S-BAND WORKSHOP
ESA/ESTEC – Noordwijk
May 14th -15th, 2012

A workshop dedicated to the S-band is organised on the 14th and 15th of May 2012 in the Einstein Room at ESA’s ESTEC facility in Noordwijk, The Netherlands. This workshop gathers the results of several ARTES funded activities in the S-band domain. This event will join together industry and operators interested in the S-band with the aim of fostering communication and exchange of ideas for the future of the S-band in Europe. All those interested to attend, please contact Ms. Ana Bolea Alamanac (ana.bolea.alamanac@esa.int) in copy to Ms. Edel Kinsella (edel.kinsella@esa.int).

Summary

Next Generation Interactive Broadcast Mobile Networks (Space Eng., Italy)
The study explored the benefits of advanced air interface techniques as well as advanced payload/ground segment solutions for providing more cost effective broadcast/interactive services in the near future. Main emphasis is on validating the merits of the new promising solutions (e.g. MIMO, interference cancellation, on-ground beamforming, hybrid satellite/terrestrial coverage) with particular regard to a possible future application for an S-band mobile satellite systems.

On Ground Beamforming Techniques (Astrium France, France)
Two alternative approaches have been followed in the development of recent multispot mobile satellite systems: systems like Inmarsat 4, Inmarsat XL or Thuraya satellites are based on On-Board Beamforming and channel routing techniques; on the other hand, US mobile satellite service operators (i.e., ICO-G1, Terrestar-1 and Skyterra-1) have adopted On-Ground Beamforming techniques. The objective of this activity is to evaluate the potential benefit of On-Ground Beamforming compared to On-Board Beamforming in terms of complexity / mass / power and cost for missions with a high number of spot beams, like in future Mobile Satellite Systems.

S-Band High-Power Reconfigurable Front-End Demonstrator (TAS-E, Spain)
S-band flexibility requirements in terms of power and beam allocation pose the need for advanced power amplifiers and flexible RF-Front-End/Antenna architectures. The Semi-Active Multimatrix antenna architecture, proposed in the early 90’s by the Agency, combines the power flexibility and the antenna reconfiguration capability, thus providing
an excellent choice for flexible payloads. This study applies this type of architecture to an European coverage with 9 linguistic beams. Several optimizations have been used to reach the best configuration in terms of feed cluster size, frequency reuse scheme, interconnection matrix, and BFN phase shifters values.

**Very High Power S-band TWTAs (Thales Electron Devices, Germany)**

This presentation describes the results achieved in the development of a complete Very High Power S-band Traveling Wave Tube Amplifier (TWTA) delivering up to 500 W RF output power (+3 dB w.r.t. current technology). Several ARTES activities have enabled this development: one dedicated to the design, manufacture and test of the TWT, another one to the development of the Electronic Power Conditioner (EPC) and a third one to the qualification of a new waveguide output WR340 1/4 height, which represents a robust solution for higher power levels.

**Low cost S-band Rx/Tx antenna for vehicular applications (Calearo, Italy / Jast, Switzerland)**

The aim of the project is to develop two antenna products, namely a Receive/Transmit and a Receive only antenna. The antennas need to cope with the hybrid satellite and terrestrial environment of DVB-SH architecture. The antennas need to be designed according to automotive market constraints, which means low cost, and highly integrated antenna units. Two parallel contracts were launched to exploit the complementarity of two proposals. In fact, the CALEARO activity is more focused on industrialisation of the final products and strong link with car manufacturer, while the JAST activity is more focused on an optimised design of the antennas. These contributions show the major achievements about design details, manufacturing aspects and testing of the developed units.

**MIMO Hardware Demonstrator (Elektrobit, Finland)**

The objective of this activity is to demonstrate the effective advantages of MIMO techniques by building an HW demonstrator and operating it in a realistic environment. The main target scenario for the demonstrator is the S-band hybrid satellite/terrestrial broadcast multimedia to mobile based on DVB-SH. During this activity several MIMO techniques have been investigated, assessing their performance by means of computer simulations. Then, the selected techniques are being implemented in the target demonstrator platform, including FPGA-based transmitters (for both space and ground components) and receiver and a COTS channel emulator.

**DENISE / ETSI S-MIM (DLR, Germany)**

The DENISE project aimed at designing a S-band interactive system capable of efficiently using the available bandwidth to provide Interactive mobile broadcast services enhancing the DVB-SH offer, Messaging
services for handhelds and vehicular terminals, and real-time emergency services such as voice and file transfer (mainly addressing institutional users on-the-move such as fire brigades, civil protections, etc). The system has been standardised within ETSI with the name of S-MIM (S-Band Mobile Interactive Multimedia).

Cost benefit of integration of LTE and satellite networks (Mott MacDonald, Netherlands & Alcatel Lucent, France)

This study analyses the benefits of integration of LTE and satellite networks in different scenarios:

- **Scenario 1:** Terrestrial only access complemented by satellite based backhaul
- **Scenario 2:** Hybrid terrestrial and satellite optimised access
- **Scenario 3:** Partial harmonised terrestrial and satellite access
- **Scenario 4:** Converged terrestrial and satellite access

A discussion on implementation challenges and feasibility for each scenario will be provided together with the use cases and potential benefits including market forecast.

Characterisation of the MIMO channel matrix for mobile satellite systems (FhG, Germany)

The objective of the activity has been to extend state-of-the-art land mobile satellite propagation channel models for including MIMO techniques at S-band, in particular dual-circular-polarisation, both for co-located and distributed antennas at the vehicular terminal. An experimental campaign of over 15 hours has been carried out using W2A satellite broadcasting in dual-polarisation mode and a measurement van with 6 antenna ports activated in a combination of co-located dual-polarised and separated antennas. Furthermore, a wideband measurement campaign in urban areas (Berlin downtown) has been carried out using a channel sounder, with transmitter on top of the highest city building as satellite emulator, and antenna arrays. A narrowband and wideband channel simulator software has been developed.

S-Band Receiver Chipset (FhG, Germany)

The primary goal of this activity is the development of a fully standard compliant DVB-SH demodulator, supporting both terrestrial and satellite components, and SH-A and SH-B architectures. This DVB-SH demodulator has been optimized for best user experience in mobile scenarios. It can be mapped to virtually any ASIC or FPGA technology. The configurable and flexible architecture enables an optimal trade-off between complexity and functionality depending on the use-case.

S-Band Receiver Chipset (SIDSA, Spain)
SIDSA has developed a full-standard DVB-SH Intellectual Property block. The design has been mapped into an FPGA emulation platform and successfully tested in an extremely complete set of field trials. It has also been synthesized into a 65nm ASIC chipset with flexible RF front-end, programmable ARM-based architecture and clean, layered, modular architecture. The project has also tried to address the challenges of a changing technical and commercial situation and rising manufacturing costs.