



Mellios, E., Hilton, G. S., & Nix, A. R. (2010). Optimising radio coverage for wireless media servers. In Antennas and Propagation Conference (LAPC), 2010, Loughborough. (pp. 233 - 236). Institute of Electrical and Electronics Engineers (IEEE). 10.1109/LAPC.2010.5666166

Link to published version (if available):  
[10.1109/LAPC.2010.5666166](https://doi.org/10.1109/LAPC.2010.5666166)

[Link to publication record in Explore Bristol Research](#)  
PDF-document

## University of Bristol - Explore Bristol Research

### General rights

This document is made available in accordance with publisher policies. Please cite only the published version using the reference above. Full terms of use are available:  
<http://www.bristol.ac.uk/pure/about/ebr-terms.html>

### Take down policy

Explore Bristol Research is a digital archive and the intention is that deposited content should not be removed. However, if you believe that this version of the work breaches copyright law please contact [open-access@bristol.ac.uk](mailto:open-access@bristol.ac.uk) and include the following information in your message:

- Your contact details
- Bibliographic details for the item, including a URL
- An outline of the nature of the complaint

On receipt of your message the Open Access Team will immediately investigate your claim, make an initial judgement of the validity of the claim and, where appropriate, withdraw the item in question from public view.

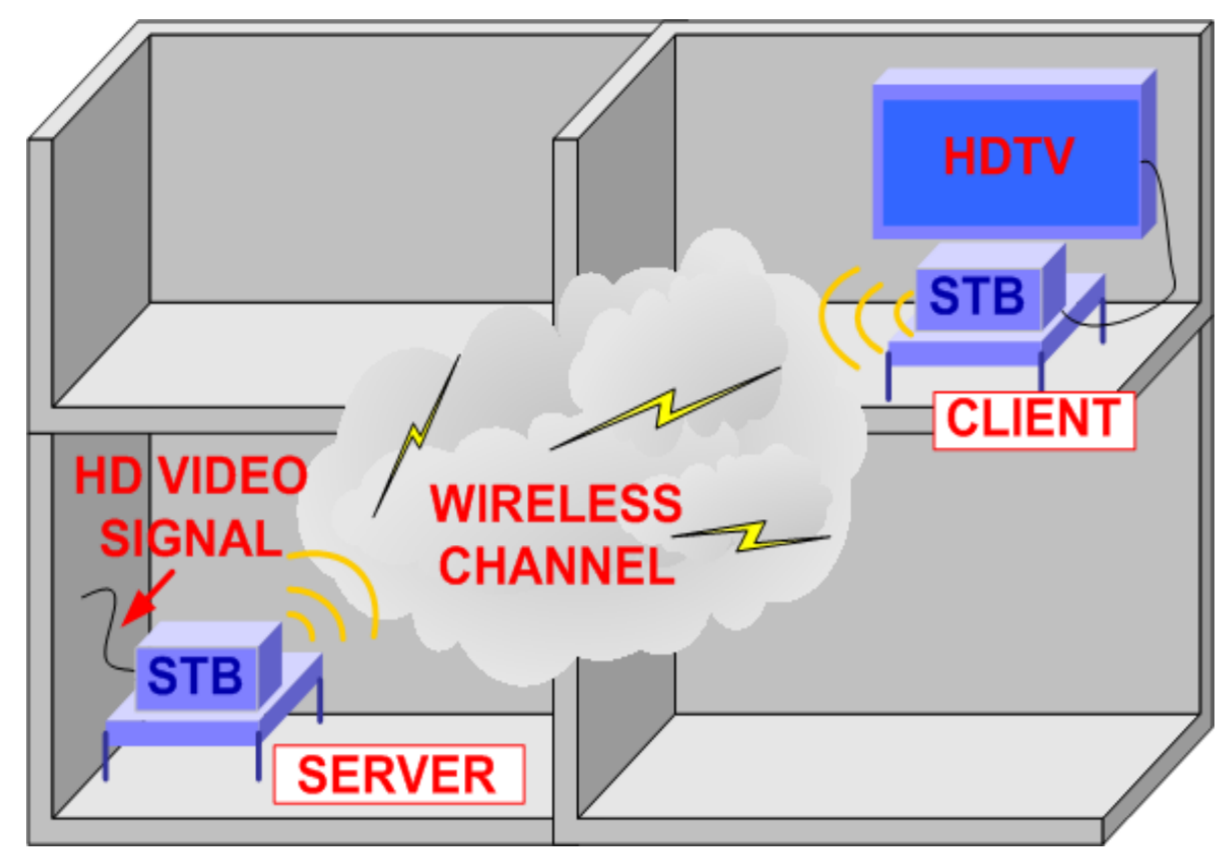
# Optimising Radio Coverage for Wireless Media Servers

Evangelos Mellios, Geoff Hilton, Andrew Nix; Centre for Communications Research, University of Bristol. Contact – Evangelos.Mellios@bristol.ac.uk

**Aim :** System level analysis of the performance of a three element patch antenna array for a 2x3 802.11n wireless home media server application for High-Definition video streaming at 2.4GHz.

## Introduction

- With the imminent switch-off of analogue television and the recently developed IEEE 802.11n standard for WLANs, which employs multiple antennas and promises data rates up to 600Mbps, a new market is emerging for wireless home media servers; these are devices that connect to a Set-Top-Box and enable the wireless delivery of the video signal around the home.
- Directional patches may be chosen over the widely used in MIMO WLANs omnidirectional antennas, as with a typical position of the box being at the edge of a room the antenna beam can be used to illuminate the room.

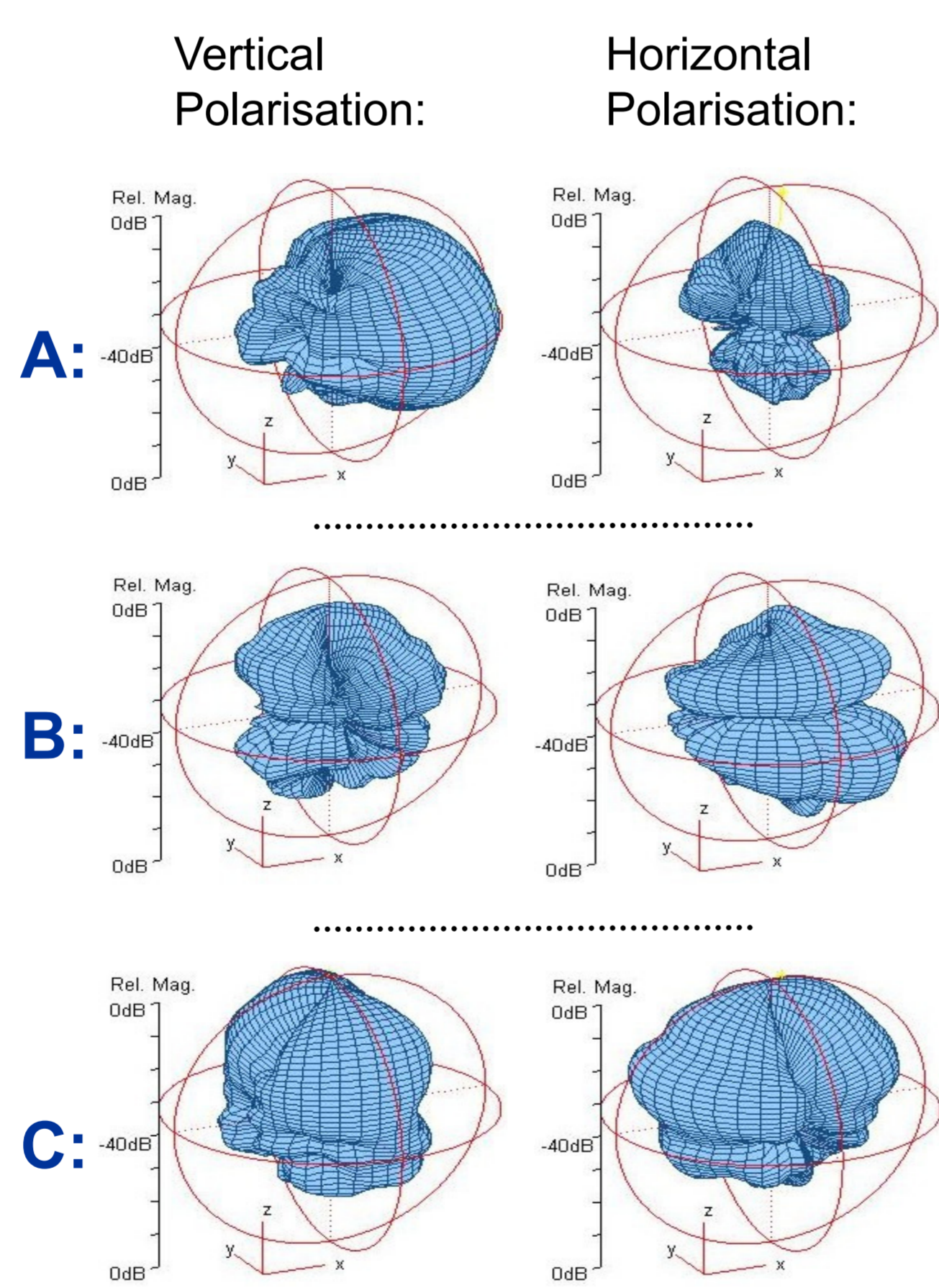
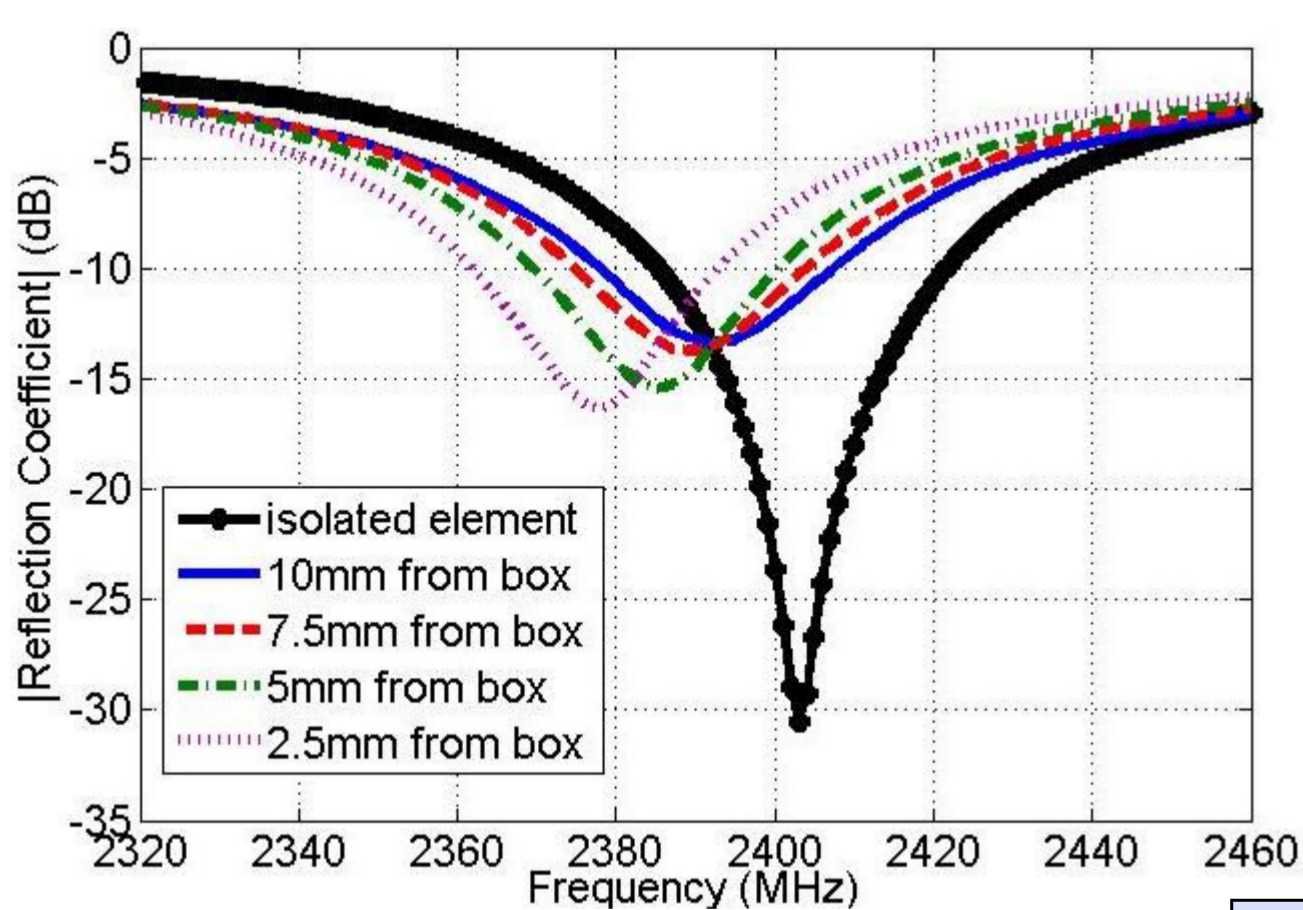
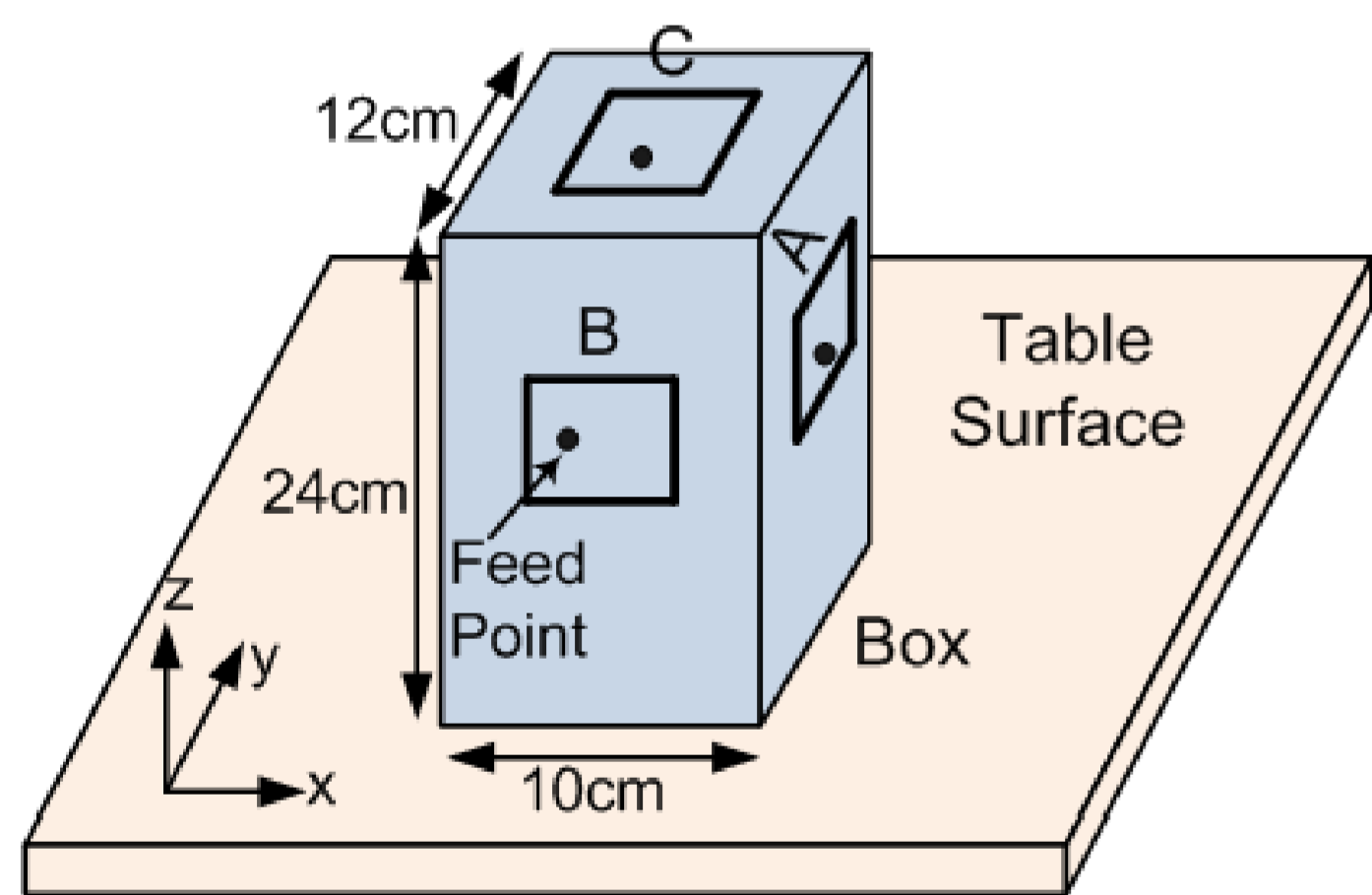


## Patch antenna substrate choice and efficiency

- RT/Duroid 5880 ( $\epsilon_r=2.2$ )  
Relative to a monopole measured efficiency: ~80%
- FR4 ( $\epsilon_r\sim 4.5$ )  
Relative to a monopole measured efficiency: ~40%
- Cost-efficiency trade-off: The use of the RT/Duroid substrate results in a 3dB improvement in performance over the significantly cheaper FR4
- HD video streaming applications: High demands in terms of throughput and packet-error-rate

## Antenna input responses and radiation patterns

- Response for a three element array with RT/Duroid substrate



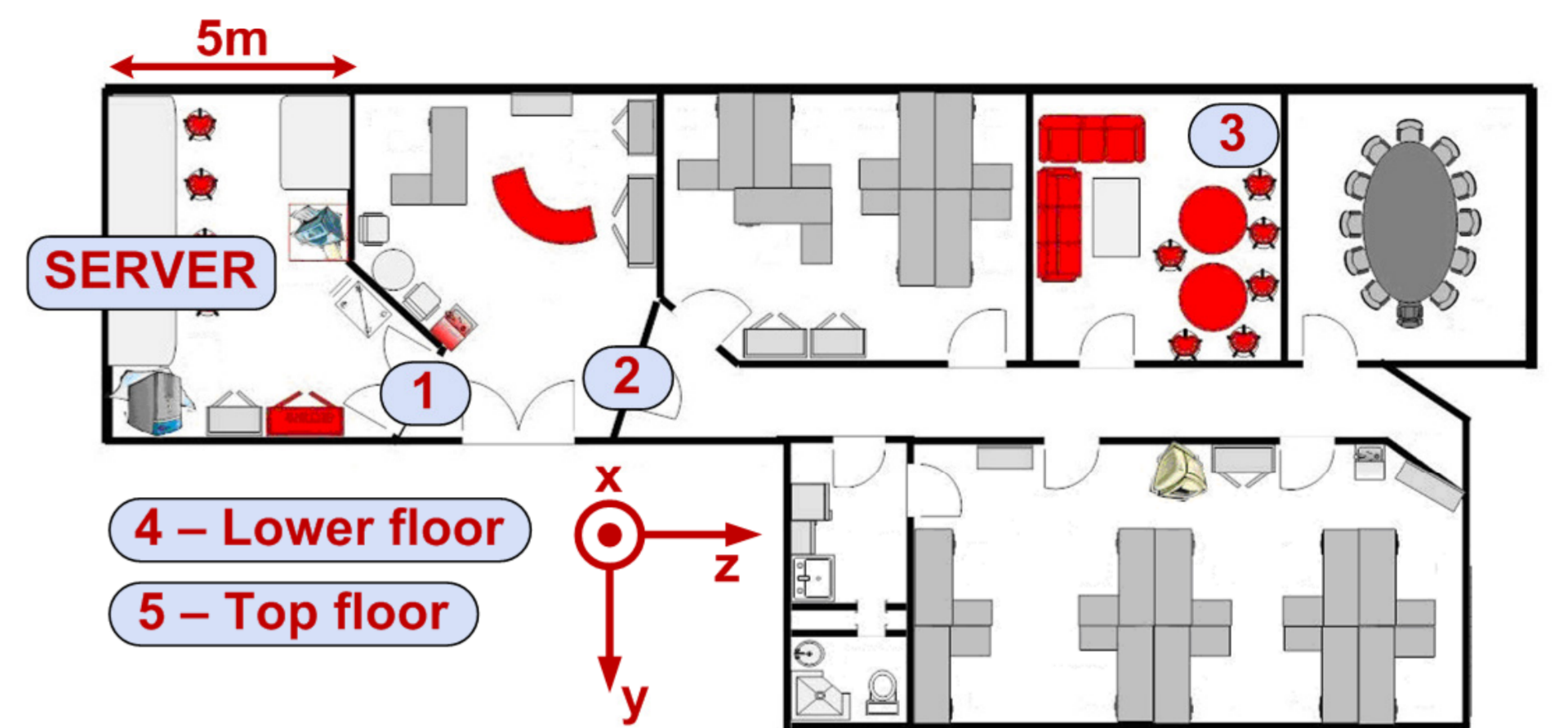
Element	Power in Polarisation (%)		Maximum Directivity (dBi)	
	Vertical	Horizontal	Vertical	Horizontal
A	95	5	7.6	-3.6
B	24	76	3.4	11.2
C	46	54	7.1	7.3
Isolated	98	2	8.0	-8.8

**Effect of box and table:**

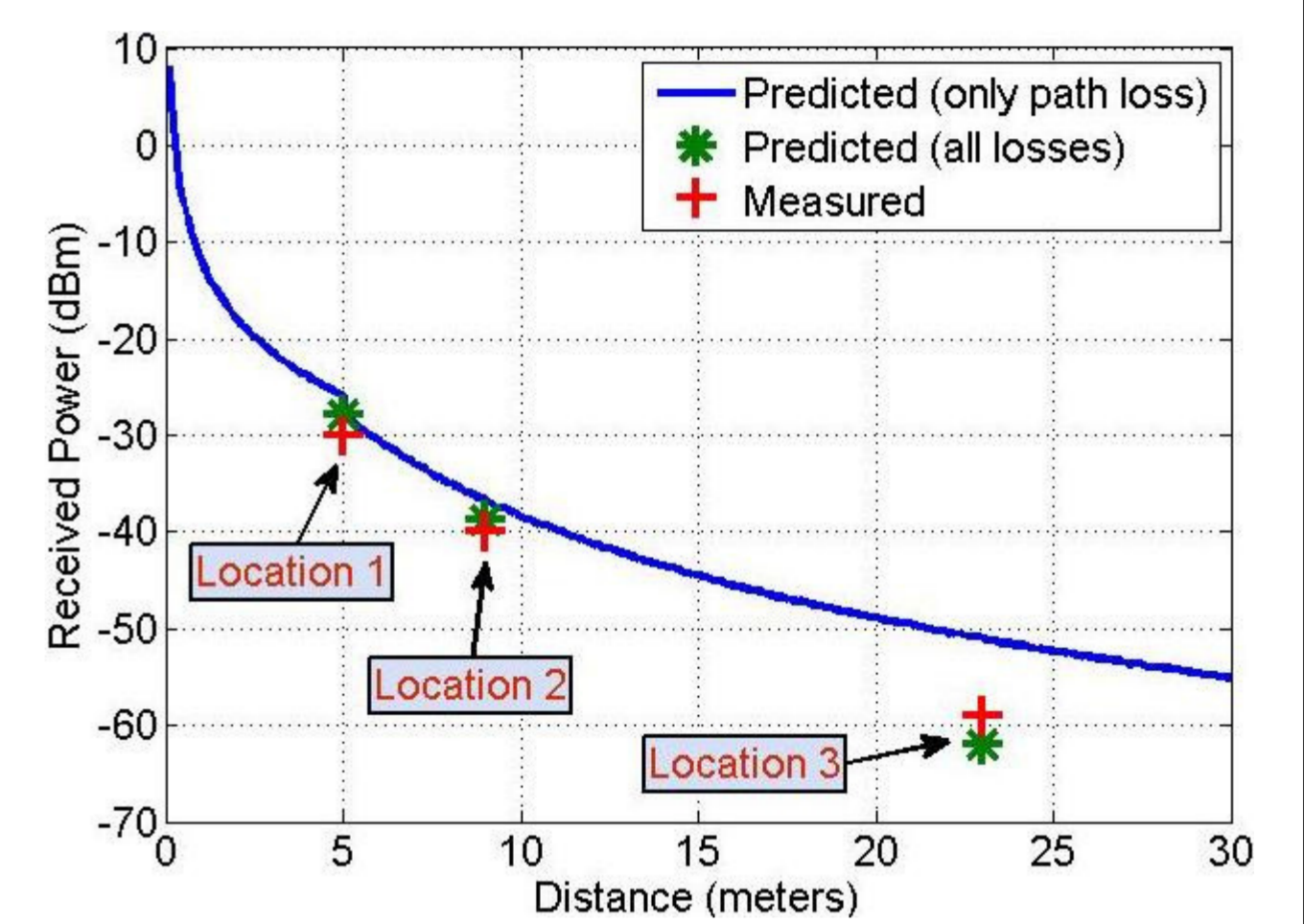
- Antennas detuned by ~20MHz
- 'Identical' elements produce significantly different patterns and directivities

## Measured system performance for an office environment

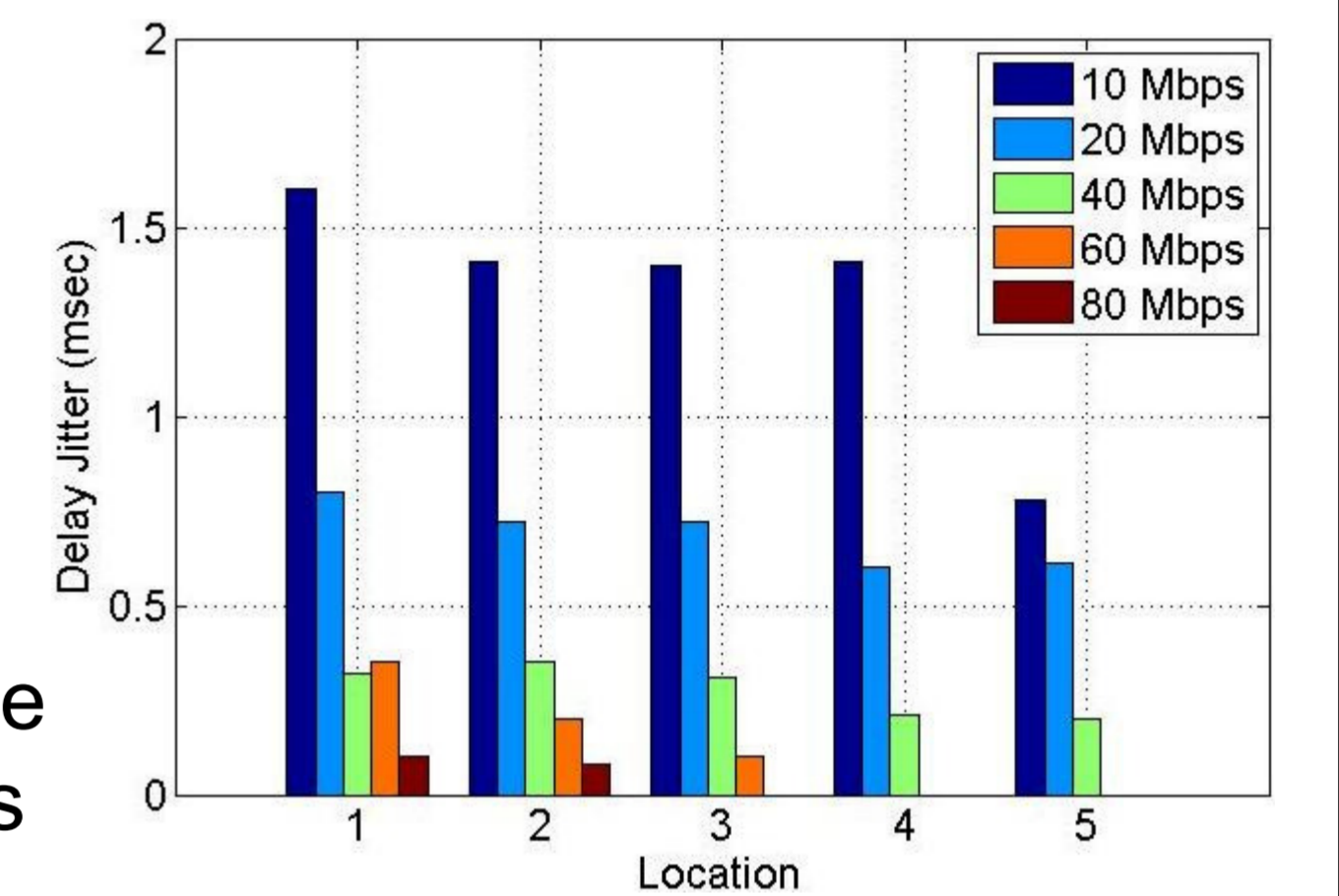
- 2x3 802.11n radio card in spatial multiplexing mode (server antennas B and C)
- Received power measured automatically by radio card; throughput and delay jitter using 'Iperf' (UDP protocol)



- Received power:
  - Predicted link-budget:  
 $P_R = P_T + G_T - PL + G_R - L_{cables} - L_{walls}$   
 $(P_T=12\text{dBm}; G_T=G_R=8.3\text{dBi}; L_{cables}=2\text{dB}; L_{walls}=3\text{ dB/wall}; PL=\text{Path loss from TGn channel models})$
- Throughput:
  - MAC layer (datagram-error-rate<10%)
  - Satisfying coverage possible in the whole office area (10-20Mbps normally necessary for HD video streaming applications)



Throughput (Mbps)	Locations				
	1	2	3	4	5
80	80	60	40	40	40



- Delay jitter:
  - Small values of delay jitter – unlike to cause problems in HD video streaming applications

Results presented here are only for the 'best' orientation of the box in every location. Measurements for a large number of different box orientations in every location demonstrated differences of up to 18dB in the received power and up to 40Mbps in throughput.

## Comparison with omnidirectional antennas

		Locations				
		1	2	3	4	5
Received Power (dBm)	Omnidirectional	-29	-39	-60	-60	-61
	Patches	-30	-40	-59	-71	-70
Throughput (Mbps)	Omnidirectional	80	60	40	60	60
	Patches	80	80	60	40	40

- Better performance with patch antennas on the same floor
- Poorer performance on top and lower floors (cannot achieve full 3D coverage)

## Conclusions

- Efficiency comparison: The use of the RT/Duroid substrate results in a 3dB improvement in performance over the significantly cheaper FR4
- Significant impact of box and table mounting on input responses, radiation patterns and directivities – needs to be accounted for when designing antennas
- Satisfying coverage for HD video streaming in the whole office area (data rate at least 40Mbps) – Performance depends heavily on the box orientation (up to 40Mbps throughput differences)
- Better performance than omnidirectional antennas on the same floor but poorer on top and lower floors
- Antenna selection in future designs: Beneficial to overcome the problems of unpredictable box orientation and poor three-dimensional coverage

### Acknowledgments:

The authors wish to acknowledge Provision Communication Technologies Ltd.

