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Graphene meandered dipole antenna for low-cost and flexible RFID application

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Outline

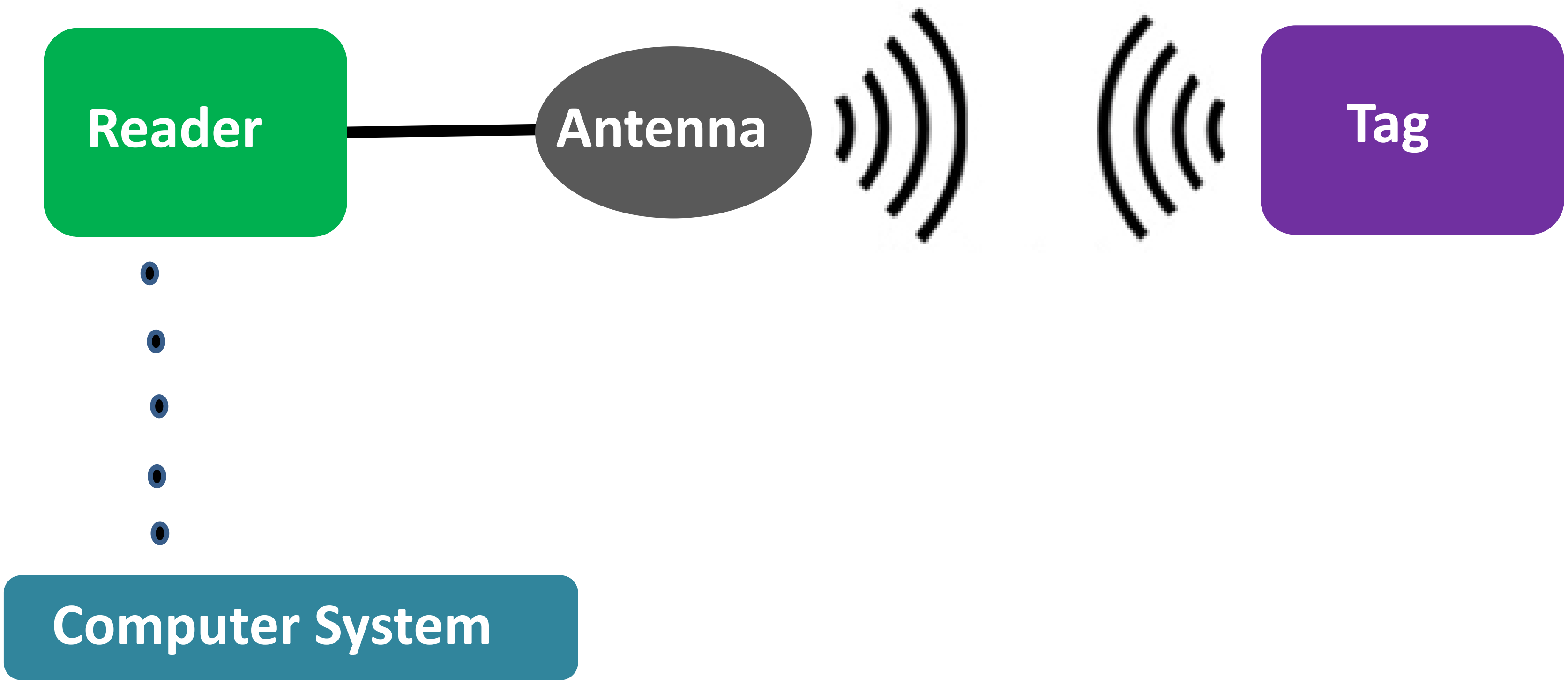
- Introduction
- Overview of RFID antennas
- Graphene meandered dipole antennas
- Result and discussion
- Conclusion

Introduction

RFID: Radio Frequency Identification

- A technology which uses RF signals for automatic identification of objects or people
- Provide unique identification that allows for a wide range of application
- Use the wireless communication technique to facilitate the system design
- Does not require physical sight or contact between reader/scanner and the tagged item

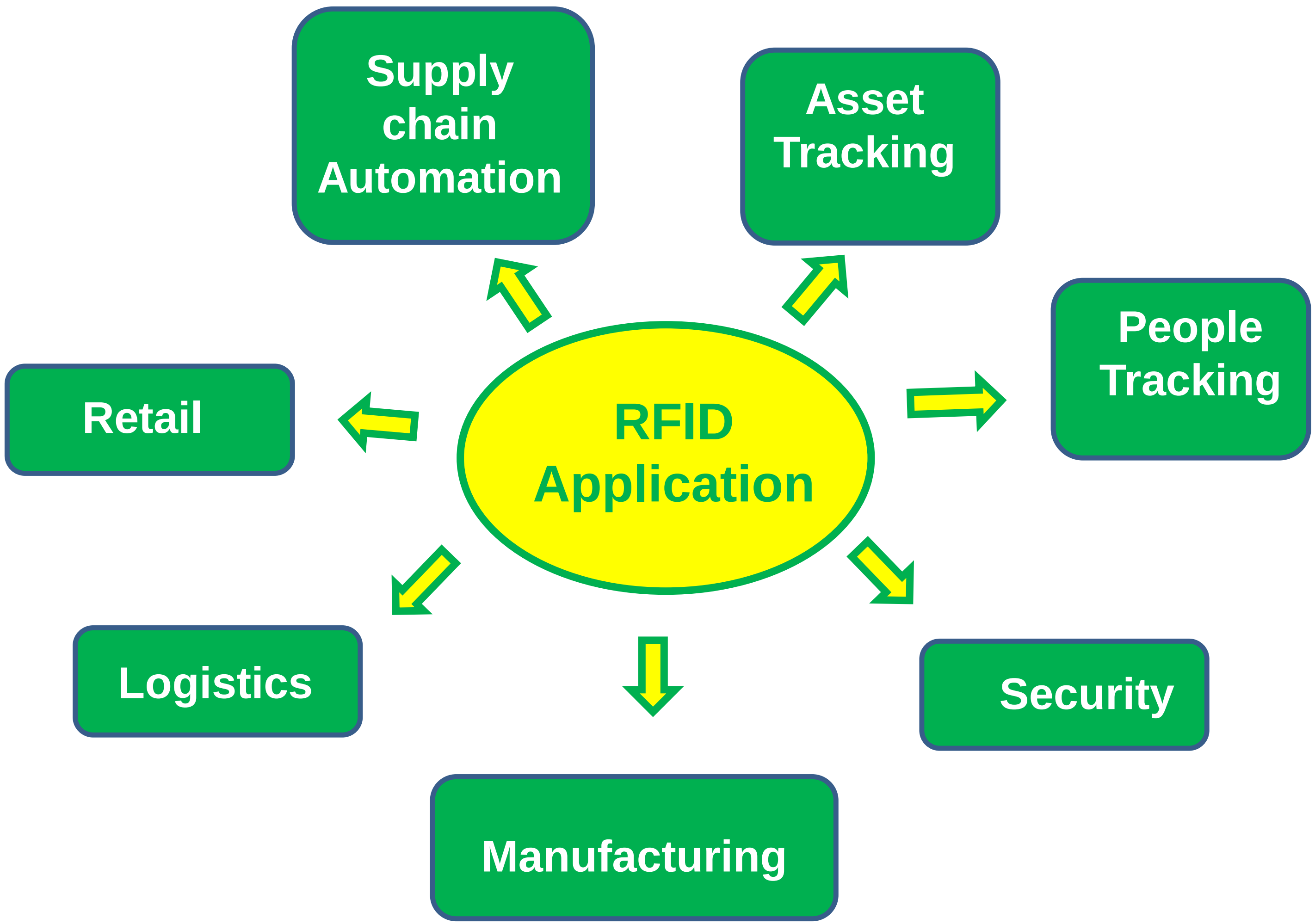
RFID System



Advantages of RFID

- RFID tags have read/write memory capability.
- More data can be stored in an RFID tag .
- Tag code data is 100% secure and cannot be changed or duplicated
- Can stand extreme conditions and temperatures
- No need of physical contact between data carrier and communication devices
- No line of sight necessary to read/write data.
- Do identify unique item
- Low error rate, long read range, portable database
- Multiple items can be read in a single scan

Application of RFID



Antennas in RFID

- **Omni directionality**
- **low cost**
- **low profile and small in size.**

RFID antennas

Reader antenna | **Tag antenna**

Frequency Band of RFID Antennas

LF
(125-135 KHz)

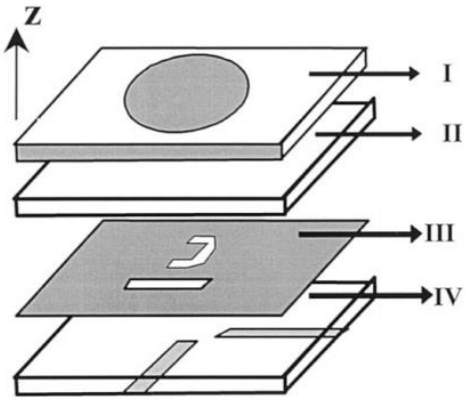
HF
(13.56 -433 MHz)

UHF
(860-960 MHz)

Microwave
(2.45 & 5.8 GHz)

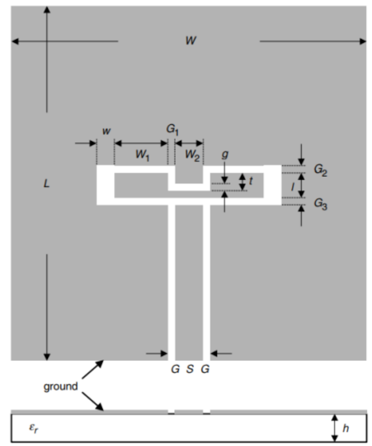
Overview of RFID Antennas

Aperture coupled circular patch antenna



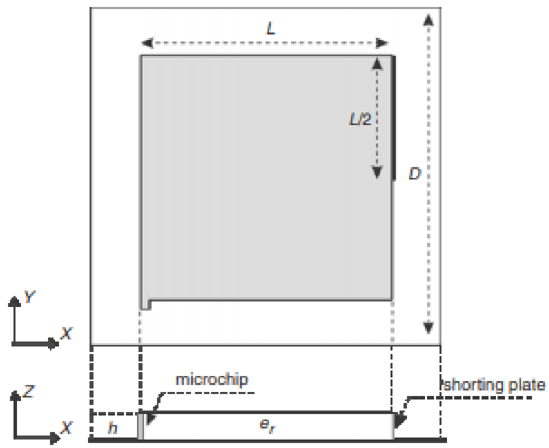
S. K. Padhi, N. C. Karmakar, C. L. Law, and S. Aditya, "A dual polarized aperture coupled circular patch antenna using a C-shaped coupling slot," IEEE Trans. Antennas Propag., vol. 51, no. 12, pp. 3295–3298, Dec. 2003

Folded-slot antenna



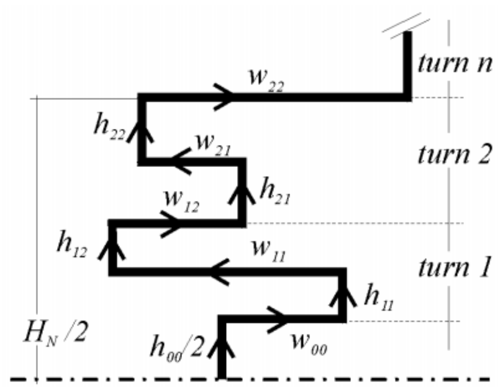
S.-Y. Chen and P. Hsu, "CPW-fed folded-slot antenna for 5.8 GHz RFID tags," Electron. Lett., vol. 24, pp. 1516–1517, Nov. 2004.

Planar inverted-F antenna



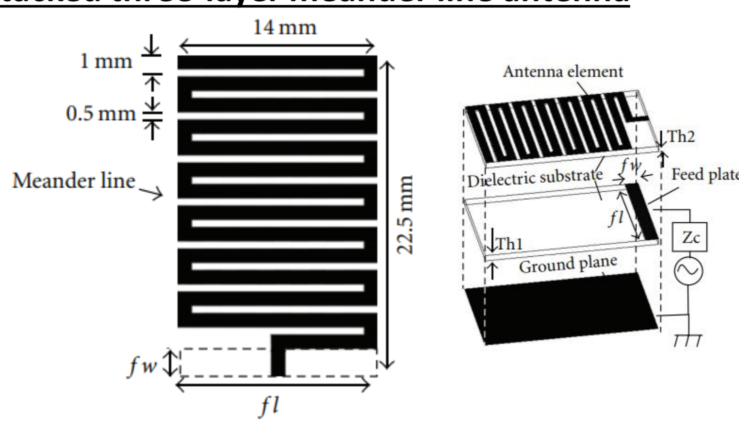
M. Hirvonen, P. Pursula, K. Jaakkola, and K. Laukkanen, "Planar inverted-F antenna for radio frequency identication," Electron. Lett., vol. 40, pp. 848–850, Jul. 2004.

Meander Line Antennas



G. Marrocco, "Gain-optimized self-resonant meander line antennas for RFID applications," Antennas Wireless Propag. Lett., vol. 2, no. 21, pp. 302–305, 2003.

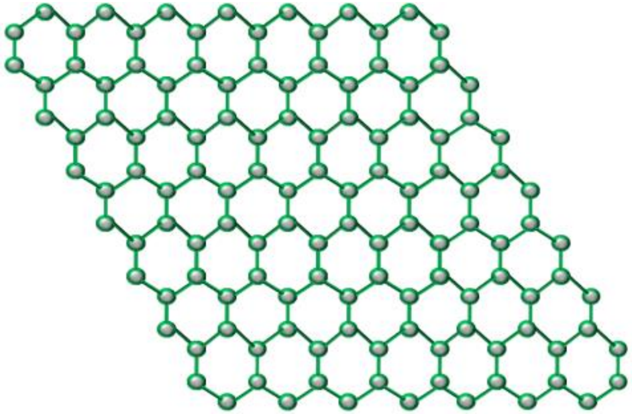
stacked three-layer meander line antenna



K. Ide, S. Ijiguchi, and T. Fukusako, "Gain enhancement of low-profile, Electrically small capacitive feed antennas using stacked meandered lines," Int. J. Antennas Propag., vol. 2010, p. 606717, 2010.

Why Graphene for Antennas

Graphene

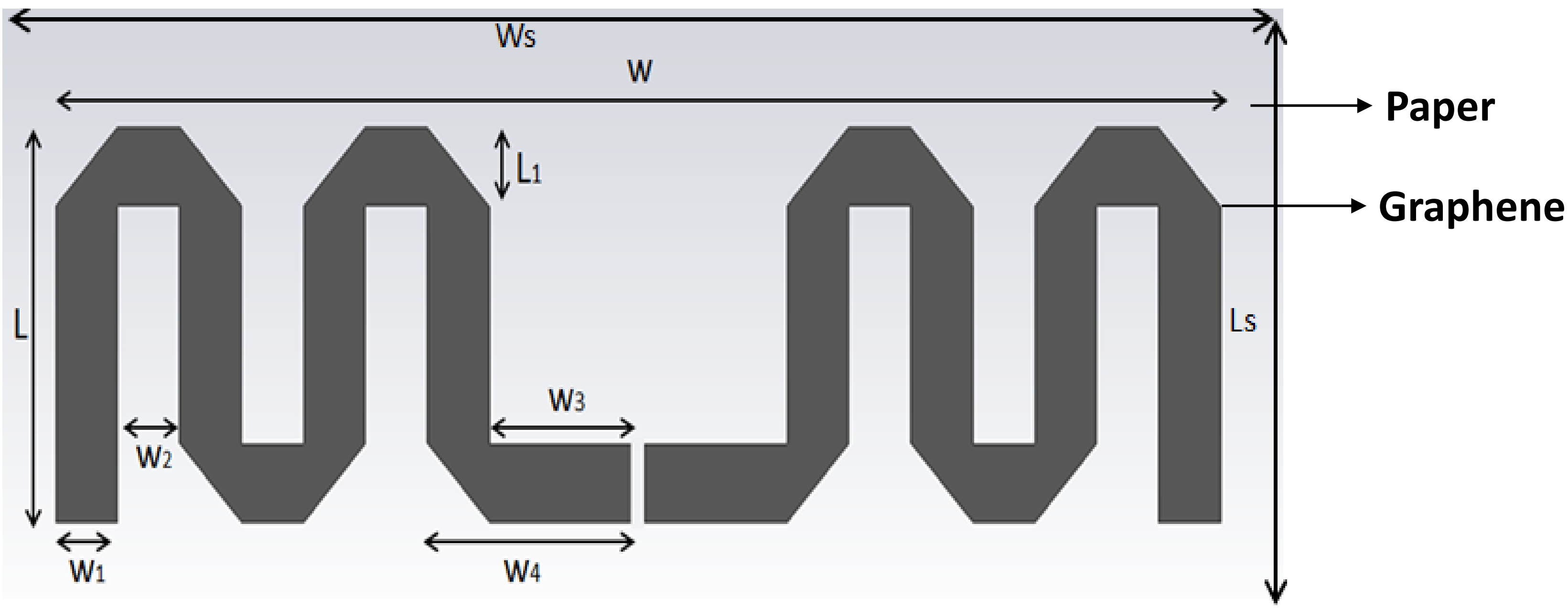


- **High electron mobility**
- **Great conductor of electricity**
- **Highest current density**
- **Almost Transparent**
- **Very stretchable and can be used as a flexible conductor**
- **Can be easily transferred / integrated on flexible substrate**

Due to its unique properties, Graphene being alternate promising material for design of RFID antennas

Initial work :

Graphene Meandered Line Dipole Antenna (1)

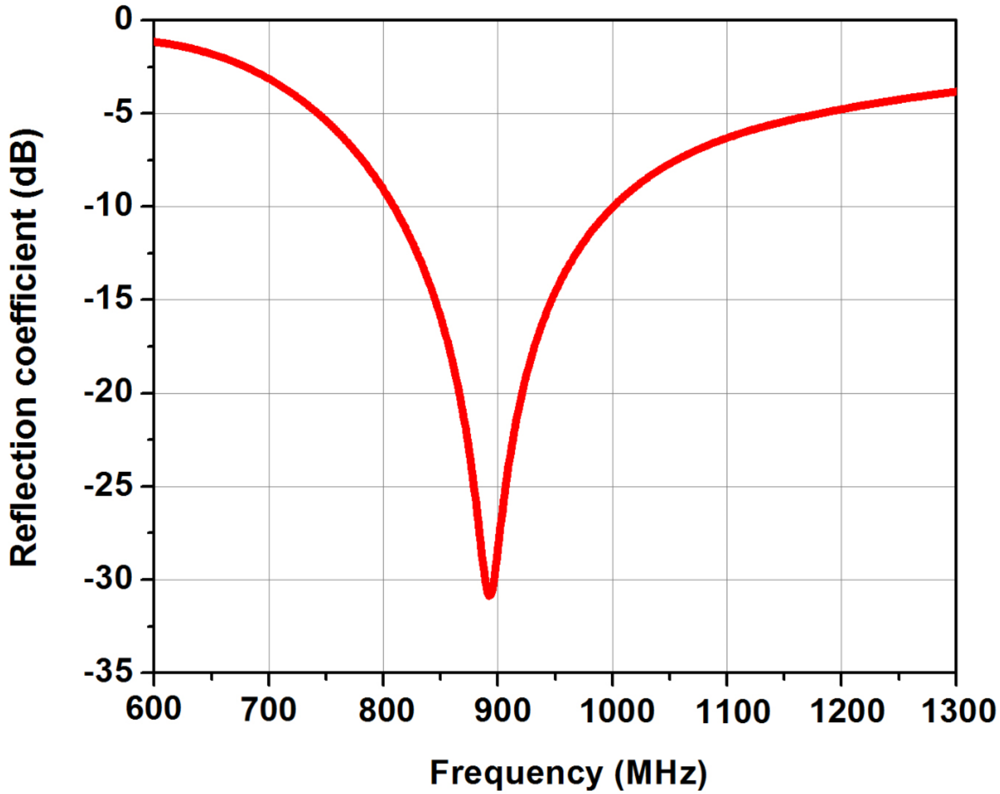


Top View

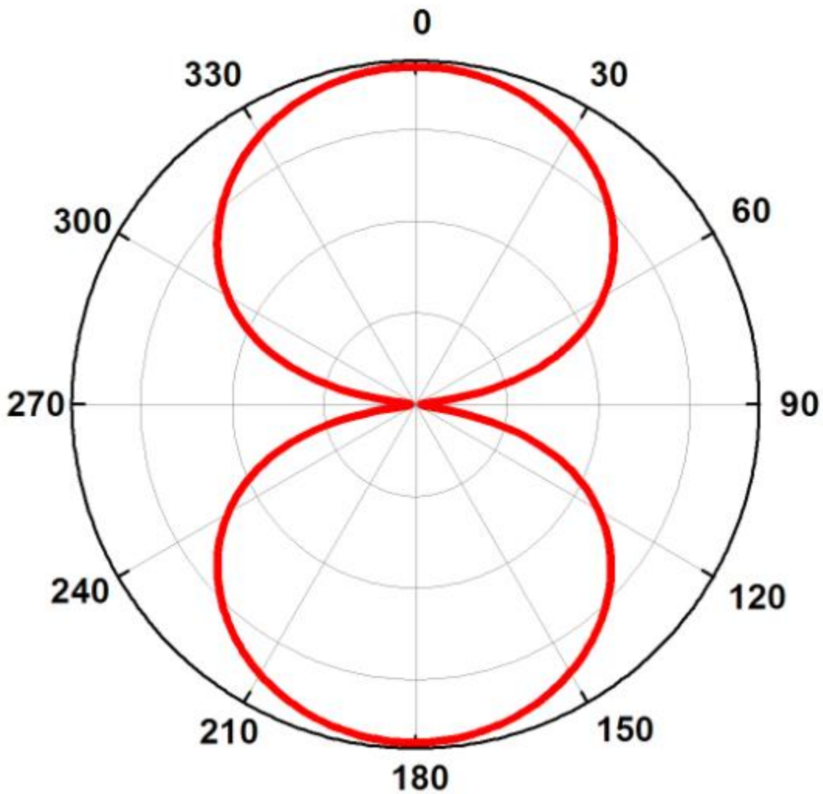
Value of geometric parameter of antenna

Parameters	Value (mm)	Parameters	Value (mm)
W	94	L	25
W1	5	L1	5
W2	5	Ws	120
W3	11.5	Ls	40
W4	16.5		

S_{11} parameter of antenna



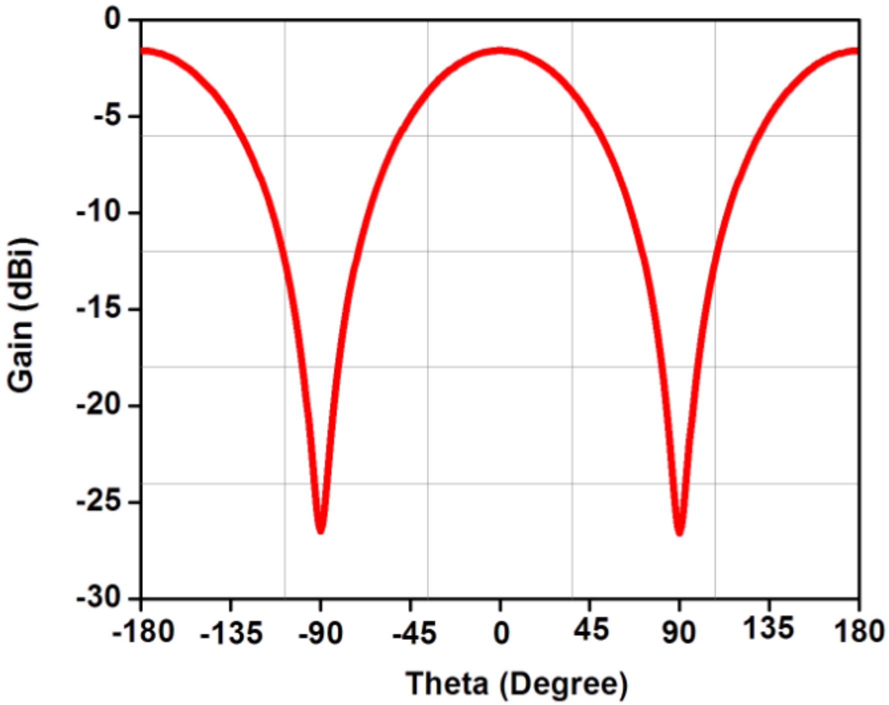
Radiation pattern of antenna



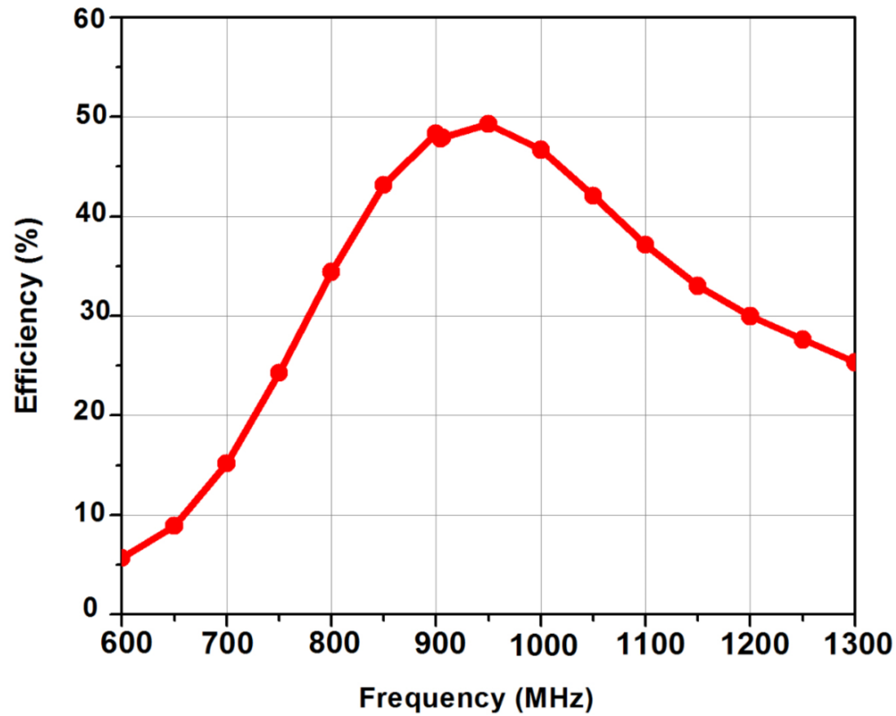
@ 890 MHz

Gain of antenna

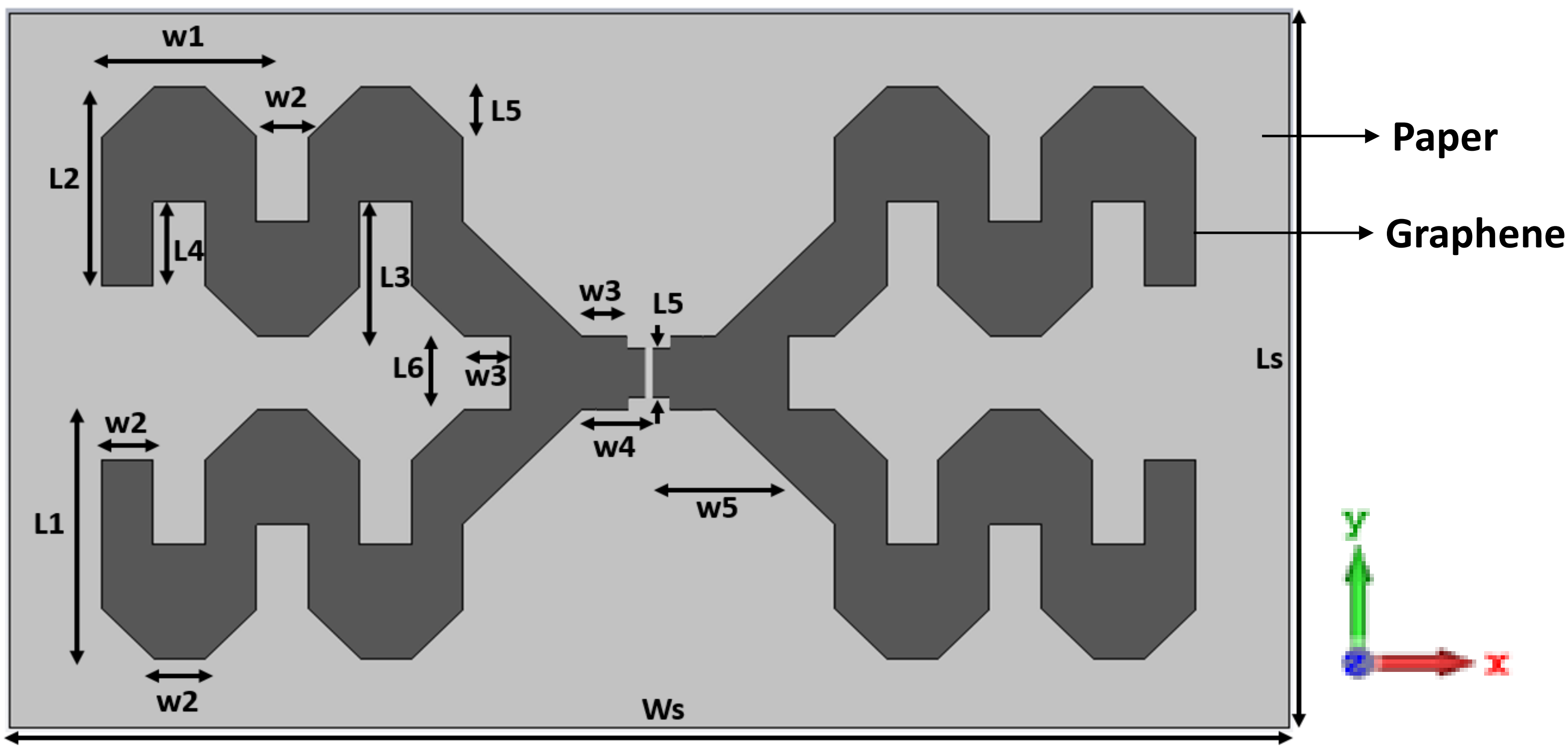
@ 890 MHz



Efficiency of antenna



Present Work:
Graphene Meandered Line Dipole Antenna (2)

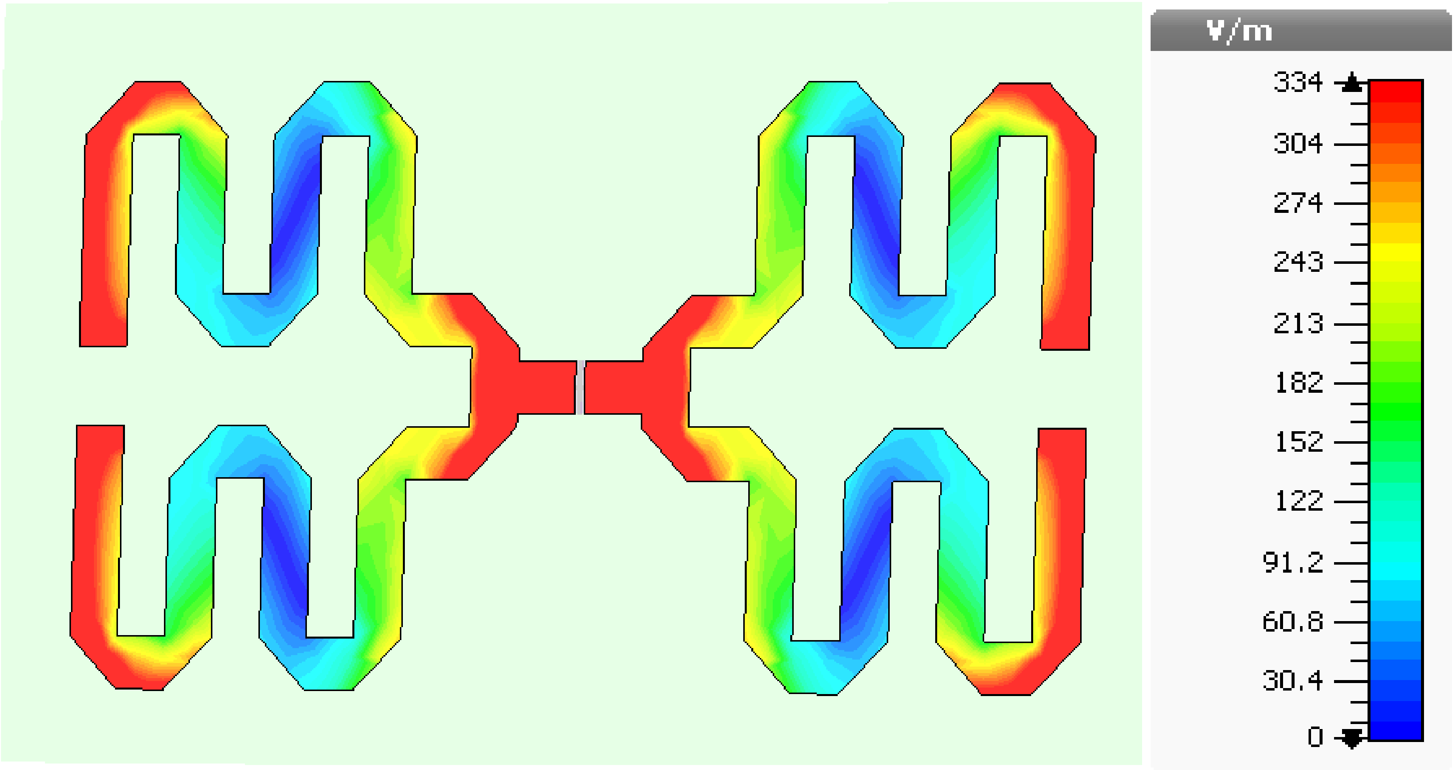


Top View

Value of geometric parameter of antenna

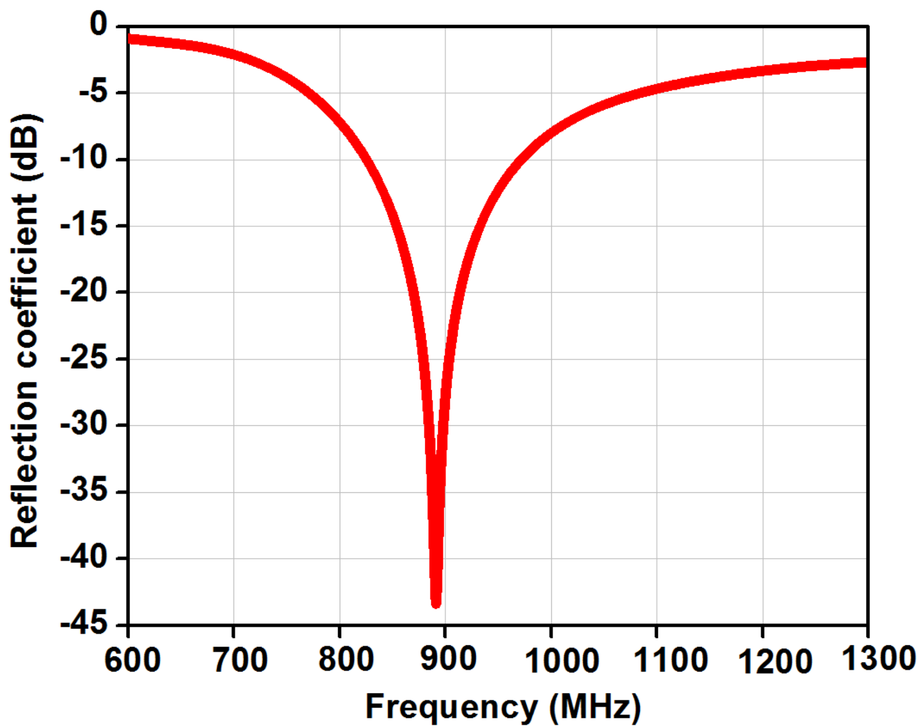
Parameters	Value (mm)	Parameters	Value (mm)	Parameters	Value (mm)
L1	25	L6	7.5	W5	13.25
L2	20	W1	15	Ls	72
L3	13.5	W2	5	Ws	124
L4	8.5	W3	4.5	Hs	0.1
L5	5	W4	6.25		

Electric field distribution of antenna

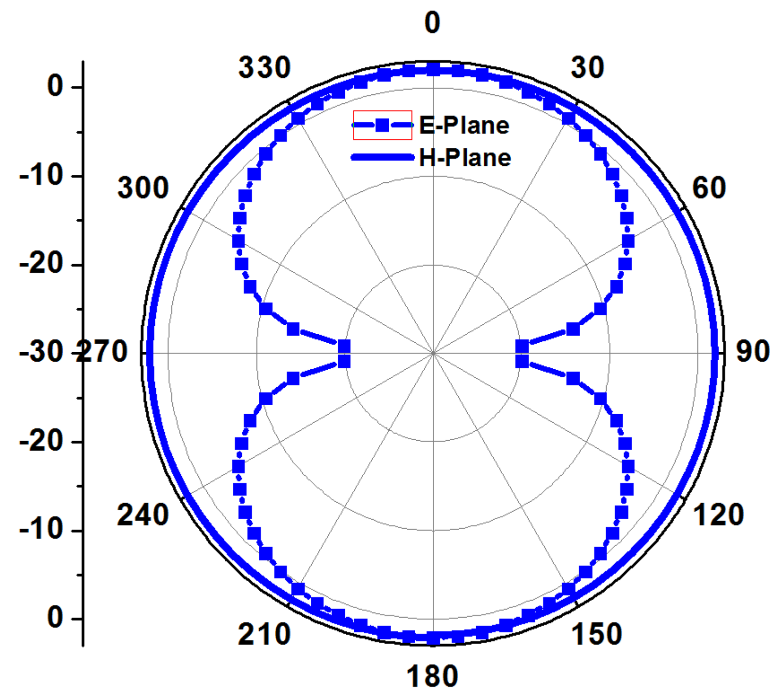


S_{11} parameter of antenna

Radiation pattern of antenna @ 890 MHz

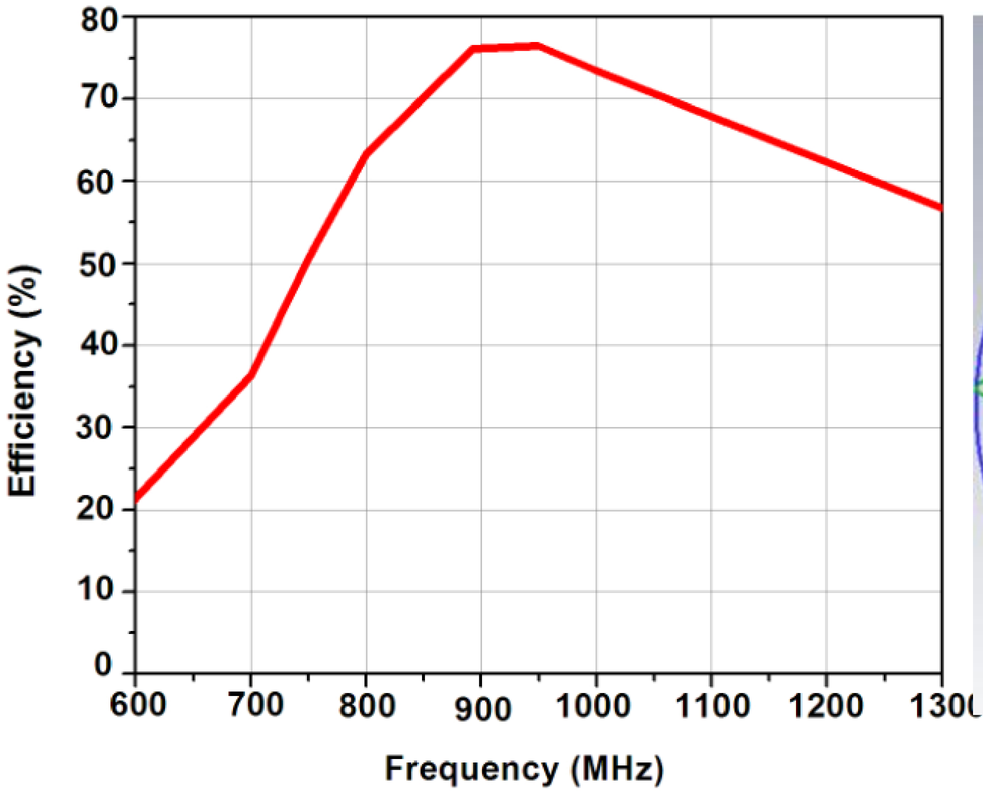


Band width = 18% (820 -980 MHz)

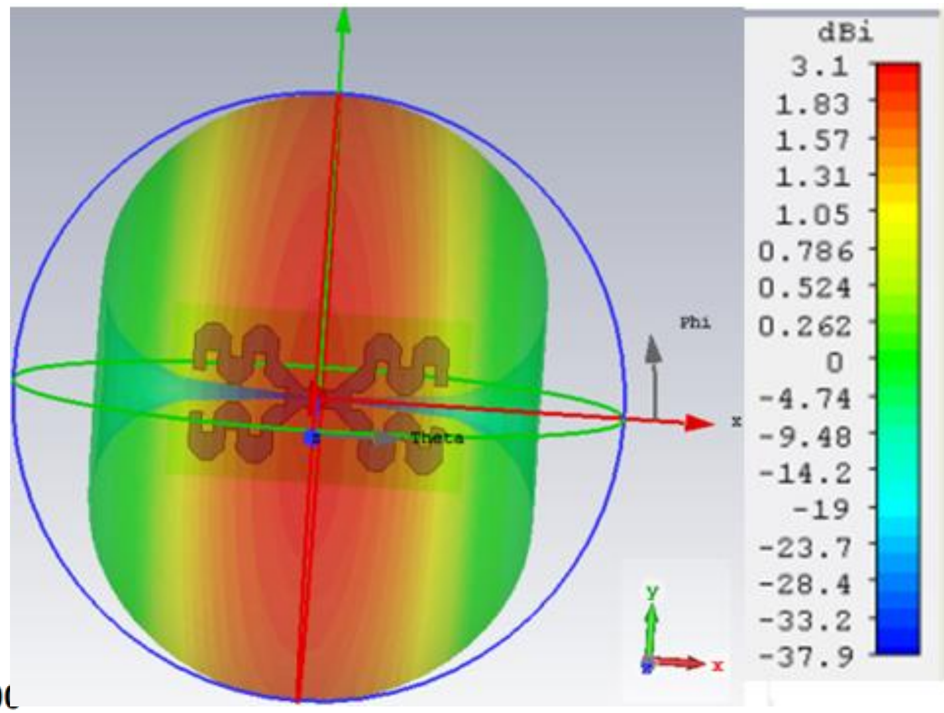


Omnidirectionality

Efficiency of antenna



3D far-field Gain pattern of antenna @ 890 MHz



Radiation efficiency increased from 47.94% to 76.17%
Gain increased from -1 dBi to 3 dBi

Conclusion

- **Graphene meandered line dipole antenna on paper substrates makes the device flexible**

- **The Proposed antenna provides 3 dB of gain, band width of 18% (820 -980 MHz), 76% of radiation efficiency and omnidirectional radiation pattern.**

- **The potential of the proposed graphene meandered dipole antennas is promising for low-cost and flexible RFID applications.**

Thank You so much for your kind attention