CISTER
Research Centre in
Real-Time & Embedded
Computing Systems

Poster

Wi-Fi-based network systems design over freshwater: Experimental evaluation using COTS devices

Miguel Gutiérrez Gaitán
Pedro Miguel Santos
Luis R. Pinto and Luis Almeida

CISTER-TR-200204

Wi-Fi-based network systems design over freshwater: Experimental evaluation using COTS devices

Miguel Gutiérrez Gaitán, Pedro Miguel Santos, Luis R. Pinto and Luis Almeida

CISTER Research Centre

Polytechnic Institute of Porto (ISEP P.Porto)

Rua Dr. António Bernardino de Almeida, 431

4200-072 Porto

Portugal

Tel.: +351.22.8340509, Fax: +351.22.8321159

E-mail:

https://www.cister-labs.pt

Abstract

Wi-Fi-based network systems design over freshwater: Experimental evaluation using COTS devices

CISTER – Research Centre in Real-Time & Embedded Computing Systems

Miguel Gutiérrez Gaitán*, Pedro M. Santos*, Luis R. Pinto† and Luis Almeida*
CISTER*, FEUP, University of Porto, Portugal
IPFN†, Instituto Superior Técnico, Lisboa, Portugal
{mjggt,pss}@isep.ipp.pt, lpinto@ipfn.tecnico.ulisboa.pt, lda@fe.up.pt

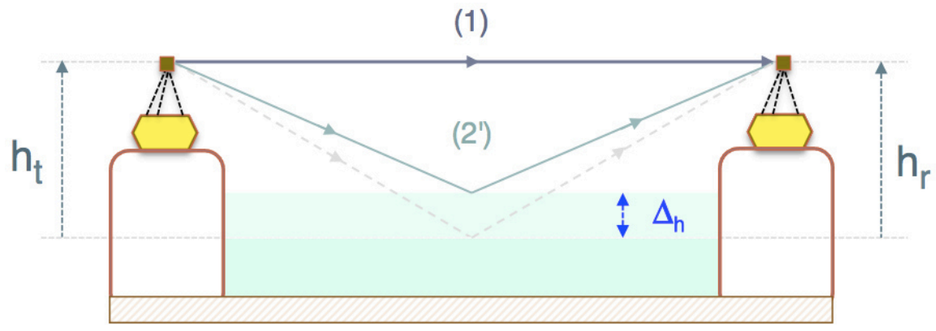
Motivation

- In the design of **shore-to-shore** and **shore-to-vessel** links, the impact of the signal reflections on the surface is often neglected.
- When choosing an antenna height for an inshore node, a typical decision is to use the **largest possible height**; but, this approach can lead to signal degradation.

Objective: To experimentally assess the impact of surface reflection on the received signal strength of a set of short-and-medium-range shore-to-shore links (<200 m) that use antennas installed at two heights, at a few meters above surface (<3 m).

Two-ray model

- The **two-ray** is the most fundamental path loss model to account for the influence of signal reflections on the received power [1].
- This condition gets further aggravated at near-shore areas as **tides** impose a variation of the reflection geometry over time [2].

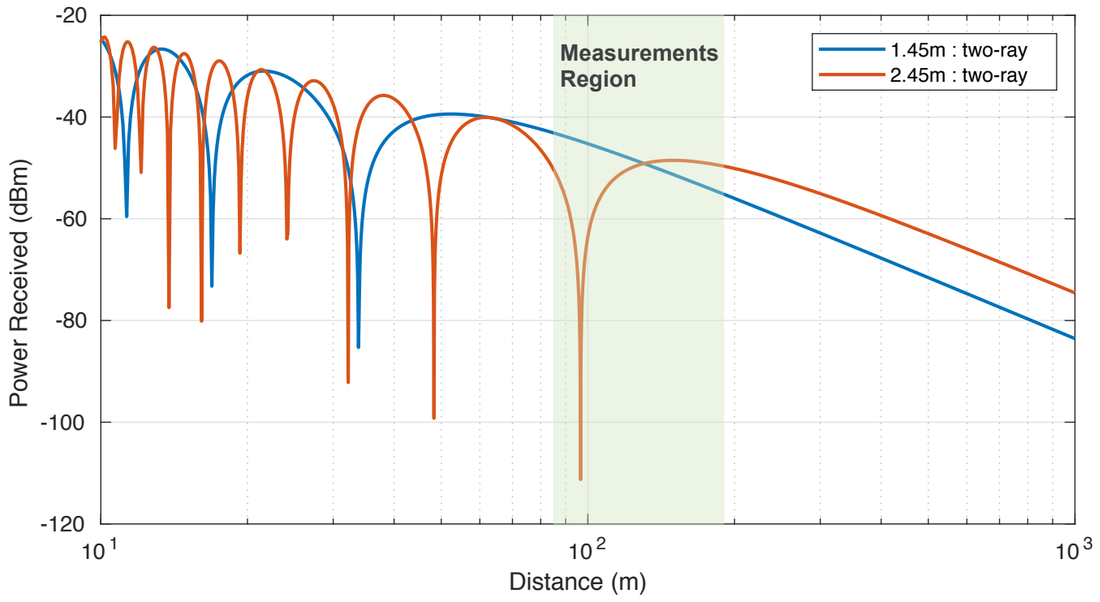


Two-ray model at two different time instants

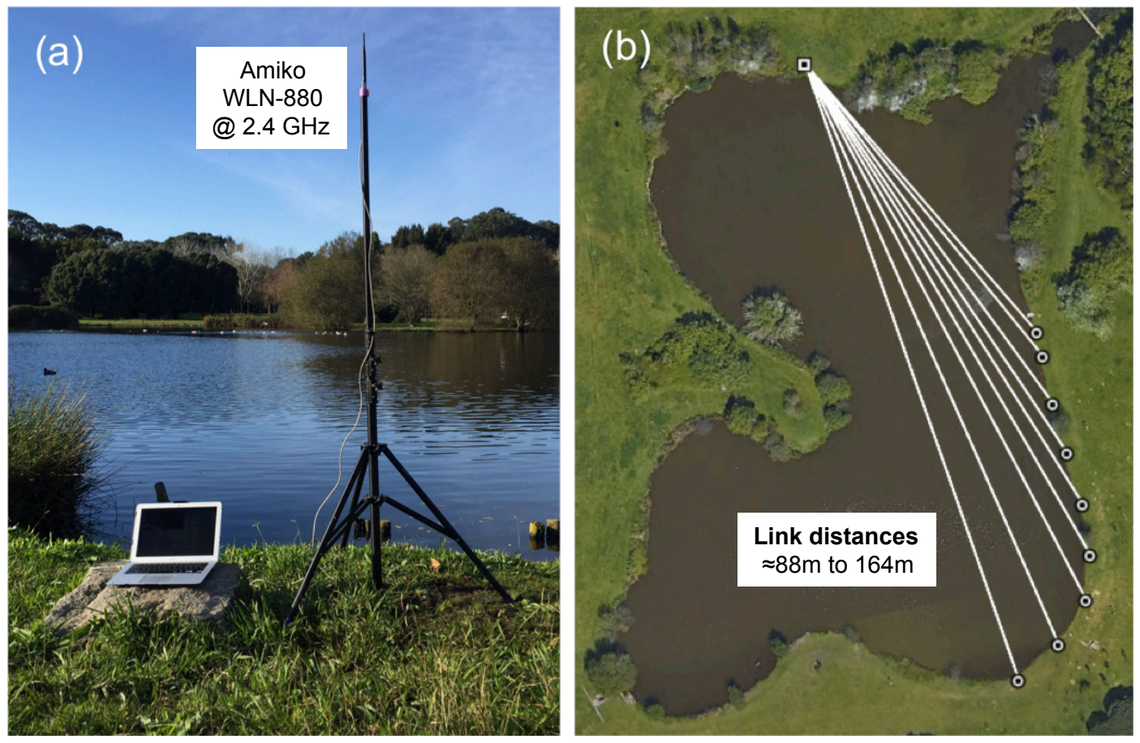
$$P_r = \frac{\lambda^2}{(4\pi d)^2}\left[2\sin\left(\frac{2\pi h_t h_r}{\lambda d}\right)\right]^2 P_t G_t G_r$$

Simulation results

- In the set of link distances and antenna heights that we explore, the **two-ray model** predicts the occurrence of strong path loss attenuation (due to the reflected ray) at well-defined distances.

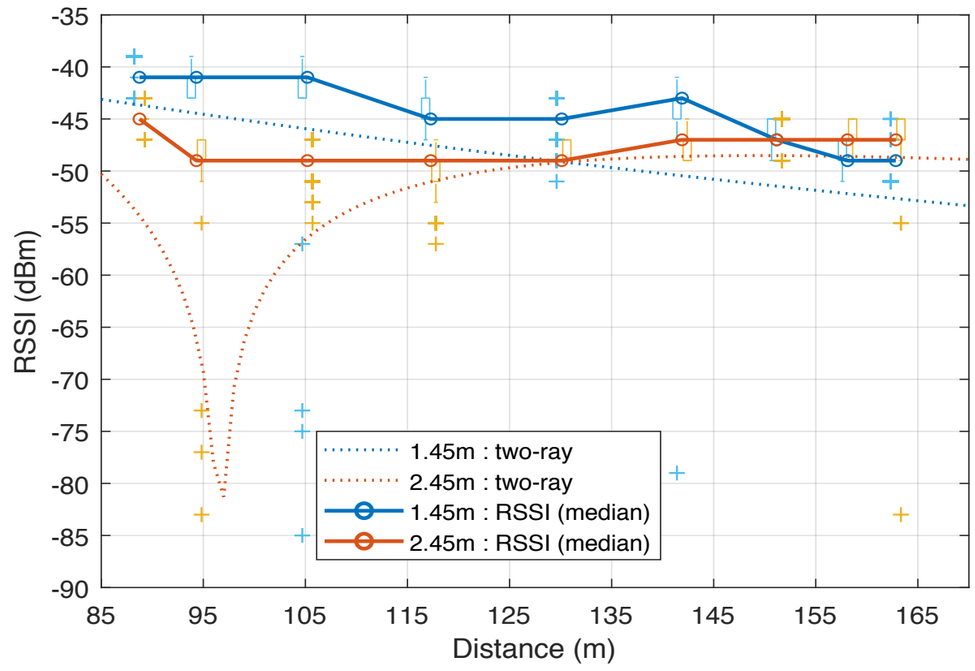


Testbed



The experimental setup showing: (a) a representative node deployment at the actual location, and (b) the set of links and nodes positions evaluated.

Experimental Results



Two-ray model (dotted) vs. RSSI measurements at different link distances and antenna heights (boxplot); with median points connected (solid).

Conclusion & Future work

- We observed **considerable consistency** between packet-based measurements of RSSI and the two-ray model estimates.
- These results provide strength to the claim that both the **two-ray model** and **antenna height adjustment** are key building blocks for effective design of over-water links in coastal environments.

References

[1] T. Rappaport, Wireless Communications: Principles and Practice. USA: Prentice Hall PTR, 2nd ed., 2002.

[2] M. Gutiérrez Gaitán, L. Pinto, P. M. Santos, and L. Almeida, “On the two-ray model analysis for overwater links with tidal variations,” in 2019 Proceedings of the 11th National Symposium on Informatics (INForum), 2019.

Co-financed by UIDB/04234/2020 (CISTER) and project PTDC/CCI-COM/30142/2017 (AQUAMON)

FCT Fundação para a Ciência e a Tecnologia

CISTER Research Centre
ISEP, Polytechnic Institute of Porto
Rua Dr. Antº Bernardino de Almeida, 431
4249-015 Porto, Portugal

+351 228 340 502
www.cister-labs.pt
info@cister-labs.pt
facebook.com/cisterlabspt

isep Instituto Superior de Engenharia do Porto
P.PORTO

U.PORTO
FEUP FACULDADE DE ENGENHARIA UNIVERSIDADE DO PORTO