Enhancing parameters of MSA for s-band and c-band application by using dumb shell oval head DGS technique

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Abstract — A novel design of various defective ground structured co-axial feed micro strip rectangular patch antenna resulting to highly enhanced parameters when compared with results of fundamental MSA antenna , is proposed in this paper. The purposed antenna is multiband operated at 2.25 and 7.32 GHz still giving enhanced results when compared with that conventional MSA antenna. By employing DGS technique the parameters like GAIN , DIRECTIVITY , VSWR , IMPEDANCE MATCHING , RETURN LOSS were enhanced. The size and employment of material is also reduced and making it light in weight and smaller in size. Initially the antenna design will be presented and then it is simulated by using ANSOFT HFSS 13.0 [12] and then results will be deeply studied.

Keywords — dumb shell oval head, dgs, HFSS, msa, co-axial feed.

1. INTRODUCTION

In this paper the parameters of microstrip strip rectangular patch antenna which is coaxial feed are enhanced with an employment defective ground structures. This antenna operates on dual band. The results are calculated carefully with the aid of ANSOFT HFSS which stands for HIGH FREQUENCY STRUCTURE SIMULATOR which can be purchased easily. The enhanced parameters will further increase the gain of an antenna which can be employed in micro transceiver. Here first basic patch antenna is designed and its parameters are measured and then further these parameters are enhanced with the aid of DGS and made it efficient to operate upon the dual frequency. The design is constructed in high frequency structure simulator and after a number of attempts and final desired results was generated. In figure 1, micro strip Patch antenna is displayed which has a dielectric substrate in between and patch and ground plate at top and bottom. Gold and silver are preferred in making the radiating[2]. Photo etching this radiating patch with feed lines are put upon dielectric substrate on whom basic radiation occurs [1]. The proposed design operates in between the frequency span of 2GHz – 7.32 GHz and is proposed for satellite devotion. After designing it on (FR-4) 2 sided Fiber Reinforced epoxy , the performing characteristic parameters like the like GAIN , DIRECTIVITY , VSWR , IMPEDANCE MATCHING , RETURN LOSS were enhanced by employing the dumb shell oval head defective ground structure technique in this paper.

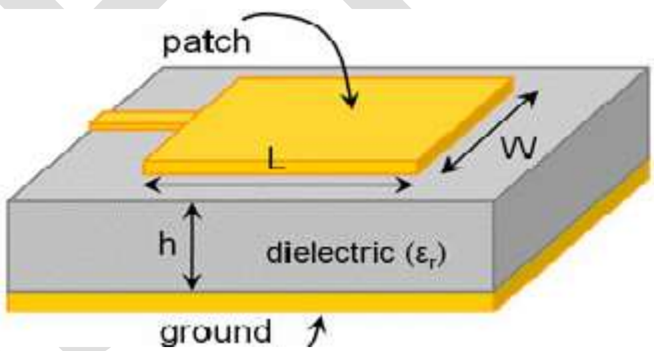

FIGURE 1 – micro strip patch antenna

1.1 OVERVIEW OF DGS TECHNIQUE

DGS is a technique which intrude the shield distribution of current in the ground plane due to defect in the ground which is cascaded periodic or may be non-periodic carved configuration defect in the ground of a planar transmission line[3]. Like line capacitance and inductance, there are many transmission line characteristics which will get change due to this intrusion[5]. Properly designed DGS and made at right coordinates always results beneficial in rising parameters. Purposed design has DGS of a dumb shell oval head shape. To make purposed design DGS shape, the two circular shapes and rectangular shaped DGS re merged together. as shown in figure 2

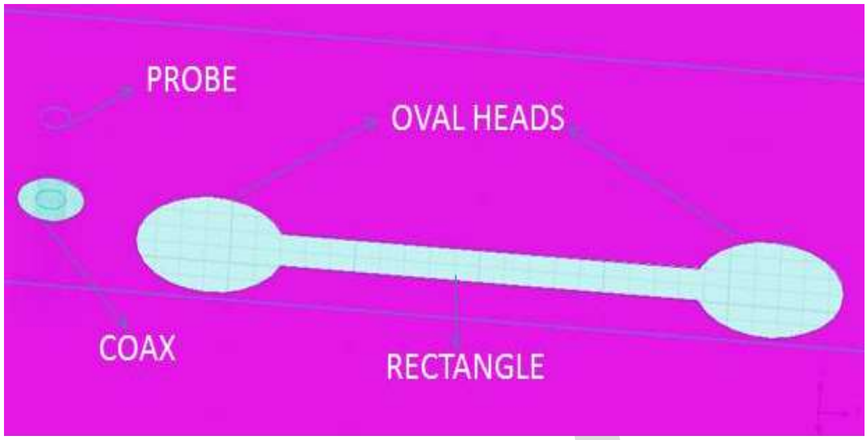

FIGURE 2 – dumb shell oval head dgs on HFSS 13.0

1.2 ANTENNA DESIGN

The design of coaxial fed micro strip rectangular patch antenna and dumb shell oval head defective ground structured coaxial fed micro strip rectangular patch antenna are displayed in Figure 3(a) and 3(b) which are operating on single band and purposed one is multiband i.e. at 2.25 GHz as well as on 7.32 GHz. The table 1 which is written below mentions co-axial feed micro strip rectangular patch antenna design without DGS dimensions. The feed points of this fundamental antenna are (30.5, 16.66) and the feed points of design with DGS are (31, 16.35). Positioning measurements of shapes and design of proposed DGS antenna are described in table 2.

VARIABLE	***VALUE***
Patch width	**40.57mm**
Patch length	**31.43mm**
Patch height	**1.6mm**
Ground width	**50.32mm**
Ground length	**41.19mm**
Interior Feed center radius	**0.3mm**
Exterior Feed center radius	**0.675mm**

Table 1 dimensions of the co-axial fed rectangular patch antenna without dgs for 2.25 GHz frequency

VARIABLE	***VALUE***
Patch width	**40.57mm**
Patch length	**31.43mm**
Patch height	**1.6mm**
Ground width	**50.32mm**
Ground length	**41.19mm**

Interior Feed center radius	**0.3mm**
Exterior Feed center radius	**0.675mm**
Radius of DGS ovals slot on the ground	**1.2mm**
Length & breath of DGS rectangle slot on the groun	**8.4mm , -1mr**

Table 2 Dimensions of the DGS MSA operating at 2.25 GHz and 7.32 GHz.

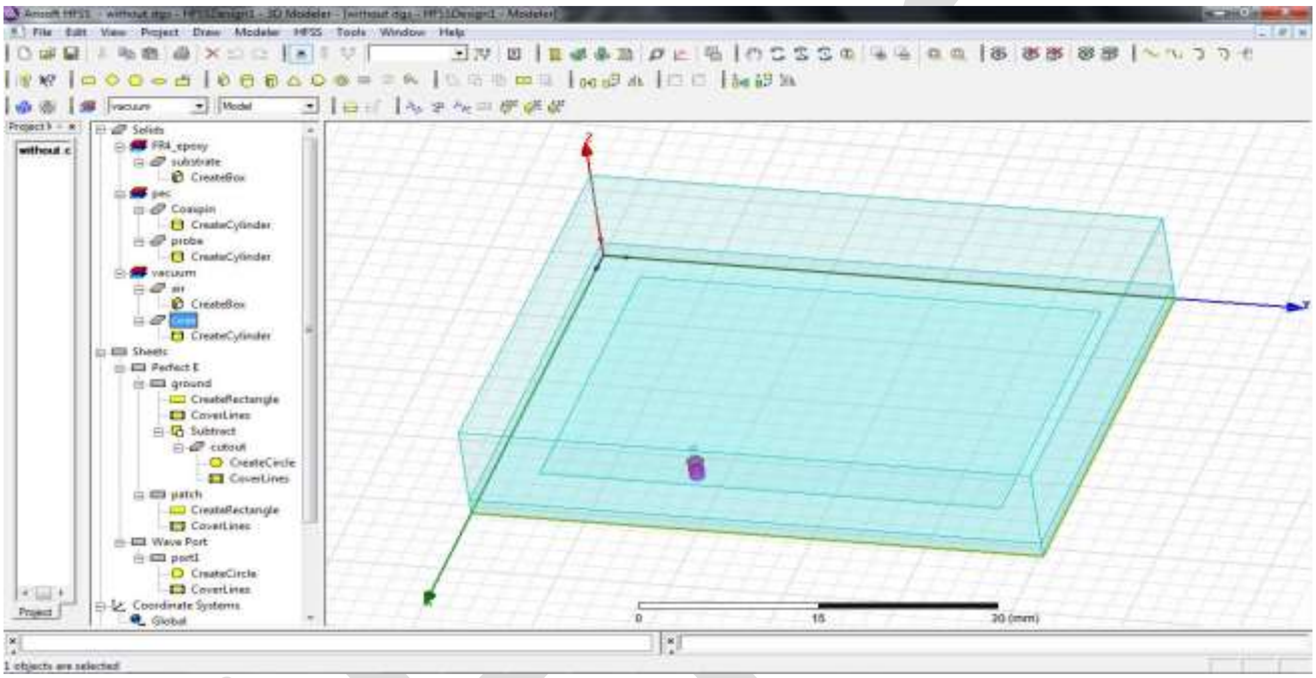

FIGURE 3(A) MSA without DGS on HFSS 13.0 operating at 2.25 ghz

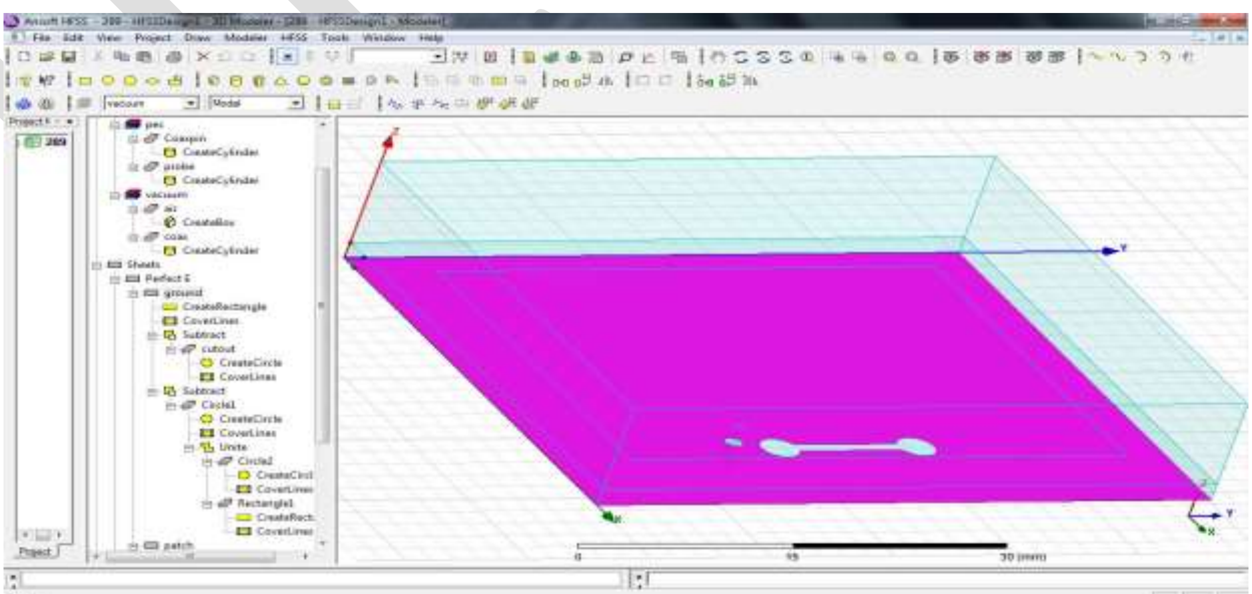

FIGURE 3(b) proposed design on HFSS 13.0 of MSA with dumb shell oval head shape DGS

2. SIMULATIONS AND RESULTS

The results of both above described antennas generated through the aid of HFSS 13.0 and parameters like S11, directivity, impedance & voltage standing wave ratio are simulated below:

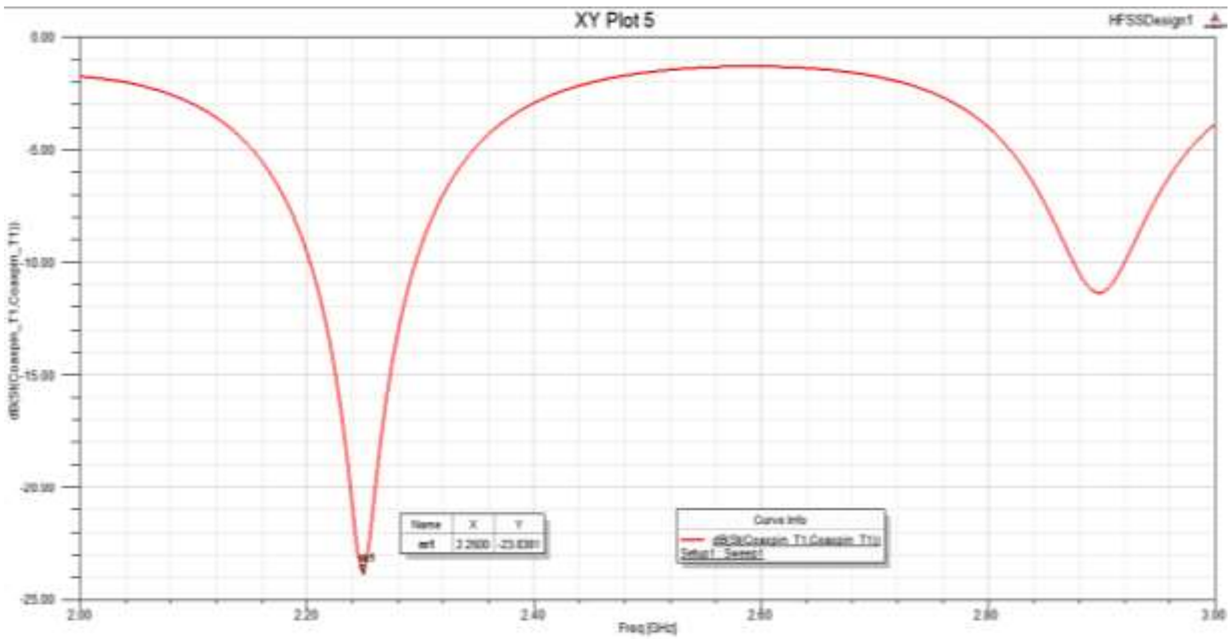

Figure 4 Simulated S11 on HFSS 13.0 of MSA without DGS operating at 2.25 GHz

The return loss S11 resulted by design without DGS is -23.8 which very close to -24 which is brilliant result while operating upon 2.25 GHz that is appropriate for Wireless Local Area Network and results the bandwidth of nearly 90 MHz. The WAN standards are - 2.2 - 2.483 GHz for IEEE 802.11 b/g and to calculate the bandwidth, the lower frequency is subtracted at -10 dB from upper bandwidth. Proposed design with DGS provides impedance of 44.8 ohms representing that antenna is approximately matched and the loss of power is very minimum. Here is represented the result of designed antenna:

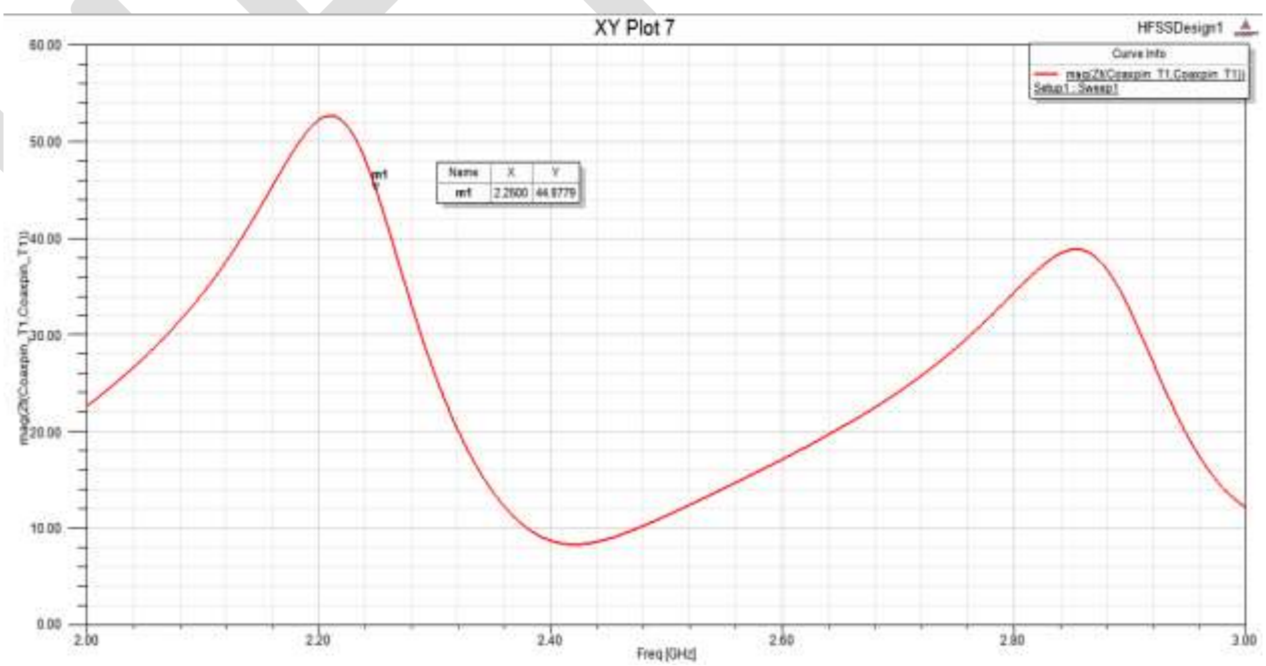

FIGURE 5 Simulated impedance on HFSS 13.0 of MSA without DGS operating at 2.25 GHz

The proposed design without DGS results out VSWR of 1.1374 in operating upon 2.25 GHz

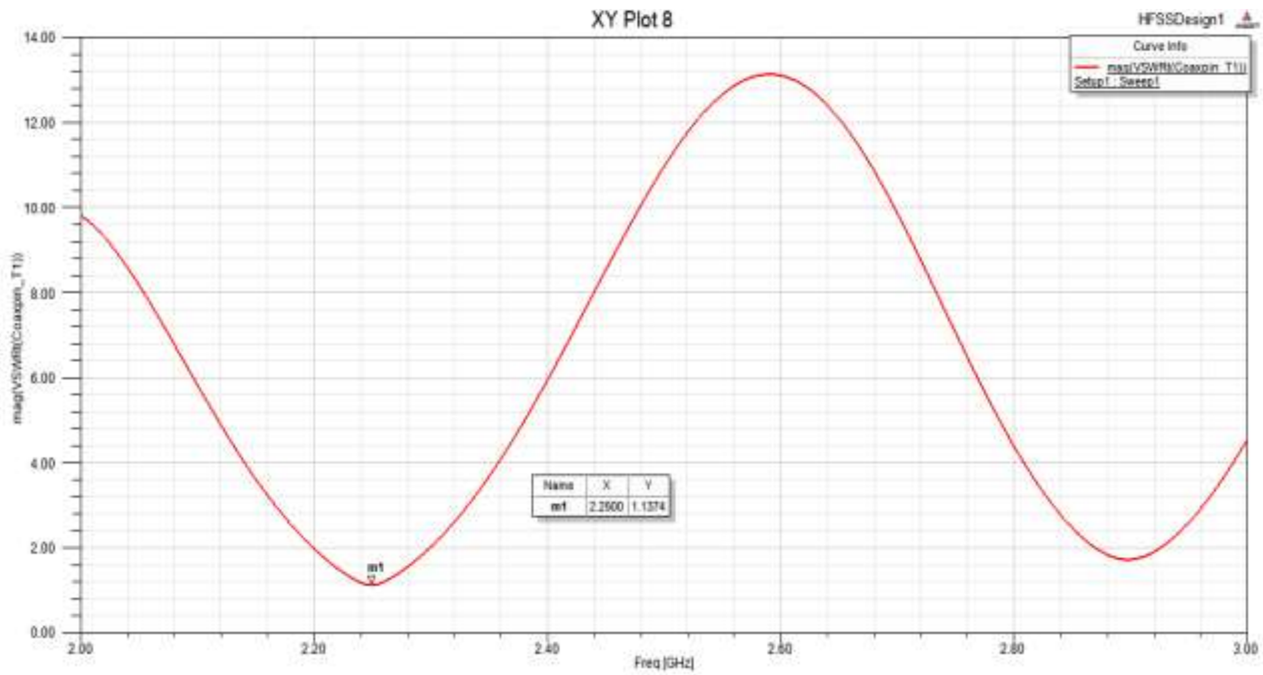

FIGURE 6 result of VSWR of MSA without DGS at 2.25 GHz on HFSS 13.0

The summarization of results generated above by HFSS 13.0 in the form of table 3 as below:

Parameters	**Values**
Operating frequency	2.25Ghz
Return loss	-23.8381
Impedance	44.8779
VSWR	1.1374
Bandwidth	90
GAIN	1.7
DIRECTIVITY	4.1

Table 3 Summary of results of designed antenna without DGS at 2.25 GHz frequency on HFSS 13.0.

2.1 SIMULATION OF PURPOSED DESIGN COAXIAL PROBE FED DUMB SHELL OVAL HEAD DEFECTIVE GROUND STRUCTURED MICROSTRIP RECTANGULAR PATCH ANTENNA

2.1.1 gain of purposed design at both c-band and s-band in HFSS

Here the simulation done very carefully in high frequency structure simulator upon two different frequencies and the results are shown simultaneously as below. The gain of microstrip antenna must be greater than 1.5dbi which is considered for c-band and s-band communication. The gain are shown in figure 7 and in figure 8. As the gain is obtained by this coaxial probe fed dumb shell oval head defective ground structured microstrip rectangular patch antenna when operated of multiple frequency is still very fine. The gain in 2.25GHz is 1.9842dbi and the gain upon that of 7.32GHz is 2.9762dbi which is good in both frequencies. So in case of gain parameter, this antenna is perfectly fine.

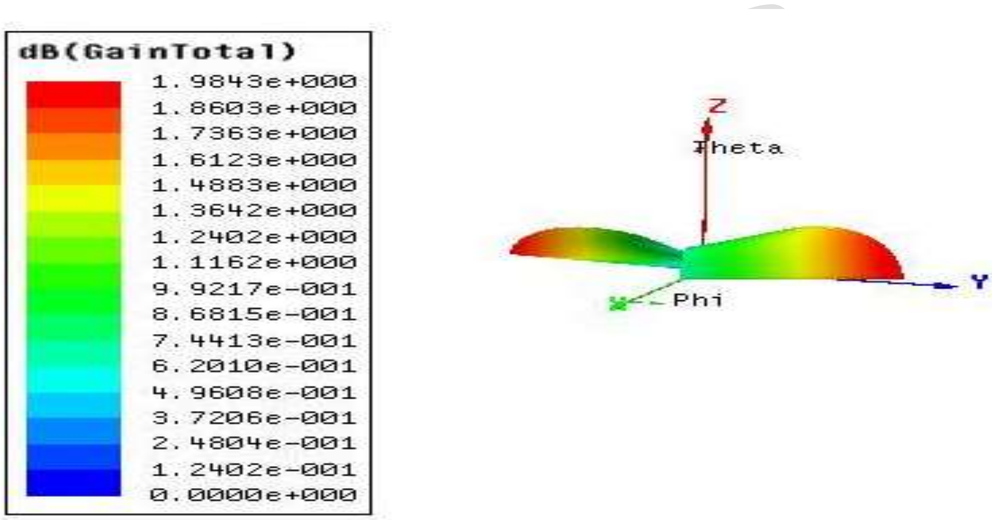

Figure 7 – gain of MSA with dumb shell oval head at 2.25GHz is 1.9843dbi

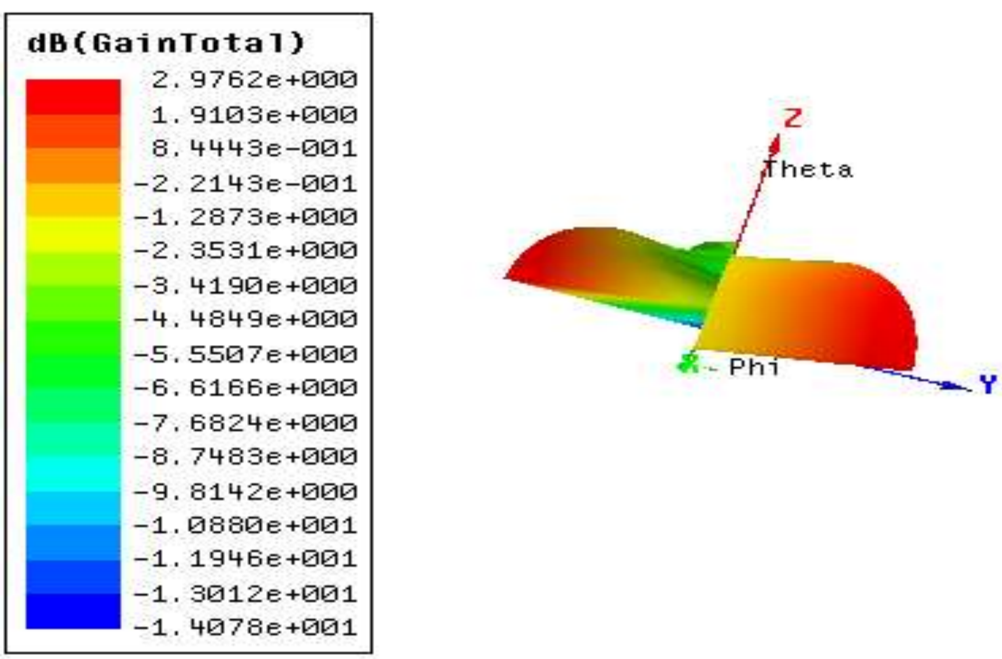

Figure 8. - gain of MSA with dumb shell oval head at 7.32GHz is 2.9762dbi

2.1.2 DIRECTIVITY of purposed design at both c-band and s-band in HFSS

As shown in figure 9 and 10 the directivity of coaxial probe fed dumb shell oval head defective ground structured microstrip rectangular patch antenna when operated of multiple frequency is still very fine. The ideal case directivity MSA is in between 5 – 7 dbi. The directivity is simulated on 2.25GHz and on 7.32GHz on HFSS and it found that the directivity on 2.25GHz is 4.2211dbi and the directivity on 7.32GHz is 4.4607dbi. therefore this antenna can be employed for c-band as well as s-band.

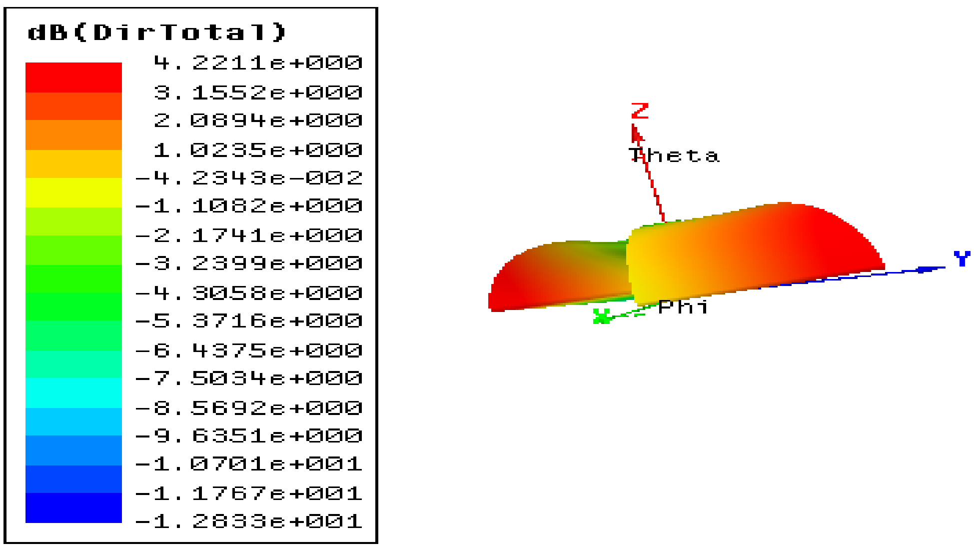

Figure 9 – directivity of MSA with dumb shell oval head at 2.25GHz is 4.2211dbi

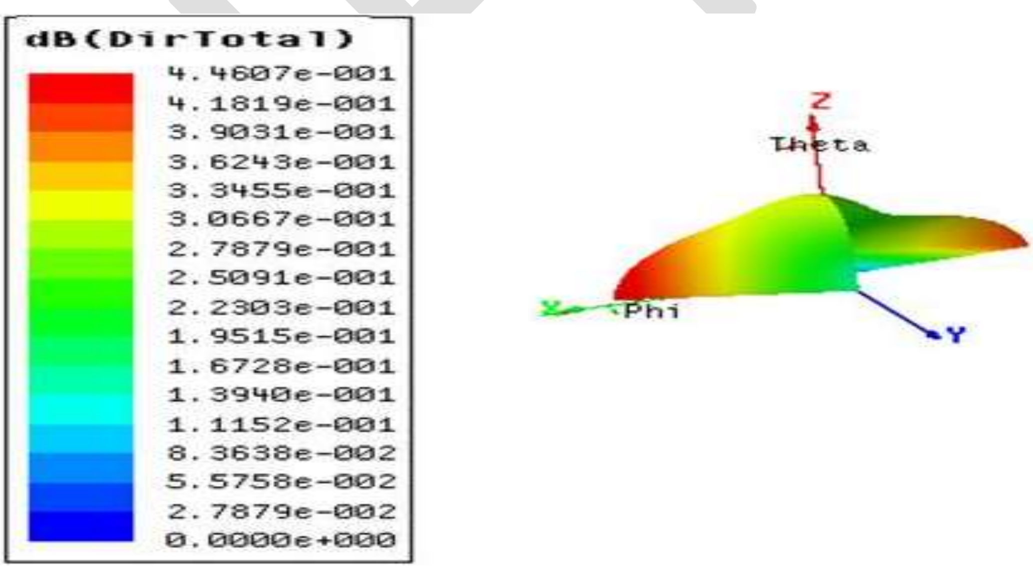

Figure 10. directivity of MSA with dumb shell oval head at 7.32GHz is 4.4607dbi

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2.1.3 S11 result of purposed design at both c-band and s-band in HFSS.

The return loss parameter is perfectly simulated and results at both the frequencies are very good and it shows that this coaxial probe fed dumb shell oval head defective ground structured microstrip rectangular patch antenna can perform good for c-band and s-band communication as shown in figure 11 and 12. The return loss for 2.25 GHz is -29.5415db at 7.32GHz is -26.8db.

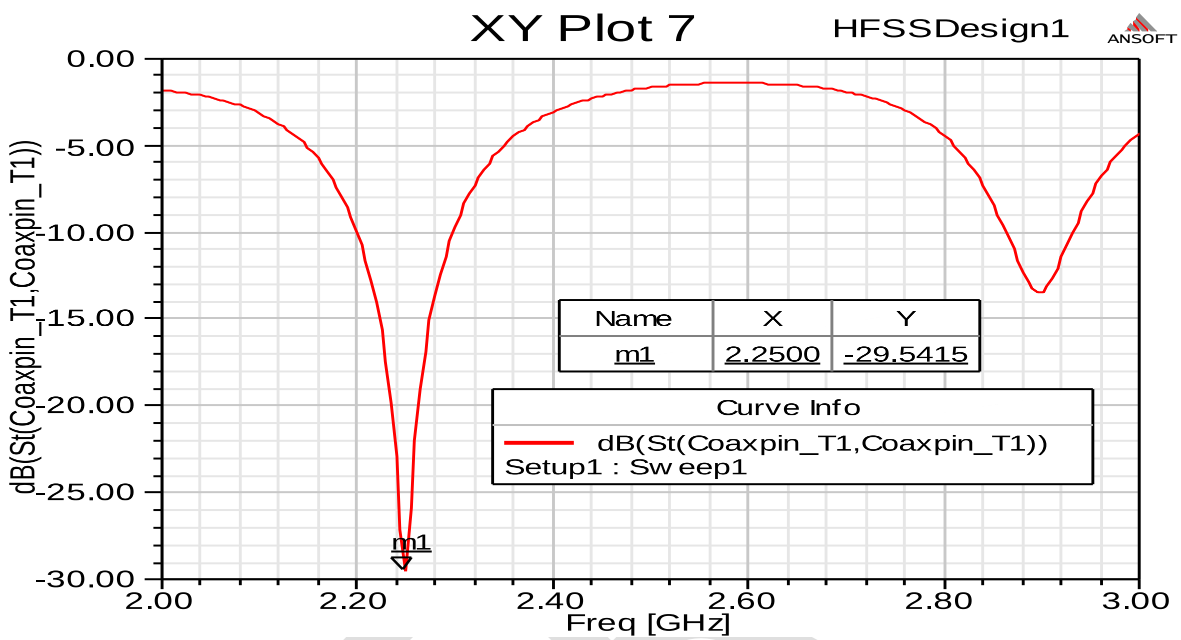

Figure 11 Simulated S11 of MSA with dumb shell oval head at 2.25GHz is -29.5415db

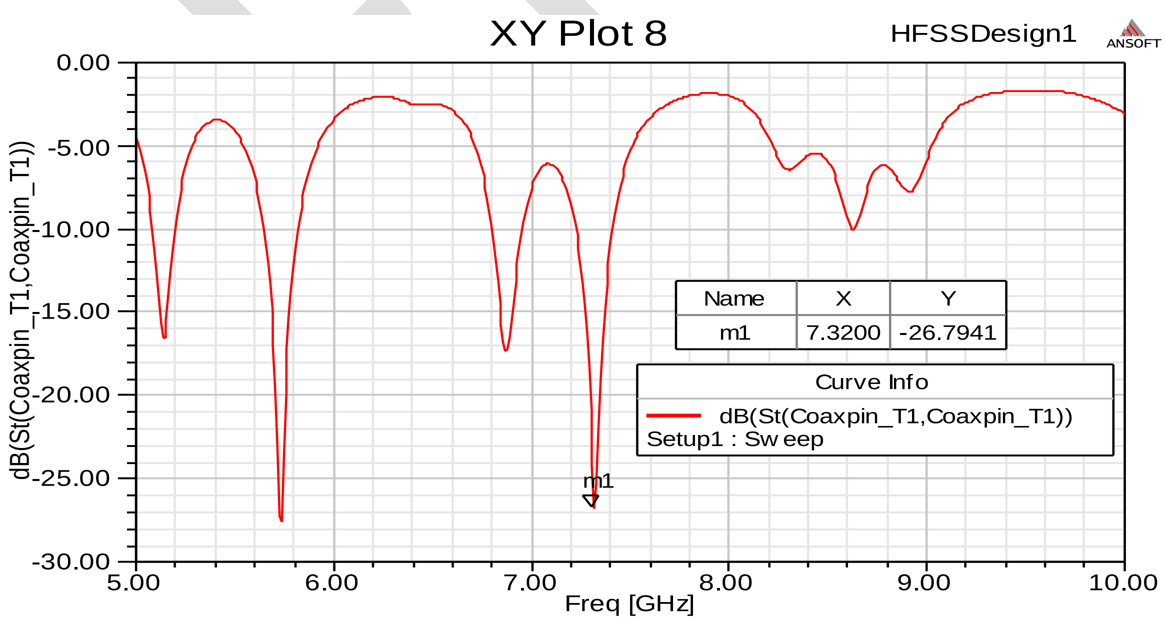

Figure 12 Simulated S11 of MSA with dumb shell oval head at 7.32GHz is -26.8db

2.1.4 vswr of purposed design at both c-band and s-band in HFSS.

The voltage standing wave ration for both the frequencies of coaxial probe fed dumb shell oval head defective ground structured microstrip rectangular patch antenna is very fine. The Simulated VSWR of MSA with dumb shell oval head at 2.25GHz is 1.06 and for 7.32GHz is 1.09 which are simulated in figure 13 and 14.

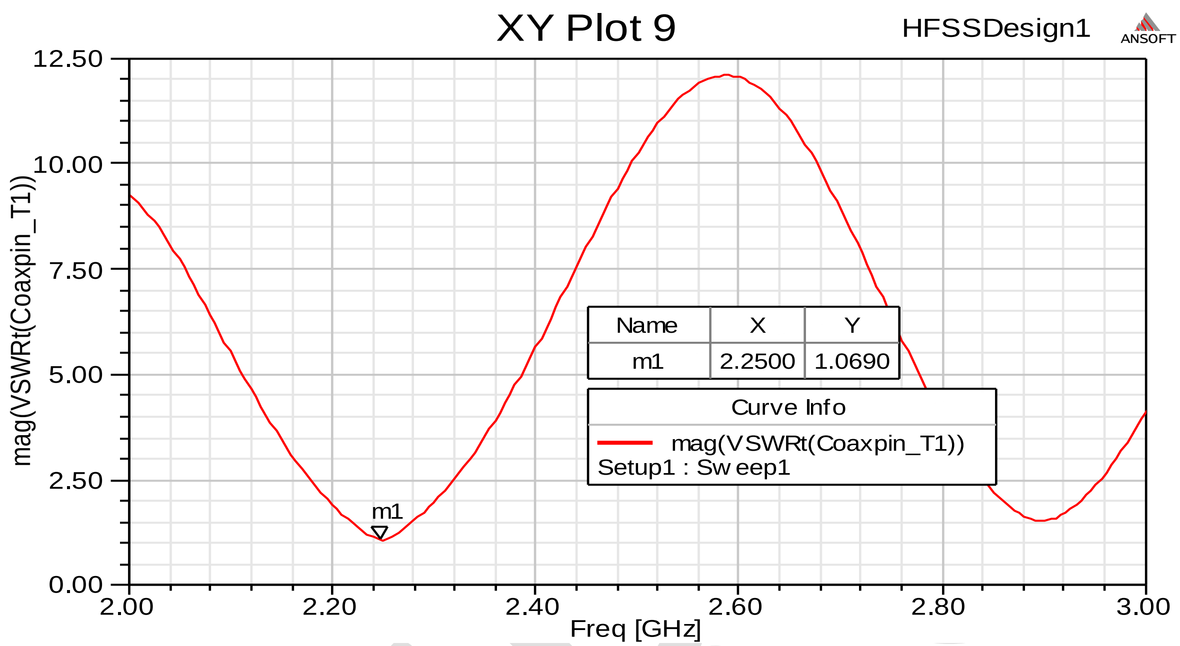

Figure 13 Simulated VSWR of MSA with dumb shell oval head at 2.25GHz is 1.06

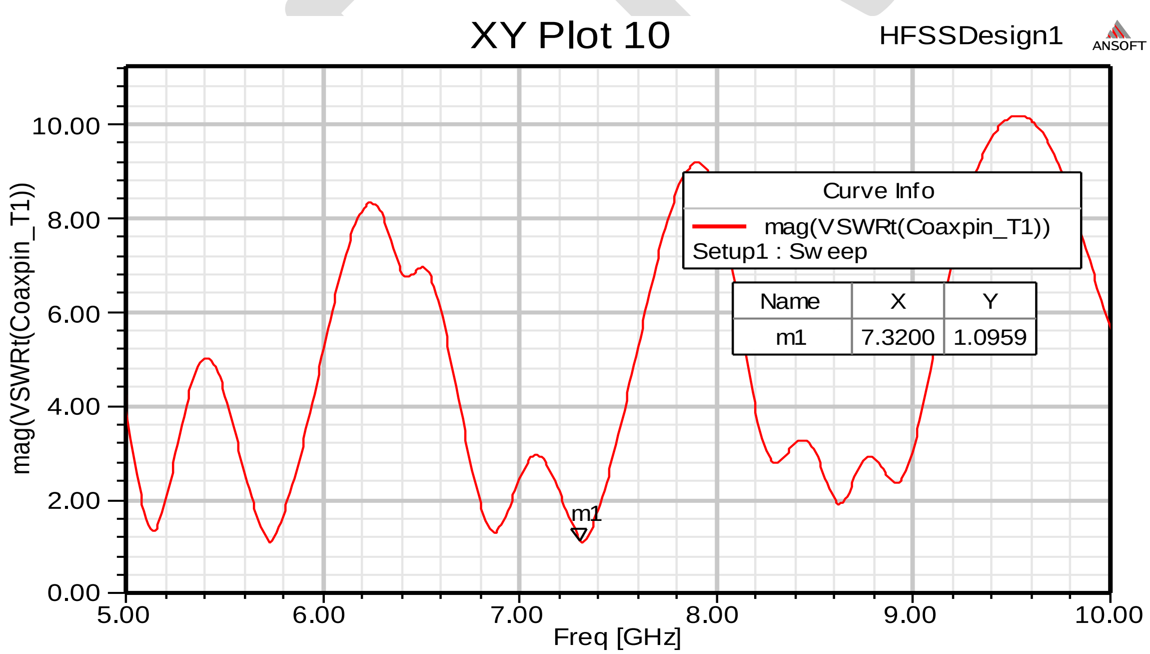

Figure 14 Simulated VSWR of MSA with dumb shell oval head at 7.32GHz is 1.09

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2.1.5 impedance matching of purposed design at both c-band and s-band in HFSS.

The impedance matching being very important parameter is also calculated and is found that in both the operating frequencies the impedance matching is obtained perfectly well. The simulated impedance matching obtained for 2.25GHz is 47.1626 ohms and that of for 7.32GHz is 51.3952 ohms which are good for communication. The results are shown in figure 15 and 16..

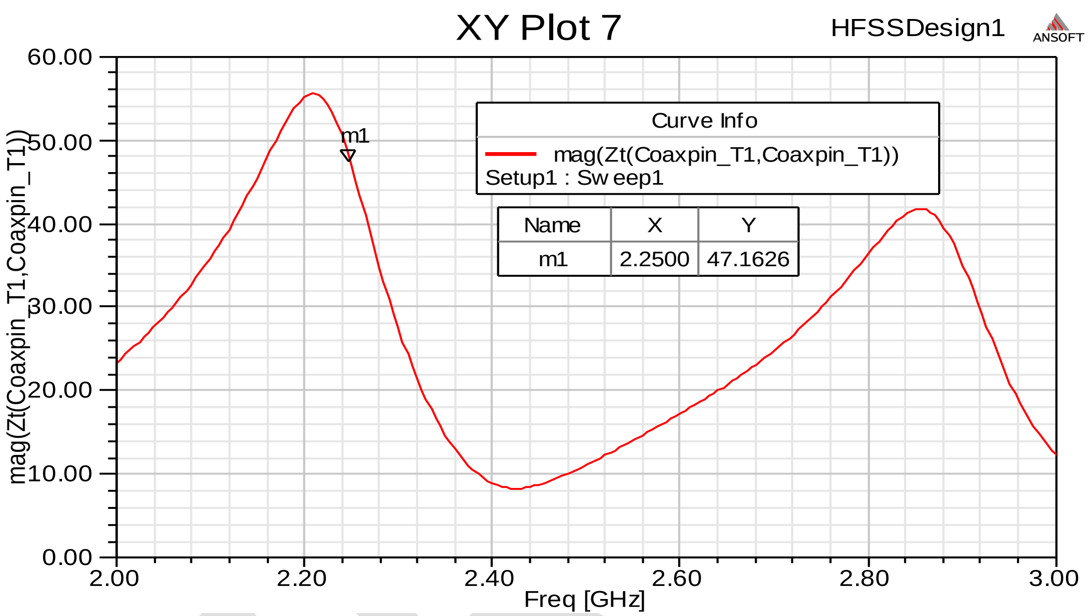

Figure 15 impedance matching of MSA with dumb shell oval head at 2.25GHz is 47.1626 ohms

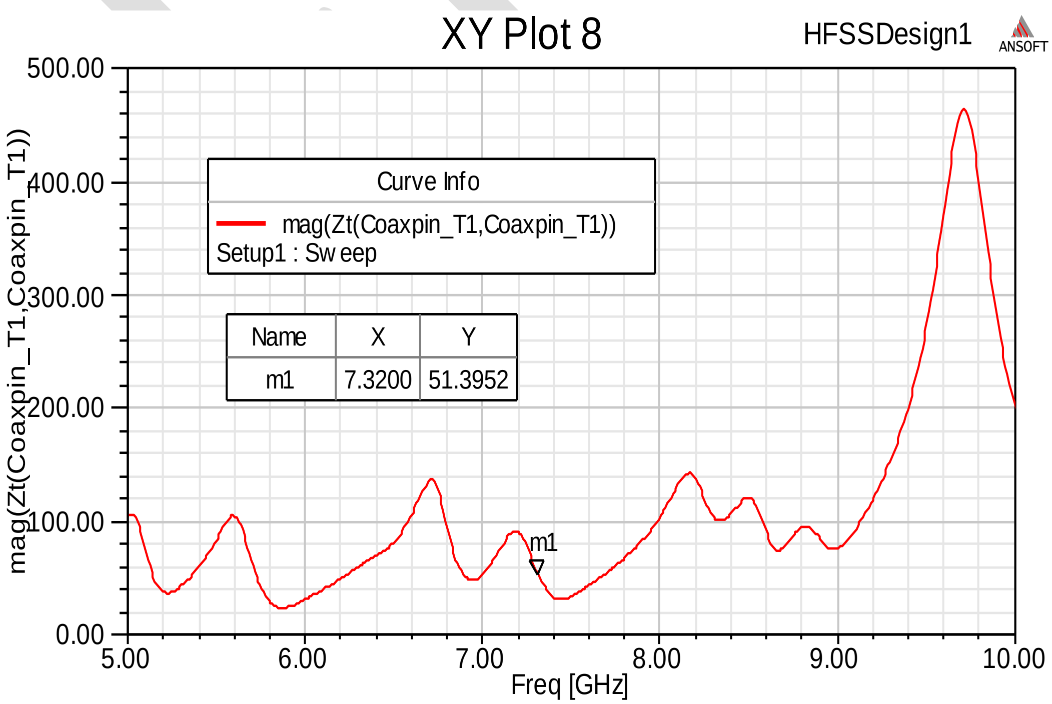

Figure 16 impedance matching of MSA with dumb shell oval head at 7.32GHz is 51.3952 ohms

3. CONCLUSION

This paper represents the designs of two antennas of co-axial feed micro strip rectangular patch antenna , with and without dumb shell oval head DGS technique , operating in between frequency spectrum of 2GHz−2.5 GHz. it is also simulationly proven that the design results out a bandwidth of nearly 4% which will always provide stable radiation pattern in between the allotted frequency range. In the center frequency the proposed design exhibit excellent impedance match of nearly 50 ohms. as proved above the enhancement of parameter by employing the dumb shell oval head DGS technique and further the comparison of both with and without DGS technique is displayed below. Which at last proves that dumb shell oval head DGS enhances an overall efficiency of co-axial feed micro strip rectangular patch antenna.

PARAMETERS -	FUNDAMENTAL MSA ANTENNA WITHOUT DGS	DUMB SHELL OVAL HEAD DUMBSHELL DGS	
GHZ	2.25	2.25	7.32
GAIN	1.7	1.9843	2.9762
DIRECTIVITY	4.1	4.2211	4.4607
RETURN LOSS	-23.8381	-29.54	-26
VSWR	1.1374	1.06	1.09
IMPEDENCE MATCHING	44.8779	47.16	51.39

Table 5 Comparison of results of with and without DGS technique in MSA

3 CONCLUSION

The aim of this paper was to design a compact microstrip patch antenna for use in s-band and c-band. Therefore coaxial probe fed dumb shell oval head defective ground structured microstrip rectangular patch antenna was designed which multiband antenna. The size is also compact as ground plane dimensions for this antenna is **48. 32mm by 39.19mm**. The patch dimensions are **39.57mm by 29.43mm**. Hence the designed antenna is compact enough to be placed even in very small device. All the important parameters which are gain , directivity, VSWR, return loss (s11), impedance matching are simulated in HFSS and is proved that the MSA can operate very well just by employing defective ground structure orientation. Because of this DGS the area consumed by antenna is very much reduced and the material usage is also reduced. This is already proved that the antenna will perform well in s-band and c-band which was desired.

4 FUTURE WORK:

Another area for future work is to extend this concept to a multiband design in which the size of the antenna could be reduced by employing multiple DGS which could further increase the efficiency of an antenna. As in near future the size of the gadgets will be a great deal and small as well light gadgets will be preferred. So employing material can be reduced by various DGS.

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