D4.3

Prototype of Antenna System – Public version

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Abstract:	This deliverable presents the final antenna prototype performance for the primary application, telecommunication system.
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Editor

Itziar Maestrojuán (ANTERAL)

Contributors (ordered according to beneficiary numbers)

Itziar Masestrojuán (ANTERAL)

Aitor Matínez (ANTERAL)

Internal Reviewers (ordered according to beneficiary numbers)

Joachim Oberhammer (KTH)

Yinggang Li (ERICSSON)

Executive Summary

Deliverable D4.3 “Prototype of Antenna System – Public version” presents the characterization data of the antenna performance prototype. A complete characterization is depicted giving special interest to the directivity measurement which has completely achieved the specifications set in D1.1 and agrees perfectly with simulations showed in D4.1.

Furthermore, the antenna prototype has been externally modified in order to be printable by means of a 3D printed machine. This second prototype has also been characterized obtaining equal results to the primary one fabricated in aluminium by a milling machine.

Therefore, D4.3 not only presents the antenna prototype characterization but also a good and low cost alternative with identical results.

Both antenna system characteristics, dimensions and fabrication method are presented in D4.3 “Prototype of Antenna System – Confidential version”.

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Chapter 1 Introduction

As described in D4.1 “Report on Concept and Design of an Off-set Reflector Antenna for Primary Prototype”, the goal of WP4 is to develop the antenna and sensor interfaces for the heterogeneously integrated THz microsystem platform, for the primary (telecommunication) and secondary (medical, food science, and industrial sensor) application prototypes. Deliverables D4.1a and D4.1b presented several alternatives that could fulfil the requirements stablished in deliverable D1.1 “System Specifications for Primary and Secondary Applications” and selected the most advantageous, easy-to-fabricate and best choice for the primary application: a reflector antenna.

In this public version of D4.3 “Prototype of Antenna System” the performance of the final antenna prototype is presented. Moreover, a 3D printed version of this antenna has also been fabricated and measured and the performance of the two prototypes is compared.

Chapter 2 Antenna System Prototype

The final antenna system comprises a reflector antenna and a feed horn antenna. The feeding horn antenna is in charge of transmitting the signal emitted by the microchip and directing it towards the reflector antenna. The reflector collects the signal coming from its focal point and sends it to the receiver system.

The final prototype will be presented in D4.3 “Prototype of Antenna System - Confidential version”.

Chapter 3 Antenna System Performance

The antenna system performance has been measured. Due to the required distance to characterize such a very high gain antenna in the far field, the only option is to measure the planar near field and apply a far field transformation afterwards. This transformation provides the exact performance of the system in far field. For this reason, the total antenna directivity as well as the radiation pattern have been calculated by means of a transformation from planar near field measurement to far field measurement. The results are depicted below.

The antenna system directivity has been measured from 140 to 150 GHz obtaining a value higher that 42 dB for the complete frequency band, see Figure 1. The obtained results present a really close performance to simulated results.

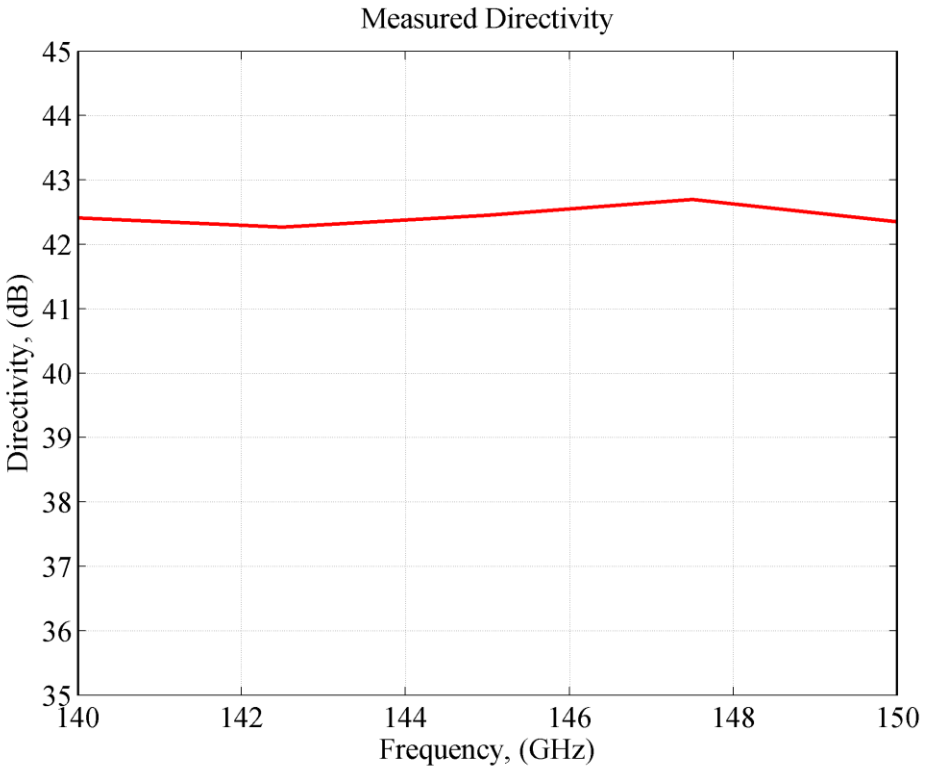

Figure 1: Antenna system measured directivity

The far field radiation pattern is presented in Figure 2. A slight misalignment is presented. This is due to the fact that the reflector antenna system was not perfectly aligned with the perpendicular planar near field measurement plane. This is not a large error and does not significantly affect the results. This misalignment can be very well seen in the planar near field images, see Figure 3.

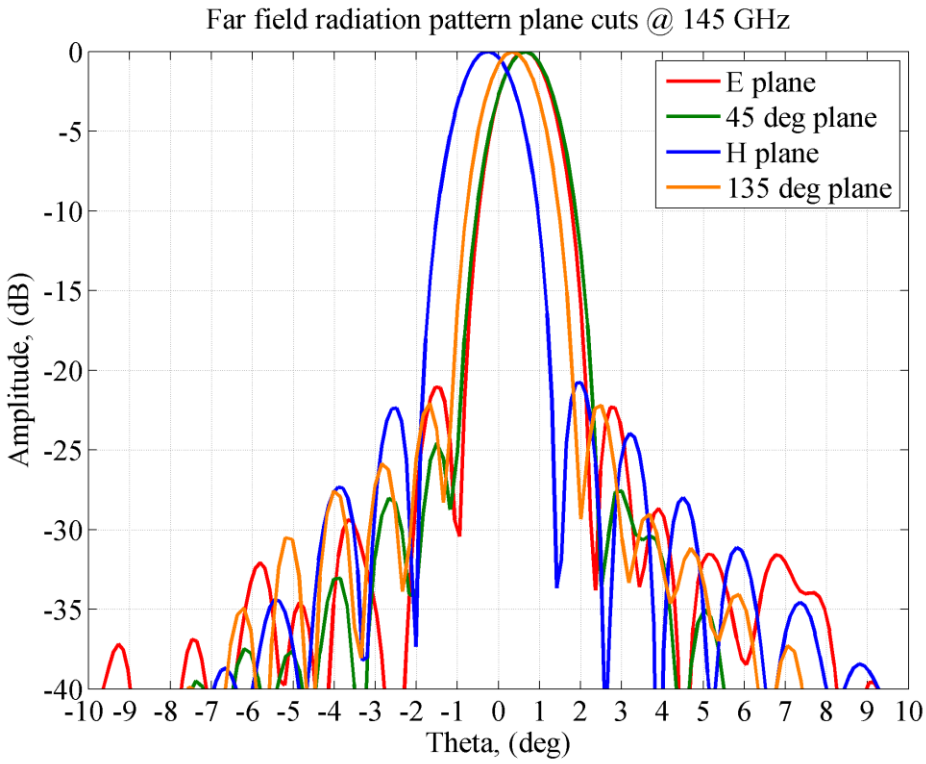

Figure 2: Antenna system far field radiation pattern

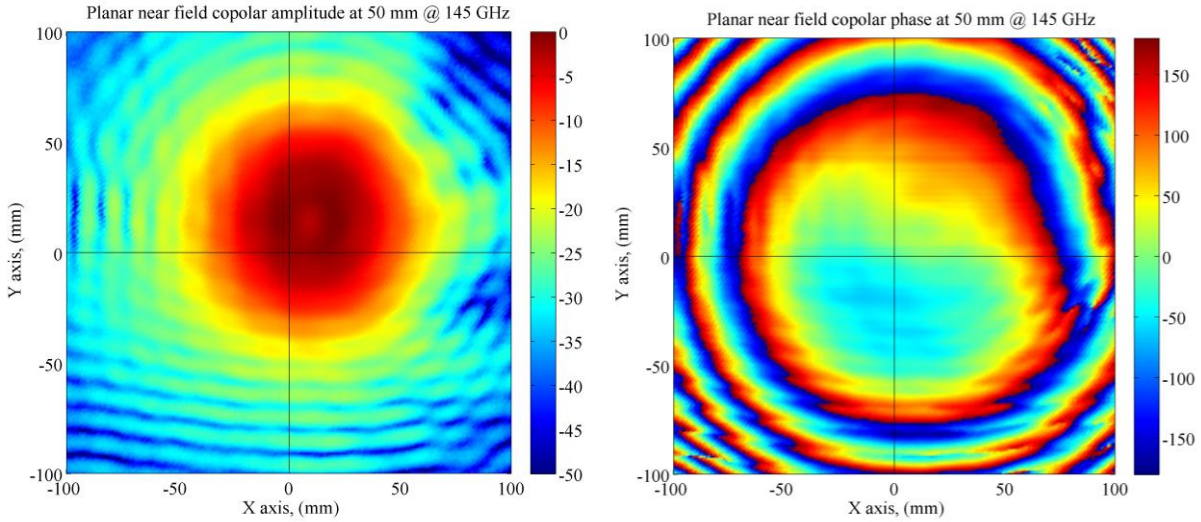

Figure 3: Antenna system planar near field

The S_{11} parameter feed horn antenna has also been measured for the complete D-Band, 110 to 170 GHz. The results are depicted below.

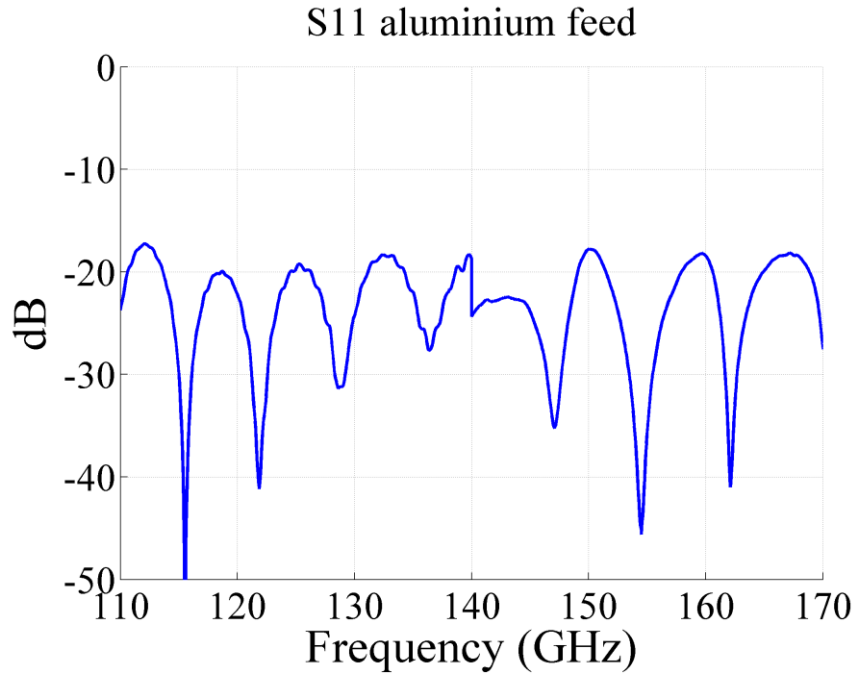

Figure 4: Aluminium feed horn S_{11} parameter

The results present a good performance for the complete frequency band. A step in 140 GHz is appreciated since the measurements have been performed using two different headsets (90-140 GHz and 140-220 GHz).

Chapter 4 Low cost Antenna System Solution

4.1 Design

The main objective of this task within the M3TERA project is to have an antenna system able to be fabricated in large scale processes. For this reason, Anteral considered that a good solution for reducing costs related to the antenna part was to fabricate it by means of 3D printing. Therefore, the antenna system design has been modified accordingly, considering the requirements and specifications that a 3D printing process might have.

The external structure of the antenna system has been modified and the resulting system will be presented in D4.3 Prototype Antenna System – Confidential version. Moreover, the fabrication process is also addressed along the confidential version of D4.3.

4.2 Test

The antenna system using the 3D printed reflector instead of the aluminium one has been tested following the same procedure. As previously mentioned, the planar near field has been measured and transformed to far field. The directivity of the complete system has also been calculated. The overall results are presented below.

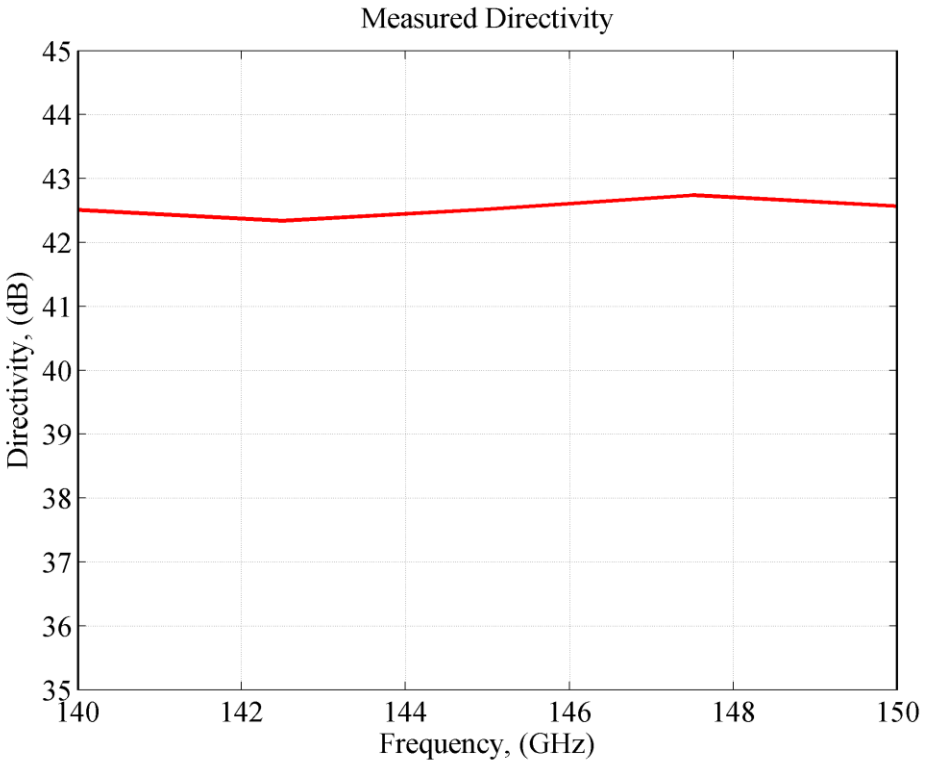

Figure 5: 3D printed reflector antenna system directivity

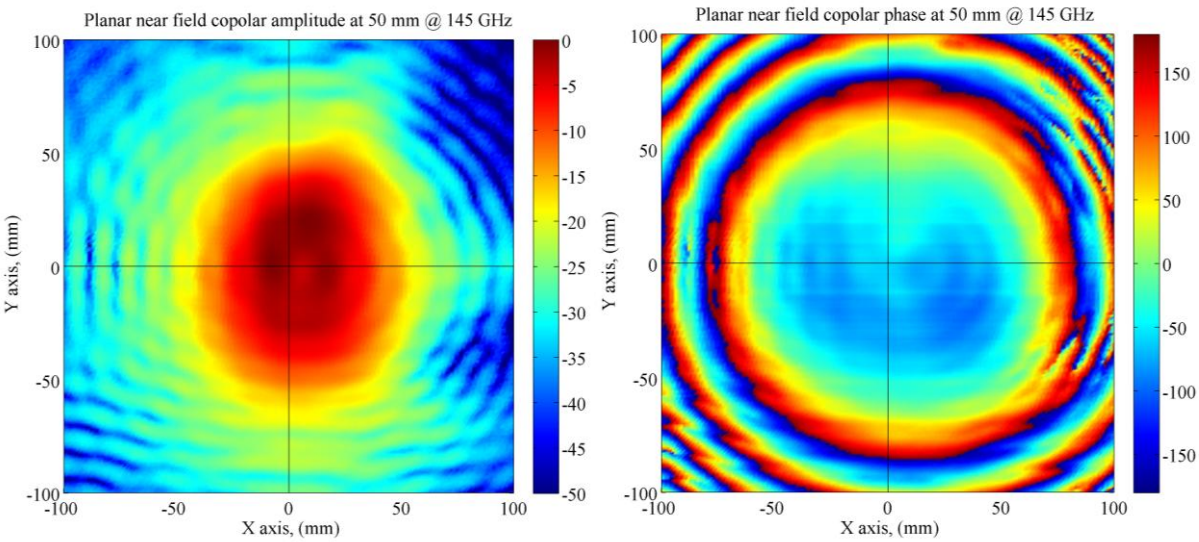

Figure 6: 3D printed reflector antenna system planar near field

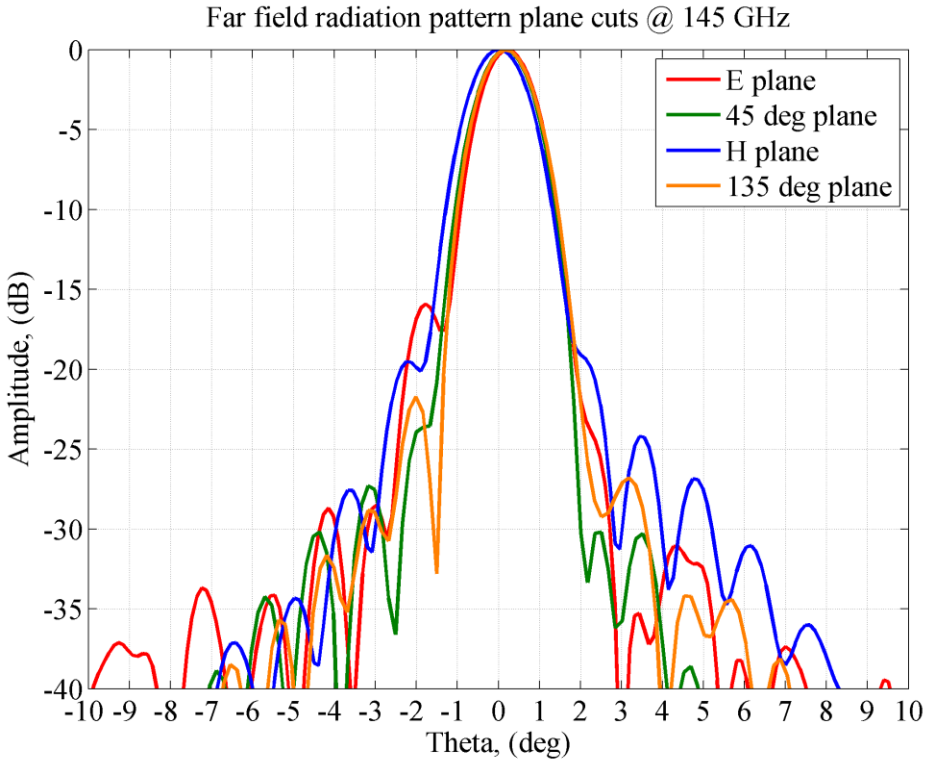

Figure 7: 3D printed reflector antenna system far field radiation pattern

Again an excellent fit between measurements and simulation, shown in D4.1 “Report on Concept and Design of an Off-set Reflector Antenna for Primary Prototype”, is obtained. An antenna systems directivity of 42.5 dB has been measured fulfilling the specifications set in D1.1 “System Specifications for the Primary and Secondary Applications”.

The S_{11} parameter of the 3D printed feed horn antenna has also been characterized for the complete D-Band. The results are presented below.

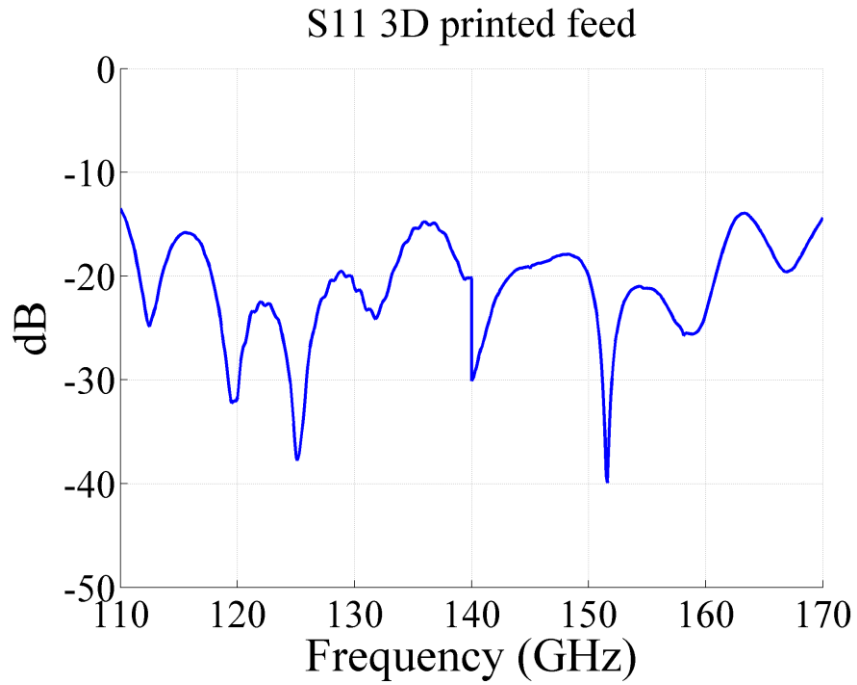

Figure 8: 3D printed feed horn S_{11} parameter

Chapter 5 Performance Comparison

Along this document the performance results of the antenna system using both an aluminium reflector and a plastic one have been analysed.

Both cases have presented equal performance. This is an important milestone since it is the first time that this kind of plastic reflector and metallizing process is employed as part of a communication antenna system instead of the commonly employed aluminium one. This new solution allows a low cost and low weight system which can be of real interest for the aforementioned application.

Figure 9 gathers the measured directivity for both solutions, using the aluminium reflector and the plastic and metallized one.

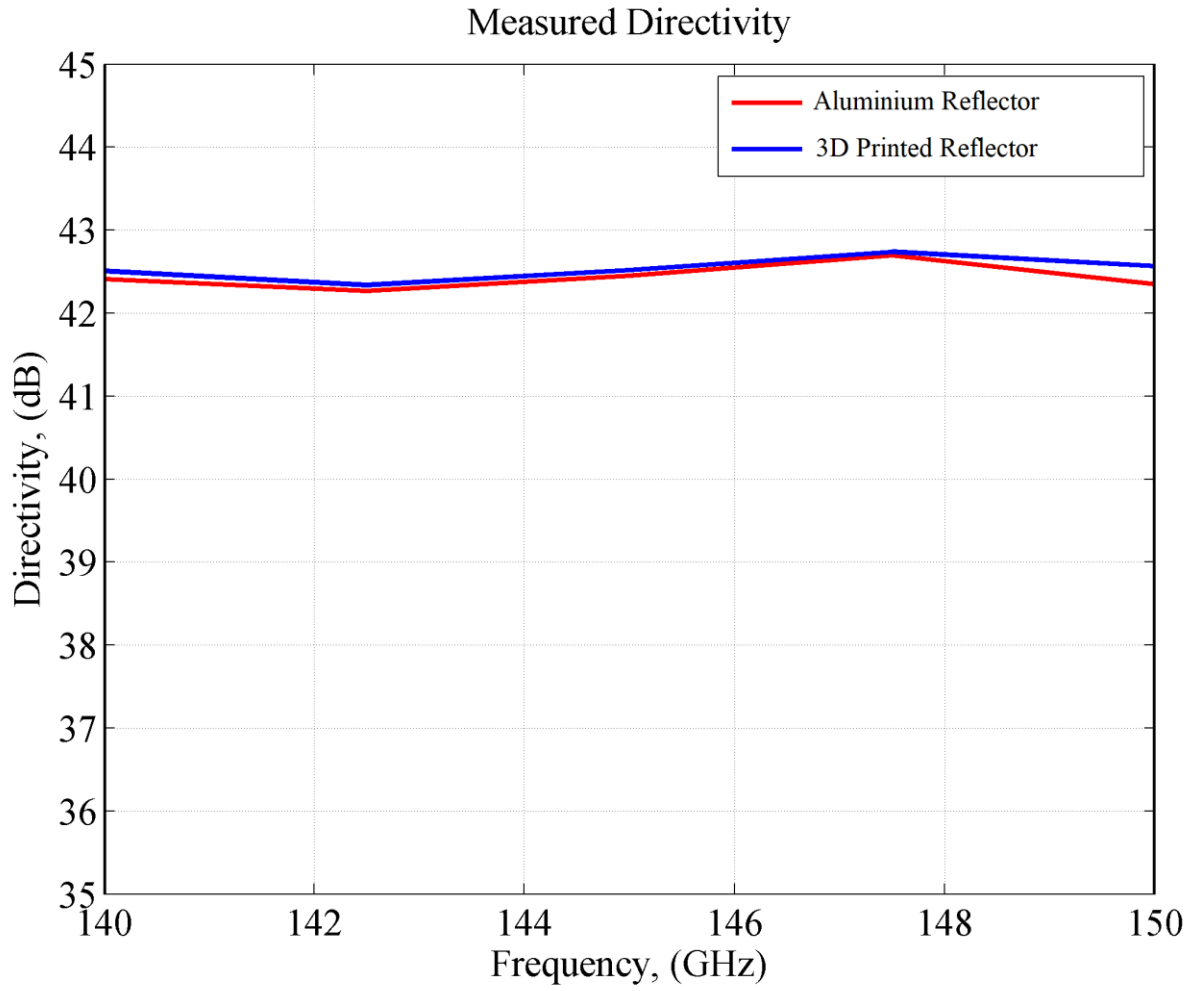

Figure 9: Measured directivity comparison

Chapter 6 Summary and conclusion

This deliverable has presented the characterization performance of the reflector antenna system prototype for the primary application of the M3tera microsystem platform. The obtained results fulfilled perfectly with the requirements established in D1.1 and with the simulation performance explained in D4.1.

Moreover, a low cost antenna system solution has been proposed using 3D printing techniques. Both reflectors, the one fabricated by a milling machine in aluminium and the plastic 3D printed one provide an equal performance allowing the use of this kind of fabrication in telecommunication applications which reduces the cost and weight of the overall solution.

Chapter 7 List of Abbreviations

THz	Terahertz
GHz	Gigahertz