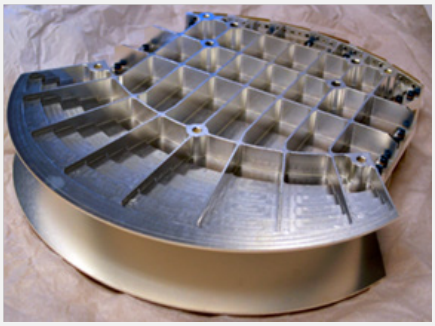
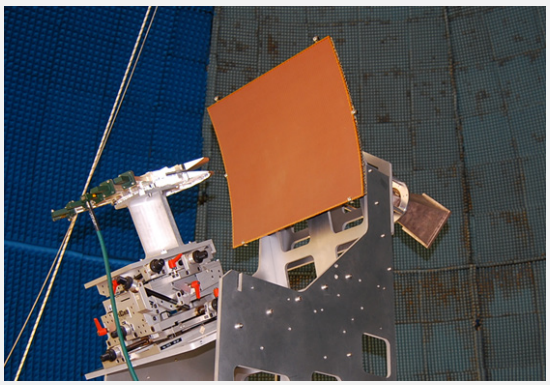
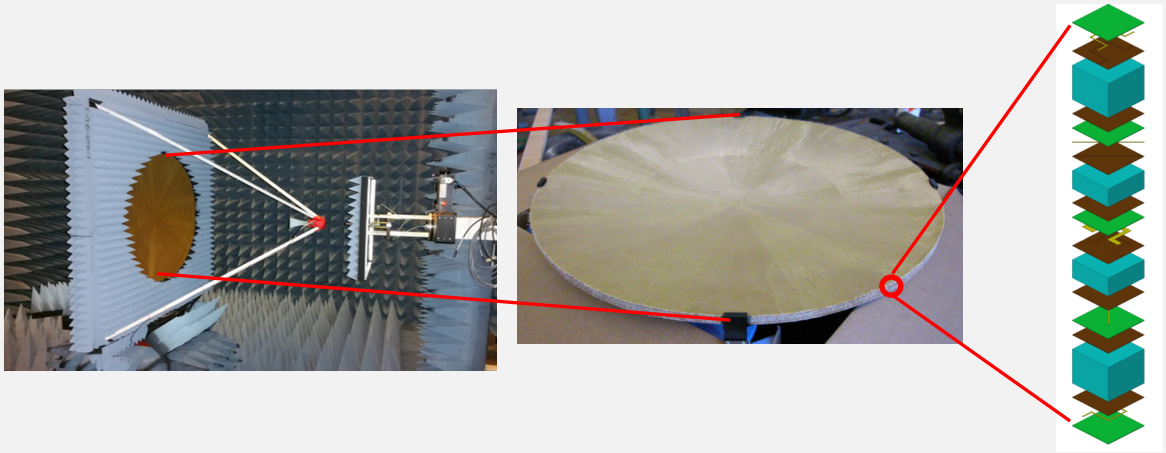
Final Presentation Day – 9 June 2016 (Nb325 meeting room)

Recent Multiple Beam Antenna Developments

9:30	**Introduction**
9:45	**Lens-Like Multiple Beam Antenna (TRP, 250 k€)** *Thalès Alénia Space (FR) and Université de Rennes (FR)*
	 A novel multiple beam antenna architecture was developed, that is based on a quasi-optical lens beamformer. It consists in the association of a doubly curved reflector with a stack of fully metallic parallel plate waveguide beamformers terminated with a flare. The resulting architecture has the capability to reduce the phase aberration over a large angular sector, and thus to improve the characteristics of the multiple beams. A novel quasi-optical beamformer based on a continuous delay lens was designed, manufactured and tested. The wide band and wide scanning capability is demonstrated at Ku band, as well as low return loss at all input ports and low mutual coupling. The agreement between measurements and simulations is outstanding, for both the S parameters and the radiation patterns. The beamformer was also designed to operate in the Ka Rx/Tx band. It is of high interest for the on-board antennas for LEO and MEO constellation systems.
10:45	**Circular Polarisation Dual-Optics Proof of Concept (TRP, 350 k€)** *Queen's University of Belfast (UK), Thales Alenia Space (FR) and Heriot-Watt University (UK)*
	 The main objective of this activity has been to develop critical Circular Polarization (CP) surfaces that will simplify the accommodation of multibeam antennas. A range of new CP surface designs including; a) a novel Circular Polarization Selective Surface (CPSS) geometry based on coupled split ring resonators; b) broadband linear to circular polarisation converters; c) dual-band dual-polarisation LP to CP converters; d) frequency selective CP absorbers with a reflection band; have been developed and validated by means of breadboards. Such designs can be exploited in e.g. a) the equivalent of dual gridded reflector antennas in CP; b) antenna architectures with multiport LP feeds; c) antennas capable to serve the down- and up-links from a single reflector and with a single feed per beam; d) reflectors with congruent beams for the up and down link frequencies. A baseline and a backup antenna architecture among those has been designed in more detail. The baseline solution was manufactured and tested, demonstrating very good agreement with theoretical predictions and thereby validating the benefits of the developed concept.
11:45	**Coffee break**

12:00	**Circular Polarisation Dual-Optics Proof of Concept (TRP, 350 k€)** *Technical University of Eindhoven (NL), TNO (NL), Lund University (SE), TICRA (DK) and ASC (DK)*
	The main objective of this project has been a proof-of-concept study of circular polarization dual gridded reflector systems. In the initial phase, two possible solutions based on Circular Polarization Selective Surfaces (CPSS) and polarizers have been investigated and assessed for different reflector configurations. At the end of the first phase, the concept based on CPSS has been selected for a more detailed design and for an experimental verification. A novel CPSS structure has been designed and its performances in a dual gridded reflector has been theoretically assessed in a realistic scenario. This structure is based on a non-resonant concept of operation, consisting of five layers of anisotropic sheets realized by metal meander lines on thin substrates, interspaced by low permittivity materials. In order to increase the bandwidth of the CPSS, the thickness of the spacers and the geometry parameters of the meander lines of each sheet have been optimized using full wave simulations in CST Microwave Studio. Throughout the target frequency band (10.75-14.5 GHz), the final design has achieved return loss and insertion loss better than 0.5 dB, for all planes of incidence, for an angle of incidence up to 30 degrees with respect to the normal direction. The axial ratio in reflection and transmission was better than 0.77 dB for almost all planes of incidence, for an angle of incidence up to 20 degrees. The CP-equivalent of a dual gridded reflector shaped in Ku band to illuminate the Australian coverage has been selected for the reflector system assessment. The antenna is implemented in a reciprocal configuration, i.e. with two CPSS surfaces. The front reflector is a reciprocal symmetric Left-Hand (LH) CPSS reflector, which reflects a field with Left-Hand Circular Polarization (LHCP) to an LHCP field while a field with Right-Hand Circular Polarization (RHCP) passes through. The rear reflector is also reciprocal symmetric and is a RH-CPSS reflector. In the last phase, a hardware demonstrator, consisting of a parabolic reflector of 75 cm diameter and an F/D=1, has been manufactured and tested, showing interesting results. From the hardware characterization, clearly emerged that the currently available manufacturing processes for large doubly curved multi-layer structure needs to be further improved. 
13:00	**Closure**