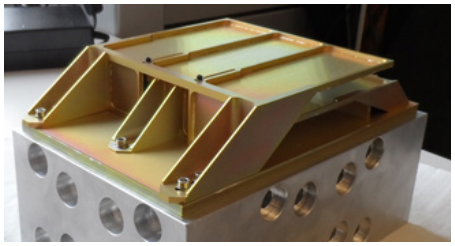
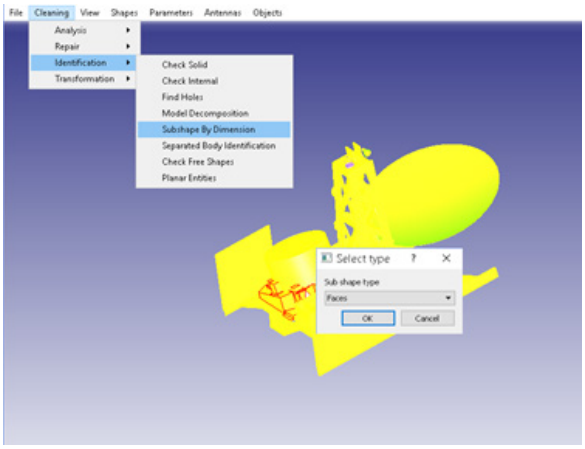
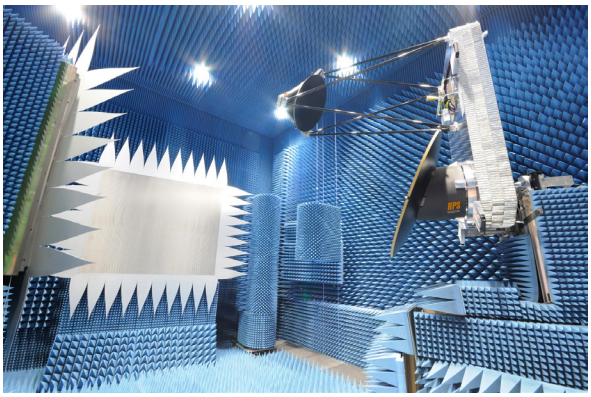
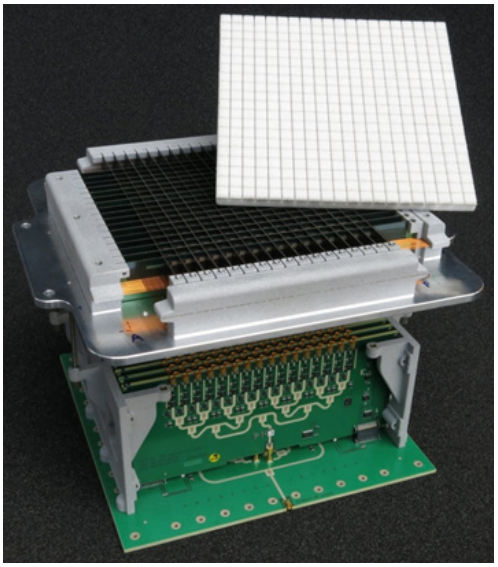
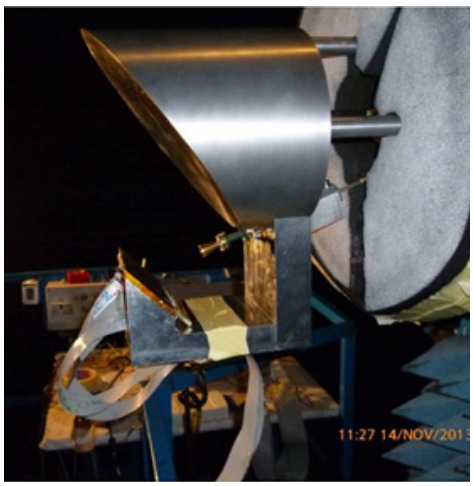
Final Presentation Day – 5 October 2015 (Newton)

Recent Antenna and Modelling Tool Developments

9:00	**Introduction**
9:15	**Novel AIS antenna and evaluation of new AIS frequencies (ARTES 21, 250 k€)** *SINTEF (NO)*
	 The project is part of the SAT-AIS ARTES 21 Design Element Programme. The main objective of the SAT-AIS Design Element is to define a satellite-based automatic identification system service that will enable maritime organizations to detect and track ships at distances from coastlines that cannot be covered by terrestrial AIS. The purpose of the project is to evaluate both antennas and new frequencies in order to optimize the performance of a satellite constellation for SAT-AIS operation. The work breakdown was twofold: 1) to investigate the potential of a compact and light weight beam-steering smart antenna for future AIS on satellite missions and 2) to evaluate the new AIS frequencies dedicated for space (channels 3 and 4 at around 156 MHz). The major critical areas were identified to be: • Size and weight of antenna vs radiation efficiency and bandwidth, • Platform dependency, • Characterization of the signal environment in the new AIS frequencies dedicated for space.
10:15	**Miniaturised multi-function antenna system (GSTP, 450 k€)** *ViaSat Antenna Systems SA (CH)*
	 The objective in this project has been to develop a tuneable UHF antenna system consisting of miniaturised radiating elements, capable of operation in three radiation modes. The end result is an Engineering Model and a design procedure supporting the customisation of the element to each mission scenario and platform. Improvements have been identified and the way forward to an EQN has been proposed. The main features are: • Miniaturized radiating elements (~$\lambda/4$) based on folded planar inverted F-antenna (PIFA) • Simple geometry (few parts; low recurring cost) easily scalable up to L or S-band • Radiating elements are independently mechanically tuneable to account for interactions on the platform • Multi-mode antenna system operating in three considerably different modes demonstrated • Software-predictable antenna system with an optimisation function for best tuning. The EM testing showed good electrical performances and tuneability, with room for further improvement, and compliance with space environmental requirements, despite the very demanding specifications.
11:15	**Coffee break**

11:30	**Parametric electromagnetic modelling (TRP, 450 k€)** *IDS – Ingegneria dei Sistemi (IT)*
	 The activity has been devoted to the development of a proof-of-concept demonstrator of a parametric electromagnetic modelling system for antenna design, antenna interactions and related radiated electromagnetic compatibility problems, based on the combination of simple-fast and accurate-slow models. The system is able to start the simulation process using existing detailed CAD models of the satellite layout and has the capability to perform parametric computations on the resulting RF-models. It includes three interweaved elements: • Semi-automated CAD model simplification and extension with electromagnetic data also handling parameterised geometries. • Parameterisation of modelling algorithms and problem partitioning, making very large problems affordable without compromising accuracy. • Physics-based parametric techniques, making complex computational procedures fast and accurate. The system kernel is programmable to allow user defined procedures, which can in turn be combined into more and more complex computational processes. The electromagnetic modelling and data processing and visualisation capabilities can be extended by adding new basic modules to the system library, via a simple wrapping mechanism. Demonstration tests have shown the applicability of the system to realistic CAD files of the complete platform as well as the effectiveness and efficiency of the whole computational core, in particular of the parametric techniques.
12:30	**Lunch break**
13:30	**Q/V band feeder link antenna (ARTES 5.1, 600 k€)** *HPS GmbH (DE)*
	 The need for wider frequency bandwidths in multimedia applications pushes payload design toward higher frequencies. Recently, a significant frequency bandwidth has been allocated by the International Telecommunication Union (ITU) in the Q/V band for Fixed-Satellite Services (FSS), making these frequencies the most promising candidates for the near future broadband systems. From on-going studies investigating next-generation high-capacity satellite architectures, it is anticipated that a first step would be a GEO mission making use of Q/V band for the feeder link, while the user link remains in Ka band. Within this frame, and under the ARTES 5.1 initiative, the European Space Agency has contracted to the team composed by HPS GmbH (as prime contractor), INVENT GmbH and TESAT GmbH (as sub-contractors), Cobham CTS Limited and other partners the development of an earth-deck antenna for feeder link applications in Q/V band (Frequency band Tx: 37.5-40.5 GHz, Rx: 47.2-50.2 GHz) to be embarked on a GEO communication satellite mission with high capacity requirements. One of the objectives of the activity was to perform an antenna architecture trade-off to identify the most suitable antenna geometry for such an application taking into account RF and thermo-mechanical aspects. As best antenna configuration a Gregorian offset geometry has been selected and validated with an EM (Engineering Model), including a representative feed chain.

14:30	**ACTiFE-Advanced Antenna Concepts for Aircraft in Flight Entertainment (ARTES 5.1, 999 k€)** *ATH – ASTROTEC HOLDING and TNO (NL)*
	 The objective is the definition and development of a fully electronically steerable transmit-receive antenna system in Ku-band for aircraft in-flight entertainment via satellite. Phase 1 of the project includes several system related subjects such as regulatory aspects, design constraints and trade-off between different architectures as well as a preliminary design for a demonstrator antenna. Phase 2 of the project consist of the design, build and test of a demonstrator connected array antenna. A connected antenna array consisting of 16x16 dual polarized elements has been designed, built and tested, to demonstrate the connected array principle for obtaining a wideband (10.7-14.5 GHz) antenna array configuration with wide scanning capabilities and high polarization purity. Its intended application is for Ku-band Tx-uplink (10.7-12.75 GHz) and Rx-downlink (14.0-14.5 GHz) satellite communication systems having only a single electronically steerable antenna. Test support equipment has been designed, built and applied, consisting of 512 channels controlling both phase and amplitude. As such it can drive each individual connected array element (16x16x2pol) in phase and amplitude and generate a resulting antenna beam that can be steered in any direction (up to at least 60 degrees) with any variable linear or circular polarization. Future development steps shall focus on the manufacturability of the connected antenna array assembly and on the integration of available dedicated MMIC functionality for the phase-amplitude control electronics.
15:30	**Innovative reconfigurable systems based on Liquid Crystals (TRP, 450 k€)** *NPL (UK)*
	 Two experimental devices which exploit the dielectric anisotropy of Liquid Crystals have been designed, fabricated and tested at frequencies above 100 GHz: i) A phase agile polarizing mirror which converts an incident slant 45 degree signal upon reflection to right hand circular, orthogonal linear or left hand circular (LHCP) polarization depending on the value of the voltage biasing the LC mixture. The polarisation converter is designed to work in a frequency band centred at 130 GHz ii) An electronically tunable Liquid Crystal (LC) reflectarray which exhibits a large phase range, bandwidth enhancement and beam scanning. An accurate electromagnetic modelling procedure has been developed for the analysis and design of the antenna, and the simulations show an excellent agreement with the measurements. The LC-reflectarray (54x52 cells) has been measured in three configurations: 1) In a quasi-optical bench to show the phase range and losses of the cells, providing an 8% bandwidth around 100 GHz and 330º of phase range. 2) As a single antenna where an electronic beam scanning in one plane with an angular range of 60º and a bandwidth of 8% (from 96 GHz to 104 GHz) have been achieved. 3) And as subreflector in a dual-reflector configuration (shown in the figure), designed to provide an electronically steerable beam in a range from -8º to +6º in elevation with 30 dBi of gain.
16:30	**Closure**