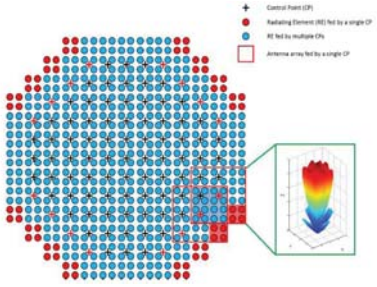
Activity Title:	***Lossless Beamforming Network for Overlapped Sub-Array Antennas***		
Contract type	**TRP**	**Budget** *(k€)*	**329,781**
Company (-ies) *(including country)*	Space Engineering S.p.A. (ITA) N.O.W. S.r.l. (ITA)		
Team *(name of the participants in the project)*	Alfredo Catalani (Space Engineering S.p.A.) Nikolas Sidiropoulos (Space Engineering S.p.A.) Marco La Rosa (Space Engineering S.p.A.) Vincenzo Pascale (Space Engineering S.p.A.) A.Morini (N.O.W. S.r.l.) G.Venanzoni (N.OW. S.r.l.) M.Baldelli (N.O.W. S.r.l.)		
(*) **Speaker (s)**	Alfredo Catalani ; Vincenzo Pascale	**Email**	alfredo.catalani@space.it; vincenzo.pascale@space.it
Short Speaker Information *(experience and involvement in this project – maximum 60 words)*	Alfredo Catalani is a senior engineer of the Antenna Department involved in several ESA studies as Project and Program Manager. He has been involved to follow and to address the BFN design in order to perform the required antenna pattern performance applicable to satellite mission scenario which considers Direct Radiating Array antenna configuration. Vincenzo Pascale is an engineer of the Antenna and Payload RF department devoted to filters and RF components design and development activities. He has been involved in the test activity of the conducted and radiating performance of the designed lossless BFN and in the consequent performance evaluation phase.		
Summary of the activity *(maximum 400 words and 2 pictures)*	The goal of the project was to demonstrate the feasibility and assess performance and development aspects of Lossless Beamforming Networks for Overlapped Sub-Array Antennas. Such BFN and Antenna configurations present several advantages with respect to a conventional active array, such as the significant reduction in the number of control elements (amplifiers, variable attenuators and phase shifters), the control of the pattern performance, the possibility to place the power amplifiers at sub-array input level, etc. The challenging nature of the project was urthermore amplified by the requirement to operate the BFN in dual-polarization. After careful trade-off between two lossless BFN concepts, a baseline has been identified in the chessboard configuration implemented in waveguide technology at 20 GHz. As next step, detailed trade-offs were performed for the definition of the key design parameters, such as radiating elements interspacing, number of levels, number of slots inside the couplers, etc. A topology based on one level (two sub-layers) of compact couplers has been selected, since it was demonstrated that adding more levels not only increases the mass and size but does not even help to achieve the desired amplitude and phase distribution at the aperture plane. A procedure for the efficient optimization of the coefficients has been developed, creating a direct link between radiated and BFN building blocks performance. Such a tool is mandatory when dealing with complex and computational consuming structures, as those involved in the lossless BFN. Using this integrated tool and accurate EM simulators capable to simulate the entire BFN within few minutes, the BFN components have been designed for manufacturing, supported by extensive tolerances analyses, multipaction threshold evaluations, etc. The key component is the 4x4 dual-polarization coupler that has been for the first time proposed in this activity in a very compact configuration, thus providing drastic (factor x0.5) savings in terms of mass, envelope and insertion loss. The BFN is fully modular. As mentioned before, the study was divided in three parts: a) Several BFN architectures were traded-off and their performance compared; BFN requirements were identified and consolidated. A preferred baseline solution was identified in the chessboard network. b) The baseline solution was deeply investigated. The detailed design of the breadboard was performed. c) The breadboard was manufactured, tested and evaluated; Lessons learnt and recommendations are drawn.  		

(*) The speaker needs to do the registration through this website