

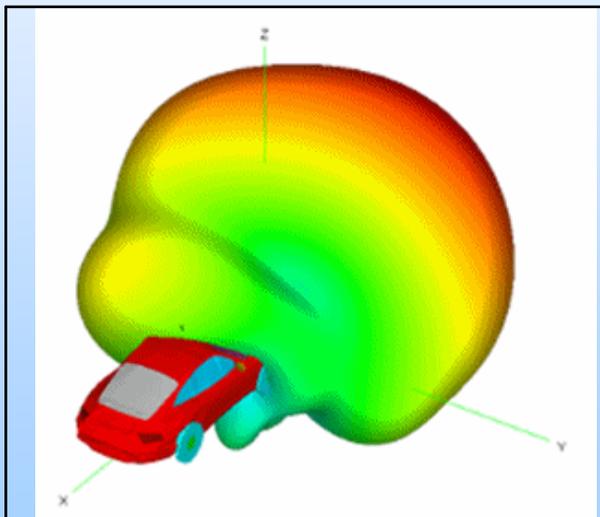
# *CARE*

*Coordinating the Antenna Research in Europe*

*CARE and the ABPGs*

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In **WP2**, the **Antennas Best Practices Groups** will provide the software tools to easily assemble complex antenna simulation and will distribute the state-of-the-art antennas measurement procedures able to guarantee the highest level of quality in indoor and outdoor Test Field.



*Obstacle radar antenna pattern  
(KIT)*



*Measurement of radiometer antenna system  
for ESA's Soil Moisture and Ocean Salinity  
mission at the DTU-ESA Spherical Near-  
Field Antenna Test Facility*

# *APBG1 - Software*

# Who are we ?

software

| No.                     | Full name  | Short name | Country     |
|-------------------------|--|------------|-------------|
| <b>Activity Leaders</b> |  |            |             |
| 2                       | Katholieke Universiteit Leuven   | KUL        | Belgium     |
| 13                      | Institut National des Sciences Appliques de Rennes   | IETR       | France      |
| <b>Participants</b>     |  |            |             |
| 1                       | IDS Ingegneria die Sistemi Spa   | IDS        | Italy       |
| 2                       | Katholieke Universiteit Leuven   | KUL        | Belgium     |
| 4                       | TICRA Fond   | TICRA      | Denmark     |
| 8                       | France Telecom R&D   | FT R&D     | France      |
| 10                      | Thales Airborne Systems  | TAS        | France      |
| 12                      | Centre National de la Recherche Scientifique   | CNRS-LEAT  | France      |
| 13                      | Institut National des Sciences Appliques de Rennes   | IETR       | France      |
| 16                      | IMST Gmbh  | IMST       | Germany     |
| 18                      | Institute of Communication and Computer Systems of the National Technical University of Athens | ICCS/NTUA  | Greece      |
| 19                      | Universita degli Studi di Roma "La Sapienza"   | SAPIENZA   | Italy       |
| 20                      | Polytecnico di Torino  | POLITO     | Italy       |
| 22                      | Universita degli Studi di Firenze  | UNIFI      | Italy       |
| 23                      | Universita degli Studi di Siena  | UNISI      | Italy       |
| 26                      | Universitat Politecnica de Catalunya   | UPC        | Spain       |
| 27                      | Universidad Politecnica de Madrid  | UPM        | Spain       |
| 28                      | Universitat Politecnica de Valencia  | UPV        | Spain       |
| 29                      | Chalmers Tekniska Hogskolan  | CHALMERS   | Sweden      |
| 31                      | Swedish Defence Research Agency  | FOI        | Sweden      |
| 35                      | Ecole Polytechnique Federale de Lausanne   | EPFL       | Switzerland |
| 39                      | University of Bristol  | UOB        | UK          |
| 40                      | The University of Liverpool  | LIVUNI     | UK          |



- *Inventory !!!*

- *standardized and detailed description of software tools available on the VCE*

- » *ACE partners*

- » *non-ACE, research*

- » *commercial solvers*



# CARE Q2: *How good is this software ?*

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- *benchmarking !!!*

- *standardized and detailed procedure for benchmarking*

- » *ACE partners*

- » *non-ACE, research*

- » *commercial solvers*

- **first run**

- elements, open
- 14 partners, 18 tools, 36 simulations

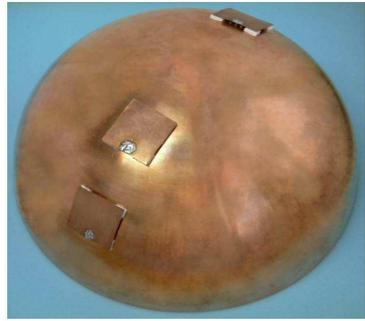
- **second run**

- finite arrays, blind
- 8 structures, 14 partners + 2 vendors, 17 tools, 28 simulations

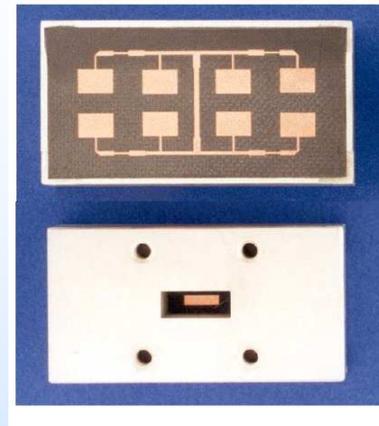
- **third run**

- environment
- 5 structures

[Link with A1.2](#)



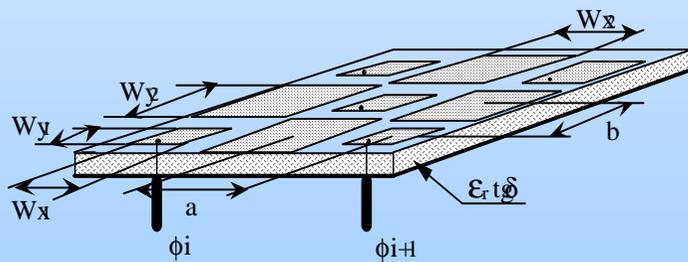
ZAGREB



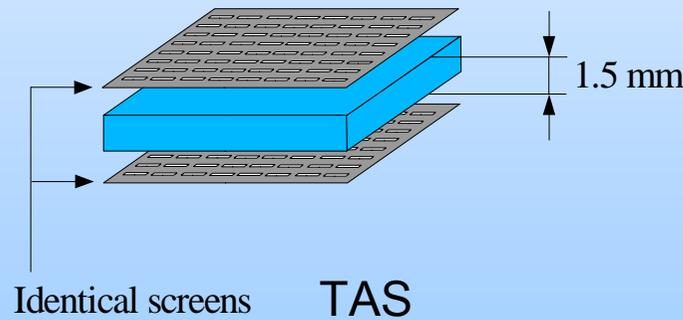
IMST



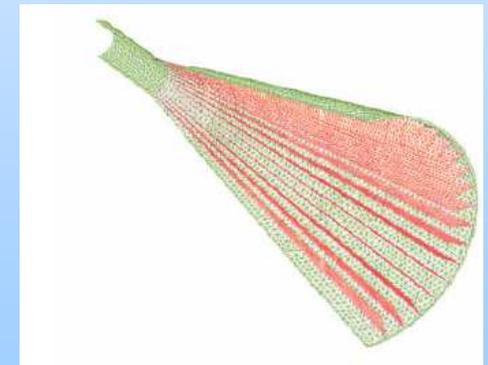
CHALMERS



CNRS-LEAT

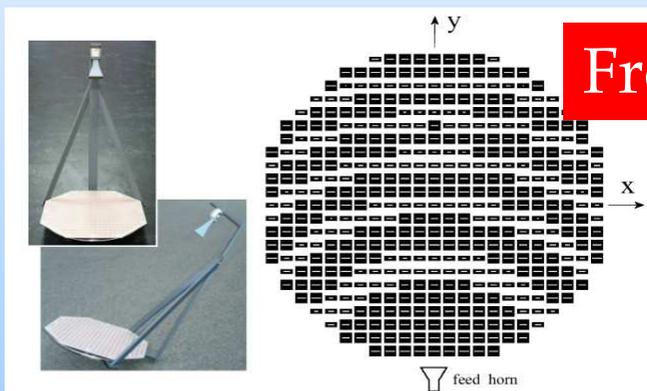


*Array structures*



FT R&D

- ✓ Challenging reflectarray structures (more than 4000 radiating patches for UPM structure)
- ✓ Multilevel approaches are used

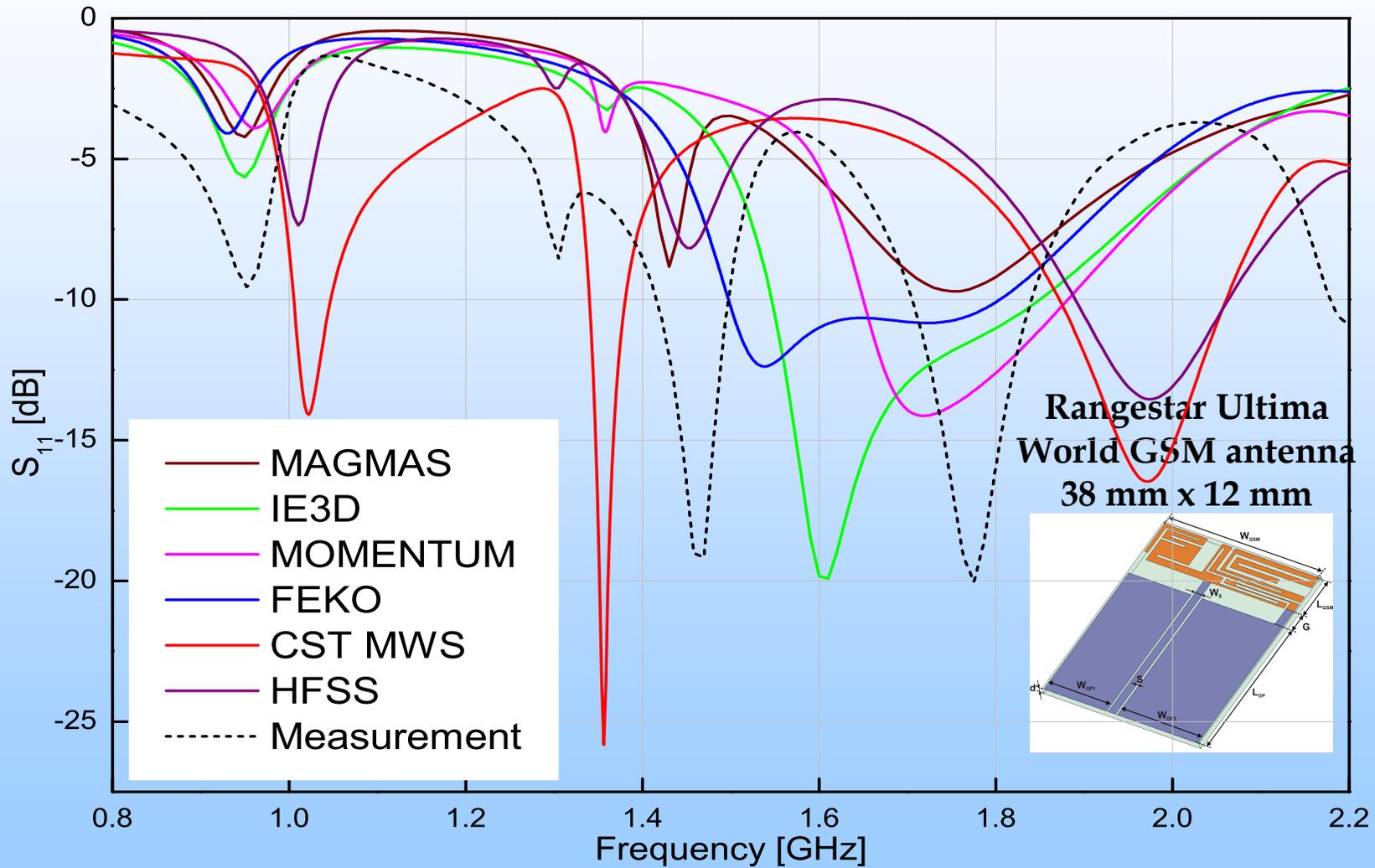


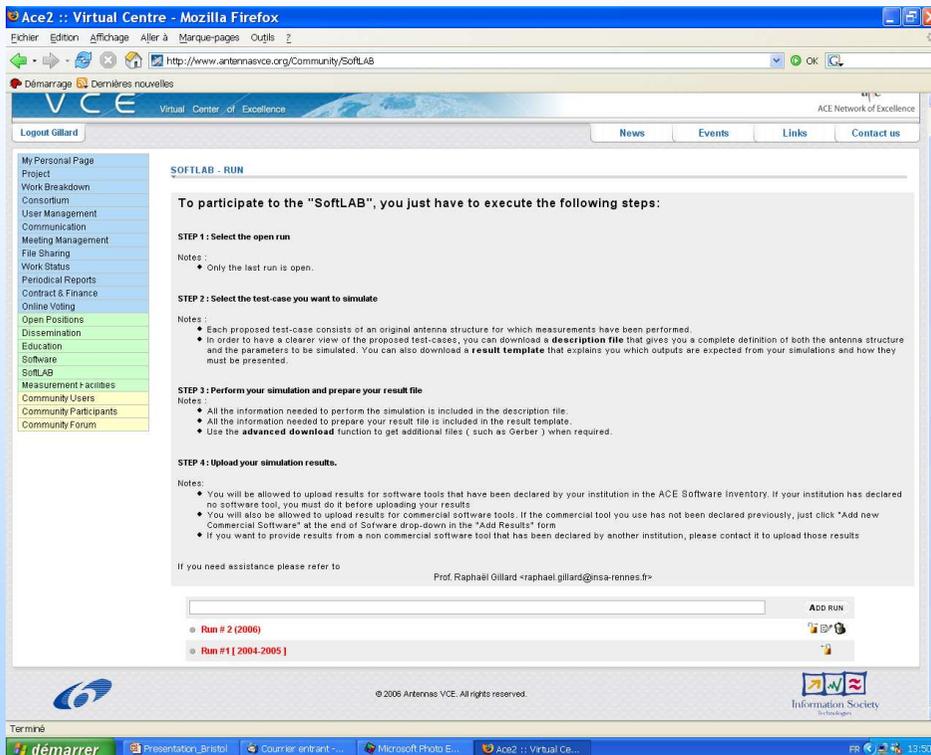
From A2.4

IETR/ALCATEL



UPM





✓ Online service for benchmarking within VCE

✓ Open to anyone in the antenna community

✓ Possibility to see benchmark results and to participate in

- *duration = 1 year*
- *organized around EuCAP, first meeting was last Tuesday*
- *procedure:*
  - *partners propose through SOFTLAB*
  - *software WG meeting at EuCAP (inaugural meeting 24/03/09)*
  - *democratic selection process (4 structures were selected)*
  - *analysis of structure by partners*
  - *reports are uploaded to SOFTLAB*
  - *discussion of results at next meeting*
  - *each structure = paper proposal in session of software WG*

- *Cylindrical structure:  $(z, \varphi, r)$*

$$E_z(r, \varphi, z) = \iint_{z' \phi} K_z^e(\phi', z') \cdot G_z^{E, K, e} d\phi' \cdot dz' + \frac{d}{dz} \iint_{z' \phi} (\vec{\nabla}_t \vec{K}^e) \cdot G_z^{E, \sigma, e} d\phi' \cdot dz'$$

$$E_\varphi(r, \varphi, z) = \iint_{z' \phi} K_\varphi^e(\phi', z') \cdot G_\varphi^{E, K, e} d\phi' \cdot dz' + \frac{1}{r} \frac{d}{d\varphi} \iint_{z' \phi} (\vec{\nabla}_t \vec{K}^e) \cdot G_\varphi^{E, \sigma, e} d\phi' \cdot dz'$$

$$G(z-z', \varphi-\phi')$$

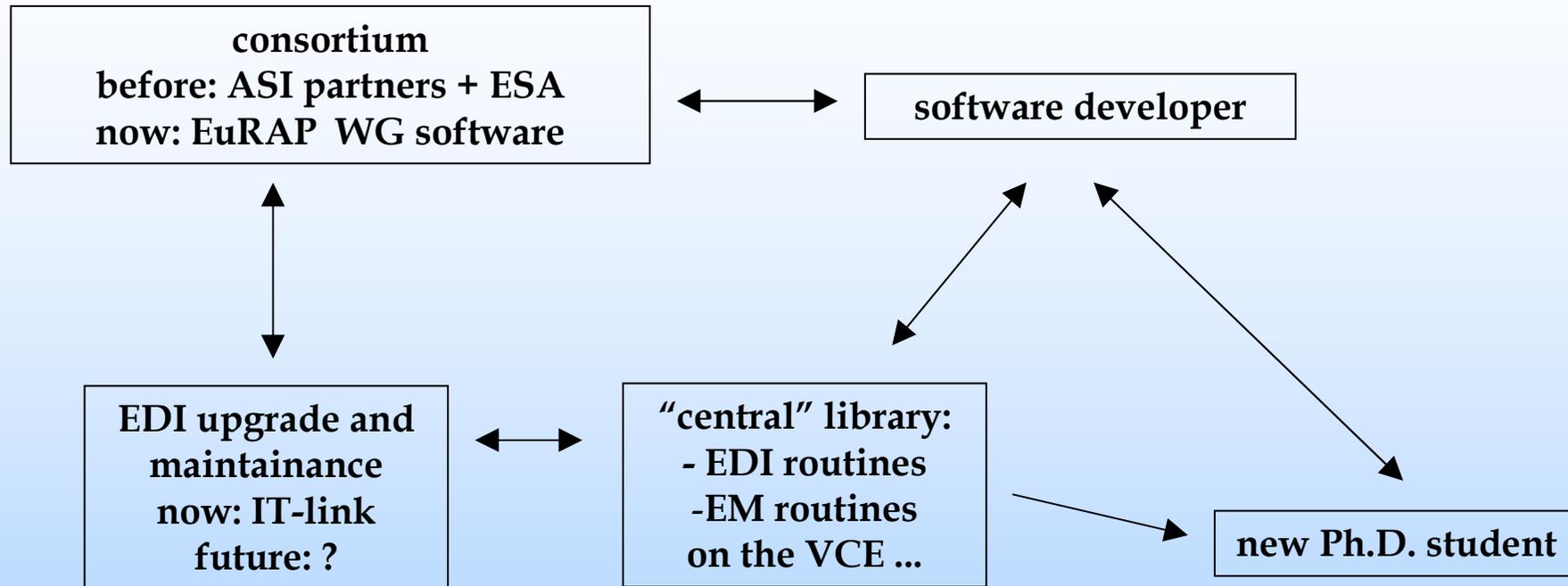
**functions of 2 variables**

**NOW:**

- *use of commercial monolithic software tools*
- *software development at a research level*
  - *only exchange of scientific information*
  - *no standardized exchange of software routines*

*This is a waste of effort, time, ... and thus money*

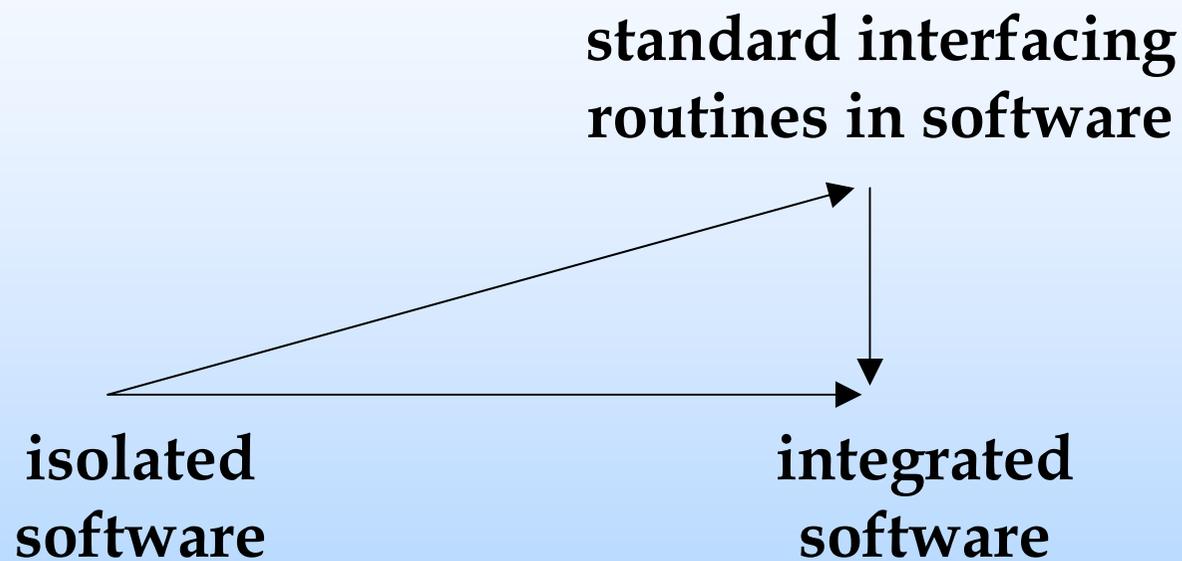
- *the new Ph.D. student ...*
- *low efficiency ... few users ...*



- ACE has provided the means to start-up this process and to lay the technical foundations
- EurAAP has the duty to continue this effort
- CARE will support this action

- *The Electromagnetic Data Interface (EDI)*
  - *6 Data Dictionaries (DD) completed*
    - » *near fields, far fields, currents and meshes: full agreement in a wider European group of partners, not only ACE*
    - » *Green's functions, modes: agreement at ACE level*
    - » *S-parameters: easiest, already some "standardization"*
  - *EDI routines implemented for 3 DDs in Matlab, Fortran, and C*
  - *implementation inside software of 10 ASI partners*
  - *establishment of the EDX working group*
- *European library of routines*
  - *through integration projects between partners*
  - *new analysis schemes: SIG on Structures and Structuring:*
    - » *based on available library*
  - *PROBLEM: at this moment: **DISTRIBUTED LIBRARY***

- **an already committed group**
  - (KUL, IDS, SATIMO, THALES, TICRA) + (ERICSSON + ESA-ESTEC + IT-Link)
  - open for other partners
- **plan organized around 4 topics will be implemented**
  - short term evolution: TICRA
  - standardization: SATIMO
  - user community: KUL
  - long-term management: ITLink
- **meetings**
  - Noordwijk, October 2008: kick-off (under the ACE umbrella)
  - Rome, February 2008: first technical meeting
  - Berlin, March 2009: first meeting under EuRAAP umbrella



- *ASI has given the European antenna software community an identity, a profiled structure where things can be discussed ...*
- *ASI has initiated a software harmonization and standardization process within Europe*
- *ASI has intensified considerably the interaction in between universities, and between universities and industry*
- *ASI has produced a considerable number of cooperative publications and has triggered a lot of bilateral cooperations*

# *ABPG2 - Measurements*

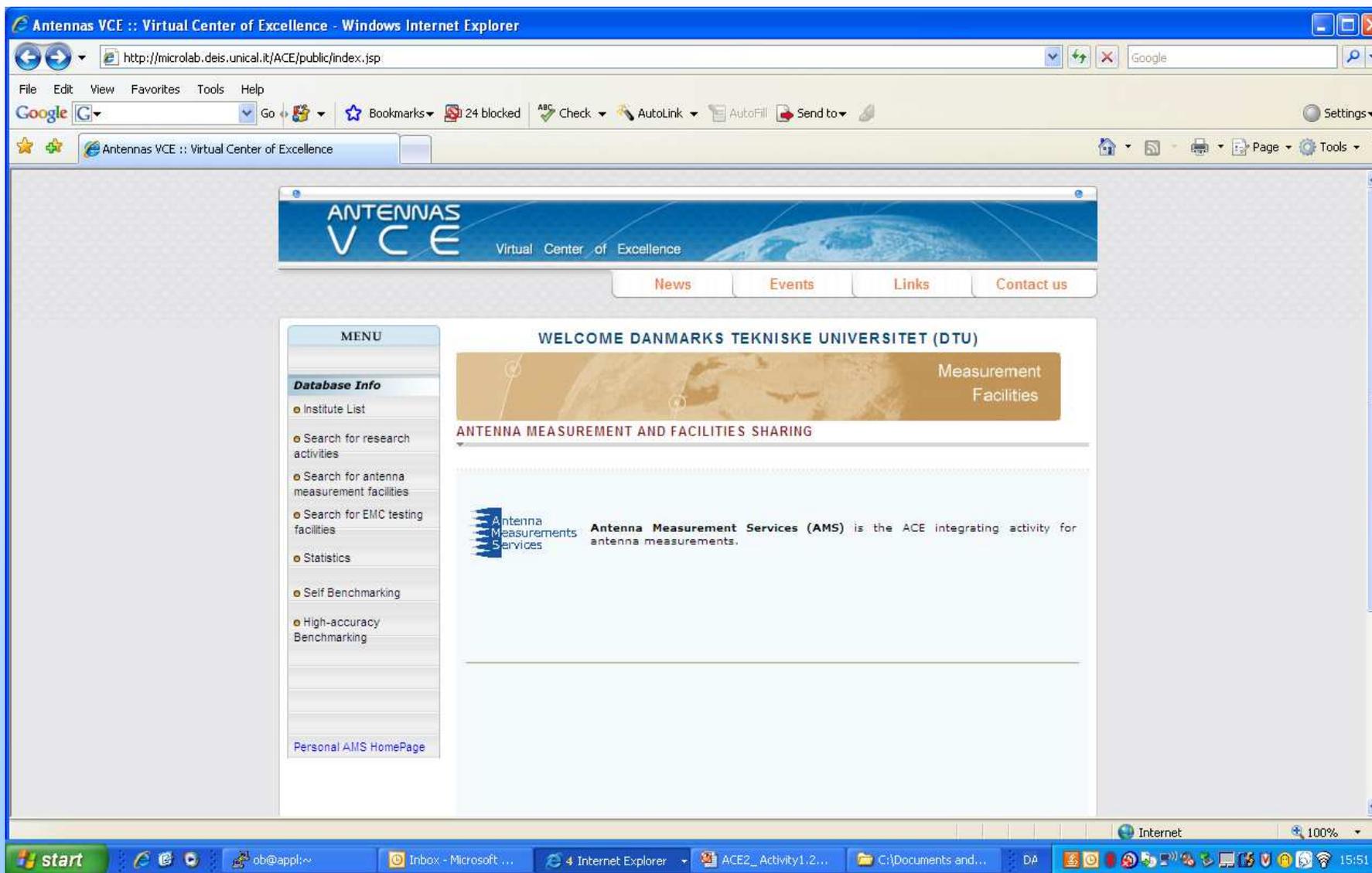
measurements

## 17 ACE Partners

- DTU
- EMW
- FTRD
- HUT
- IETR
- IMST
- *LIVUNI*
- NSCRD
- *SATIMO*
- SES
- TICRA
- UNICAL
- UNICAS
- UNIOVI
- UPC
- UPM
- TUD
- WUT

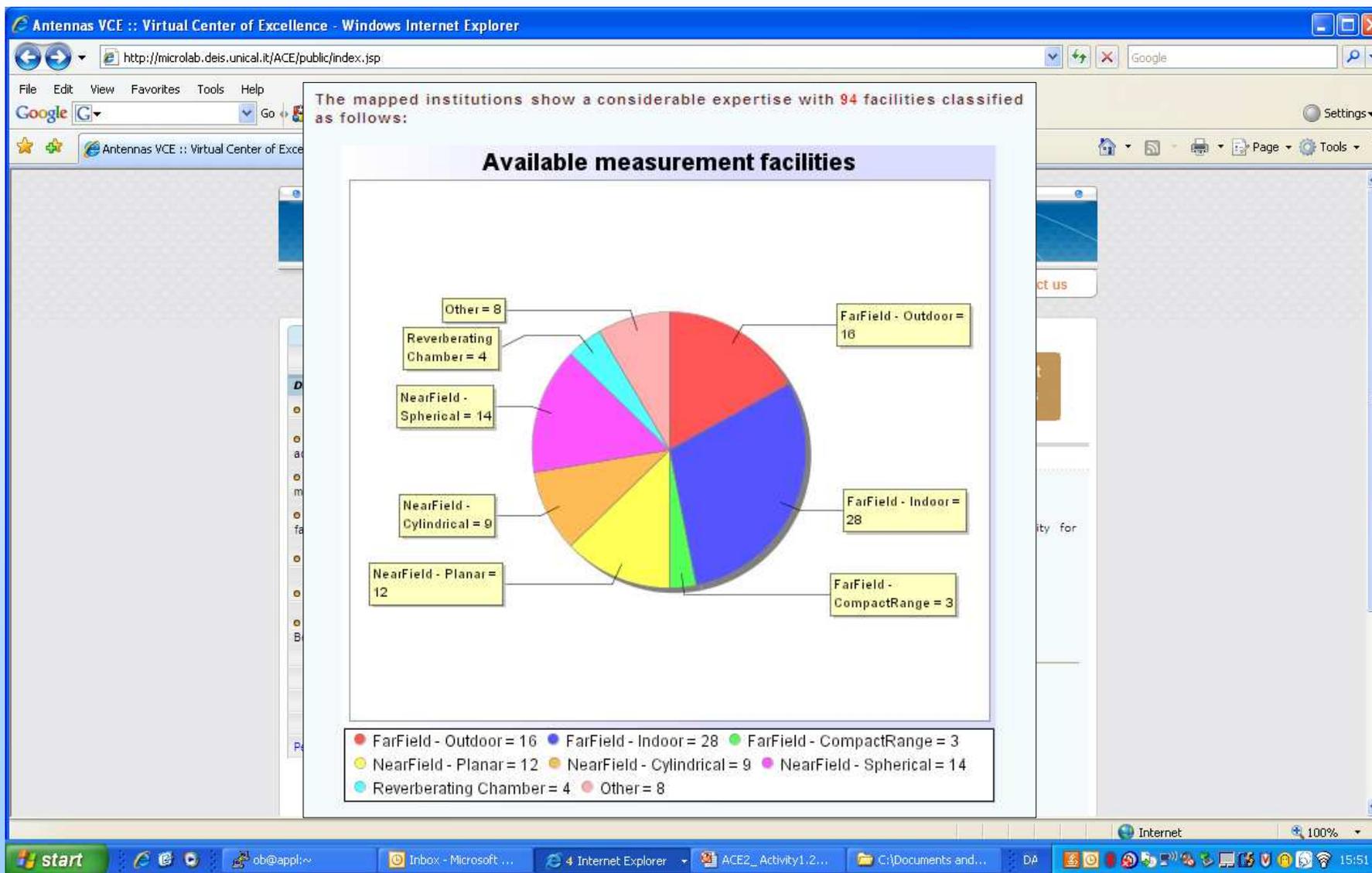


# CARE Q1: What infrastructure do we have ?



The screenshot shows a Windows Internet Explorer browser window displaying the website for the Antennas VCE (Virtual Center of Excellence). The browser's address bar shows the URL <http://microlab.deis.unical.it/ACE/public/index.jsp>. The website header features the "ANTENNAS VCE" logo and the text "Virtual Center of Excellence". Below the header are navigation buttons for "News", "Events", "Links", and "Contact us". A "MENU" sidebar on the left lists various options under "Database Info", including "Institute List", "Search for research activities", "Search for antenna measurement facilities", "Search for EMC testing facilities", "Statistics", "Self Benchmarking", and "High-accuracy Benchmarking". The main content area is titled "WELCOME DANMARKS TEKNISKE UNIVERSITET (DTU)" and includes a "Measurement Facilities" section. Below this, there is a section for "ANTENNA MEASUREMENT AND FACILITIES SHARING" which describes "Antenna Measurement Services (AMS)" as the ACE integrating activity for antenna measurements. The Windows taskbar at the bottom shows the Start button, several open applications (Inbox, Internet Explorer, ACE2\_Activity1.2...), and the system tray with the time 15:51.

# CARE Q1: What infrastructure do we have ?



- *example:*
  - SOLIVAR



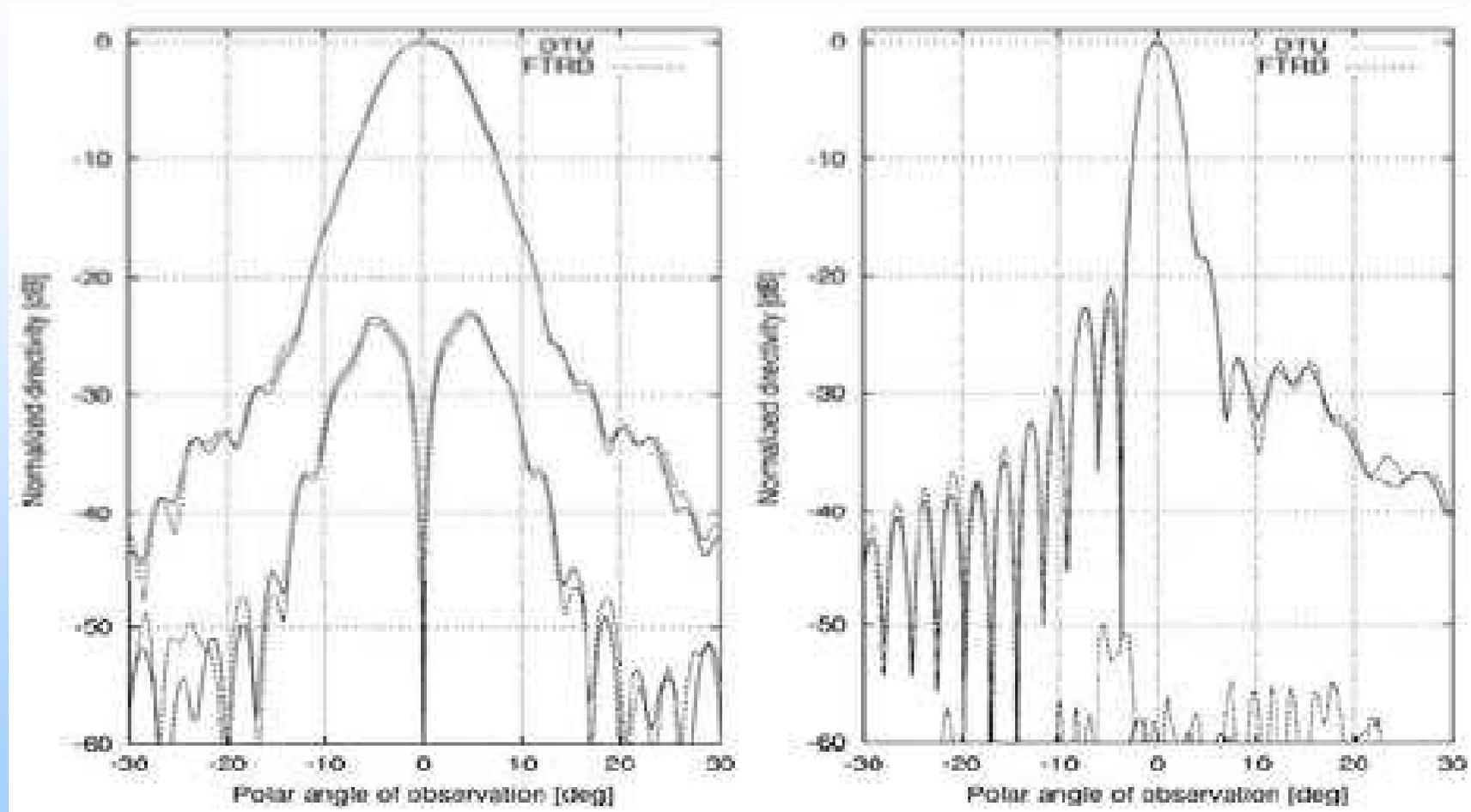
- offered to the Antenna Community
- through the ACE Virtual Center of Excellence

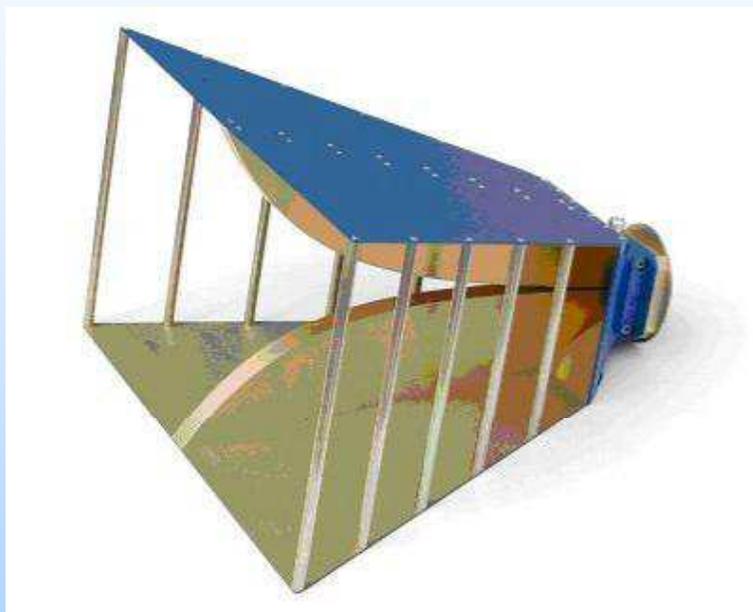
- *comparison campaign*

- DTU-ESA 12GHz Validation Standard Antenna (VAST)
- SATIMO, SH800 0.8-12GHz Dual Ridge Horn (DRH) in the 1.5-6GHz band
- SATIMO SH2000 2-32 GHz Dual Ridge Horn
- set of calibrated Standard Gain Horns (SGH) covering the 1.5- 40 GHz range from the DTU-ESA Spherical Near-Field Antenna Test Facility

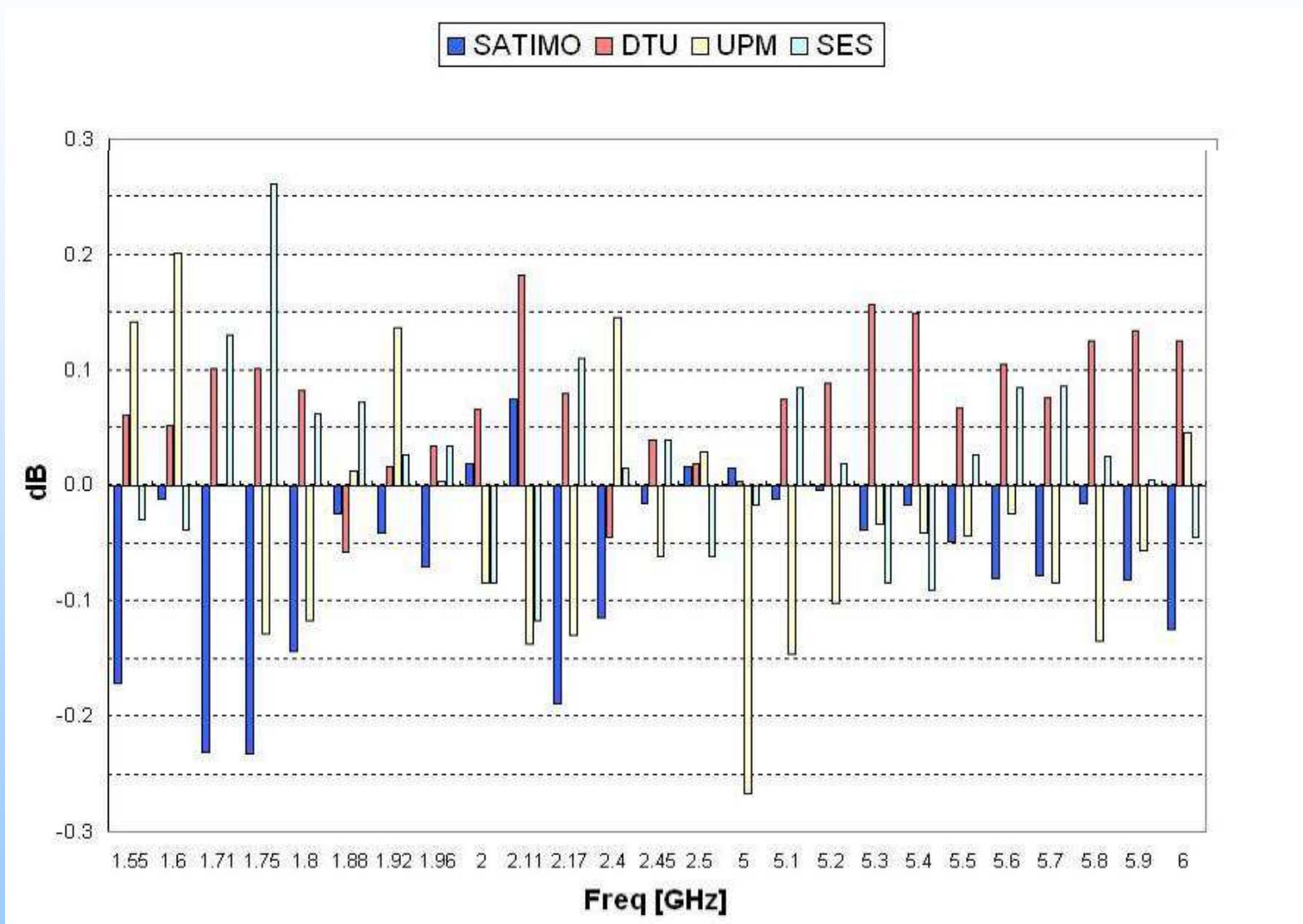
DTU-ESA VAST antenna







| Freq | DTU   |       | SATIMO |       | UPM   |       | SES   |       |
|------|-------|-------|--------|-------|-------|-------|-------|-------|
|      | Dir   | Gain  | Dir    | Gain  | Dir   | Gain  | Dir   | Gain  |
| 1.55 | 9.97  | 9.93  | 9.78   | 9.70  | 10.01 | 10.01 | 9.87  | 9.84  |
| 1.60 | 10.22 | 10.04 | 10.06  | 9.98  | 10.33 | 10.19 | 10.05 | 9.95  |
| 1.71 | 10.73 | 10.67 | 10.43  | 10.34 | 10.56 | 10.57 | 10.89 | 10.7  |
| 1.75 | 10.8  | 10.72 | 10.48  | 10.39 | 10.57 | 10.49 | 10.85 | 10.88 |
| 1.80 | 10.49 | 10.4  | 10.26  | 10.17 | 10.3  | 10.2  | 10.49 | 10.38 |
| 1.88 | 9.41  | 9.32  | 9.45   | 9.35  | 9.35  | 9.39  | 9.65  | 9.45  |
| 1.92 | 9.35  | 9.26  | 9.29   | 9.20  | 9.23  | 9.38  | 9.43  | 9.27  |
| 1.96 | 9.67  | 9.57  | 9.56   | 9.47  | 9.36  | 9.54  | 9.55  | 9.57  |
| 2.00 | 9.86  | 9.74  | 9.79   | 9.69  | 9.63  | 9.59  | 9.72  | 9.59  |
| 2.11 | 10.14 | 10.05 | 10.03  | 9.94  | 10.24 | 9.73  | 9.82  | 9.75  |
| 2.17 | 10.44 | 10.38 | 10.20  | 10.11 | 10.37 | 10.17 | 10.37 | 10.41 |
| 2.40 | 11.1  | 11    | 11.03  | 10.93 | 11.1  | 11.19 | 11.07 | 11.06 |
| 2.45 | 11.15 | 11.06 | 11.10  | 11.01 | 11.17 | 10.96 | 11.13 | 11.06 |
| 2.50 | 11.21 | 11.11 | 11.21  | 11.11 | 11.23 | 11.12 | 11.17 | 11.03 |
| 5.00 | 12.39 | 12.32 | 12.49  | 12.33 | 12.23 | 12.05 | 12.45 | 12.3  |
| 5.10 | 12.66 | 12.55 | 12.62  | 12.46 | 12.54 | 12.33 | 12.71 | 12.56 |
| 5.20 | 12.85 | 12.74 | 12.80  | 12.65 | 12.75 | 12.55 | 12.93 | 12.67 |
| 5.30 | 13.03 | 12.93 | 12.89  | 12.74 | 12.9  | 12.74 | 12.91 | 12.69 |
| 5.40 | 12.96 | 12.86 | 12.84  | 12.69 | 12.92 | 12.67 | 12.86 | 12.62 |
| 5.50 | 12.66 | 12.56 | 12.60  | 12.44 | 12.7  | 12.45 | 12.77 | 12.52 |
| 5.60 | 12.65 | 12.54 | 12.51  | 12.36 | 12.68 | 12.41 | 12.78 | 12.52 |
| 5.70 | 12.7  | 12.6  | 12.60  | 12.45 | 12.61 | 12.44 | 12.88 | 12.61 |
| 5.80 | 12.77 | 12.66 | 12.67  | 12.52 | 12.65 | 12.4  | 12.82 | 12.56 |
| 5.90 | 12.76 | 12.64 | 12.58  | 12.42 | 12.63 | 12.45 | 12.77 | 12.51 |
| 6.00 | 12.69 | 12.57 | 12.48  | 12.32 | 12.65 | 12.49 | 12.67 | 12.4  |



- standardization of primarily near field antenna measurement techniques in order to eliminate measurement inaccuracies due to the practical implementation of the measurement

- Development of measurement techniques and procedures for new and emerging antenna technologies within the 5 vertical research activities of ACE
  - » millimetre and sub-millimetre wave integrated antennas
  - » small antennas
  - » wideband and multi-band antennas
  - » planar and conformal arrays
  - » smart antennas



- *ACE has given the European antenna community an identity, a profiled structure where things can be discussed*
- *ACE has initiated a harmonization and standardization process within Europe*
- *ACE has intensified considerably the interaction in between universities, and between universities and industry*
- *ACE has produced a considerable number of cooperative publications and has triggered a lot of bilateral cooperations ... both for software and measurements*

*These efforts will be continued within the COST-ASSIST and EurAAP frameworks, with the help of CARE.*