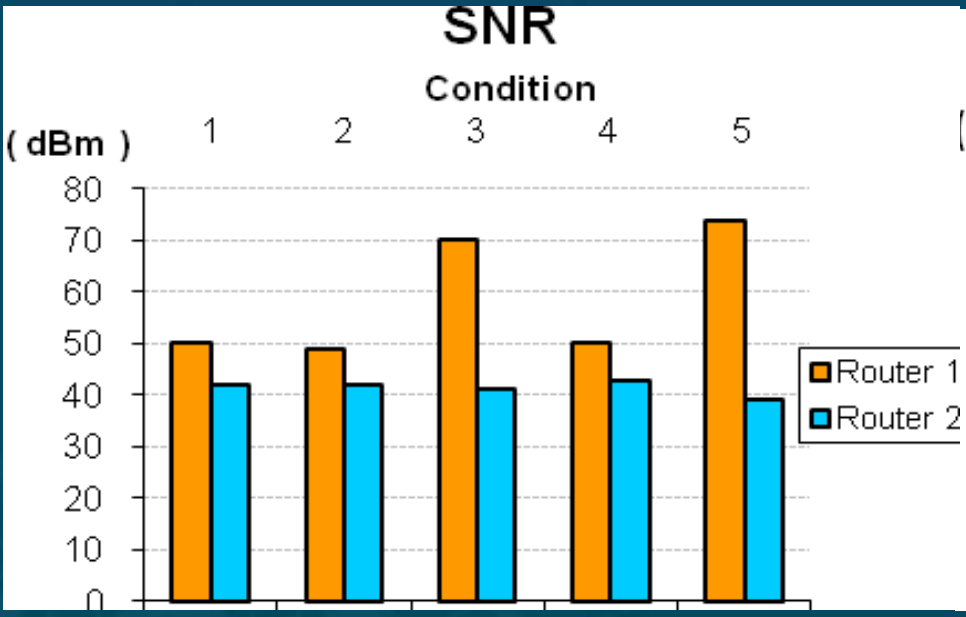
Laboratory Tests

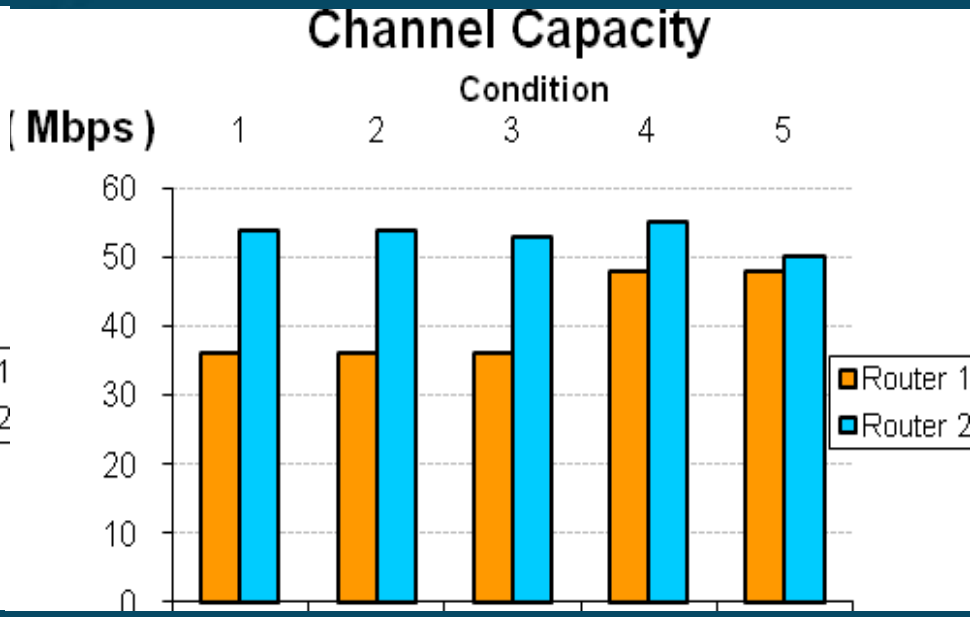
Five different **configurations** were **tested** to choose the best antenna arrangement.

CONFIGURATION	ROUTER 1 ANTENNAS		ROUTER 2 ANTENNAS	
	Right	*Left*	*Right*	*Left*
1	TX/RX	OFF	TX/RX	OFF
2	AUTO	AUTO	AUTO	AUTO
3	OFF	TX/RX	OFF	TX/RX
4	TX/RX	OFF	OFF	TX/RX
5	OFF	TX/RX	TX/RX	OFF

Laboratory Tests

The best antenna configuration is configuration number 5

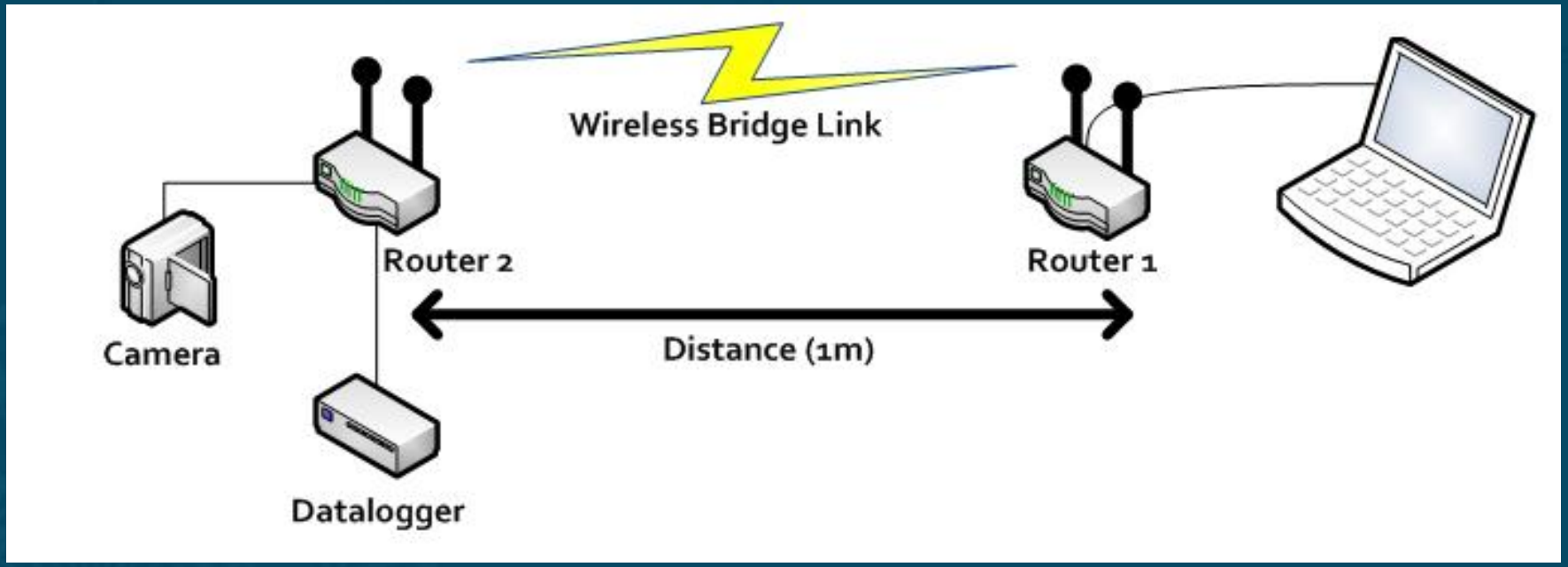




CONFIGURATION	ROUTER 1		ROUTER 2	
	Right	*Left*	*Right*	*Left*
5	OFF	TX/RX	TX/RX	OFF

Laboratory Tests

A series of **tests** were made in order to determine the **required bandwidth**, using the following setup:

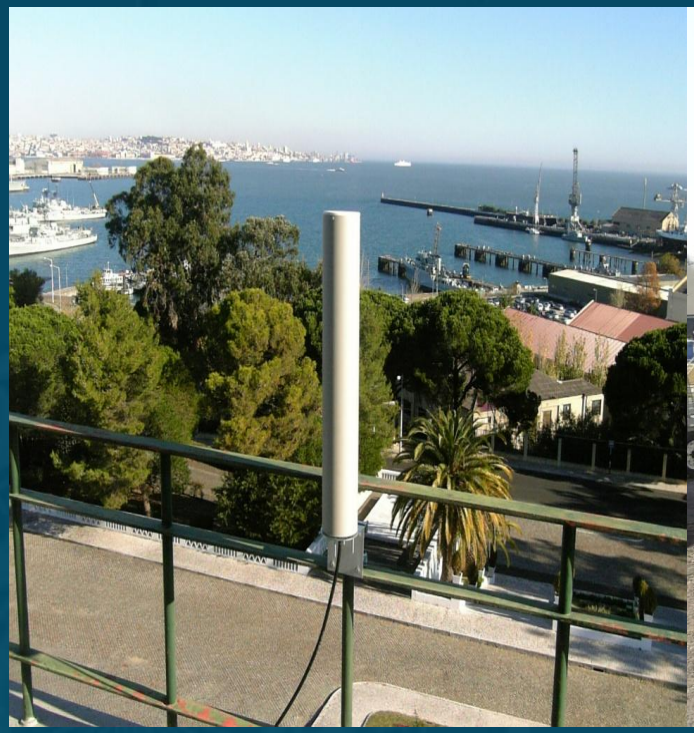


Data: 15 KB/s

Video: 200 KB/s

Sea Tests

The test was carried out in the "Tagus estuary" using the Academy's sea training boats in mild weather conditions



Sea Tests


Pos4
Pos3
Pos2
Pos5
Pos1
Torre
7.50 Km
Image © 2008 DigitalGlobe
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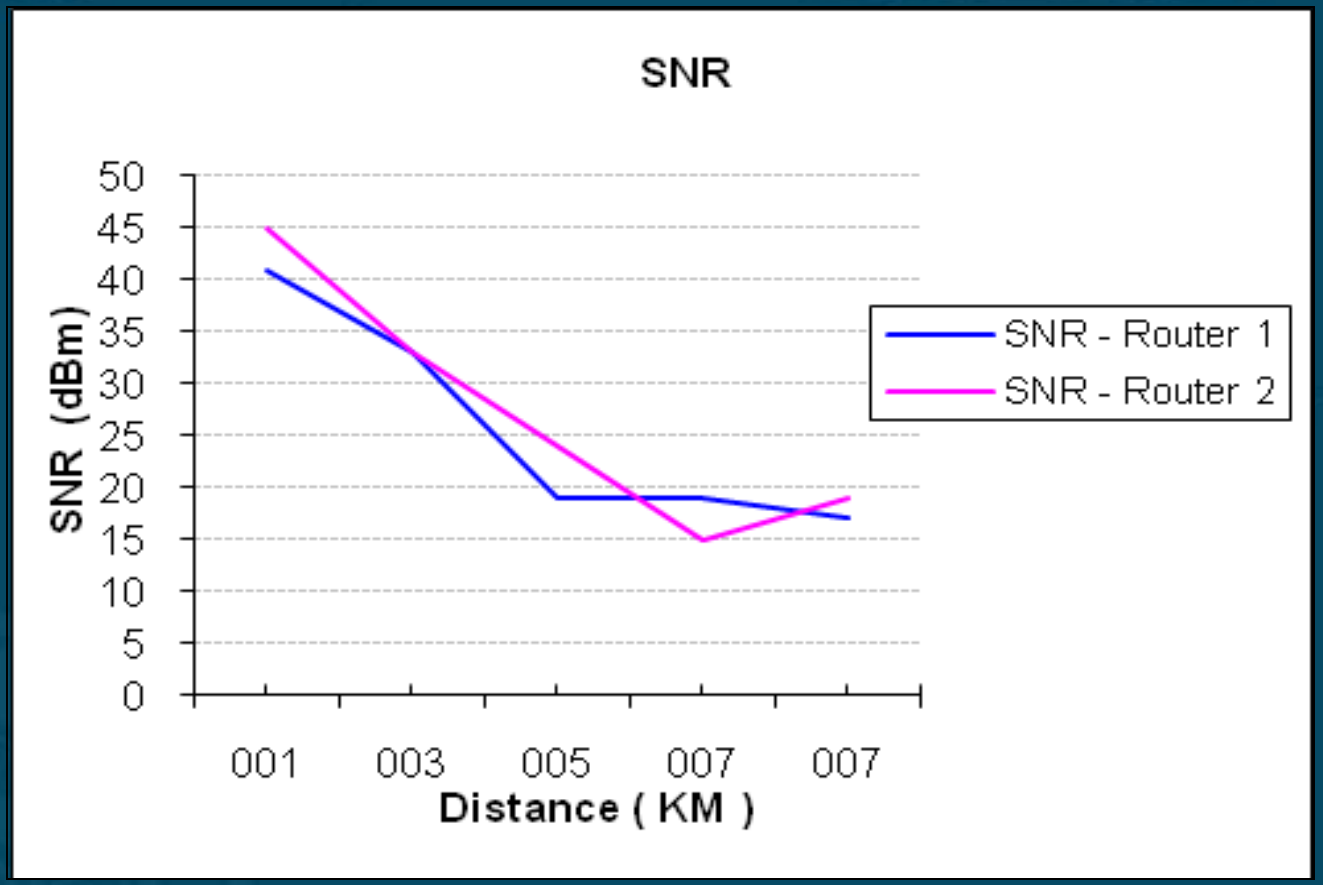
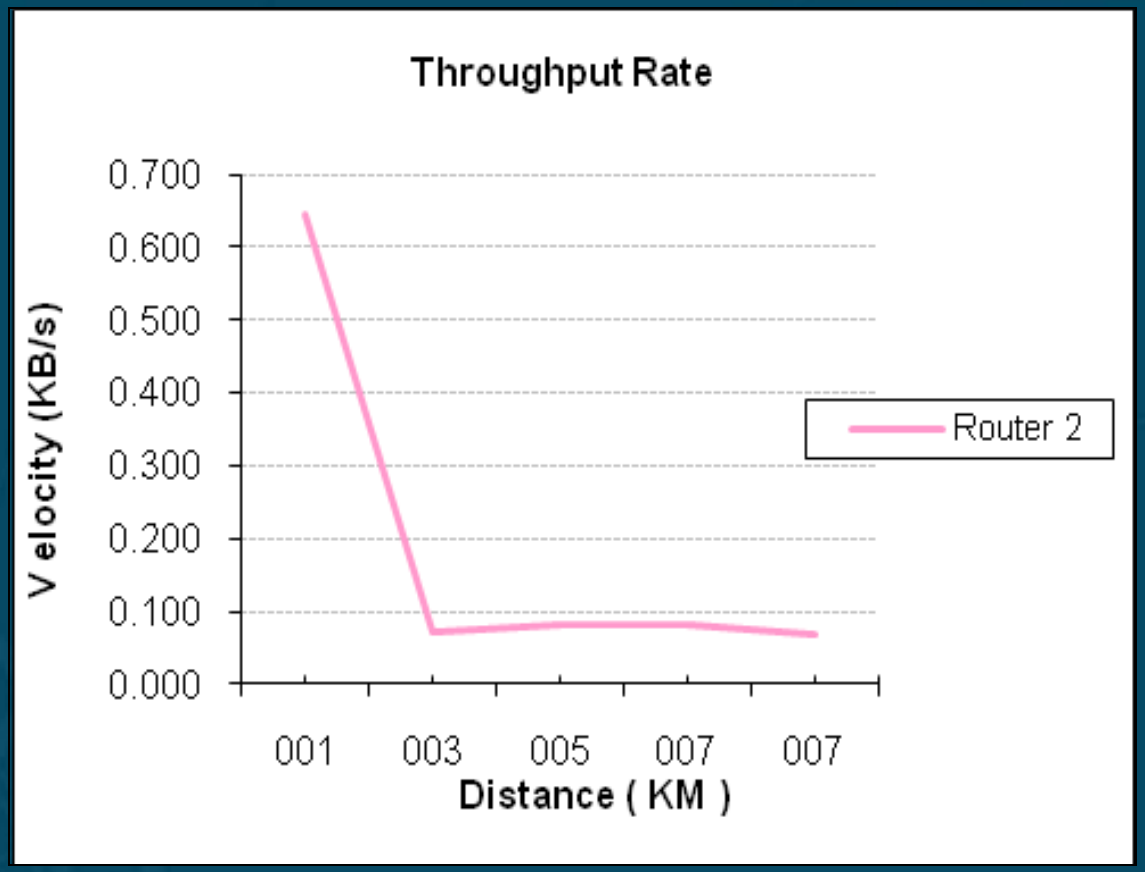
Sea Tests



At **7.49 km**, the signal has a level of **-74 dBm** for **router 1**, and **-75dBm** for the other.

Sea Tests



At **7.49 Km** throughput was **68 KBps** (**544 Kbps**)

Conclusions

- This work highlights the potential of Wi-Fi technology in data transmission over long distances;
- Increasing transmission power, higher distances can easily be achieved;
- The available bandwidth at 7.49 Km allows the transmission of data but not of video.




Future Work

✓**Test** the system at **high sea**;

✓**Construct** a **high-gain directional antenna** for use on the monitoring ship;

✓Finally, a lot of work must still be done in **analyzing the data collected by the sensors**, and in **optimizing the sensors and sensor layout**.

Questions

The End