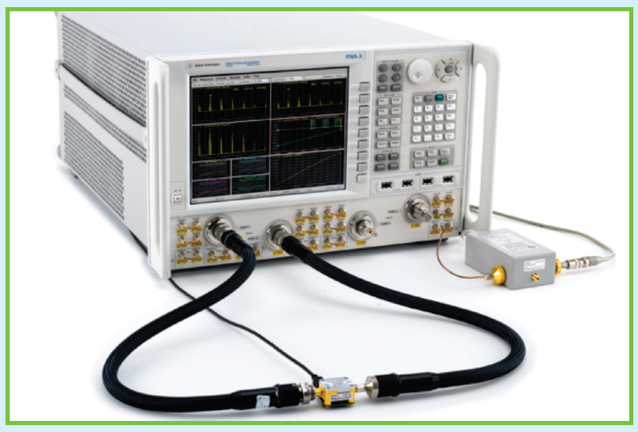
SIB62 RF-Circuits: Metrology for new electrical measurement quantities in high-frequency circuits

EURAMET
European Association of National Metrology Institutes

1. The Problem / Challenge

Over the past 10 years, suppliers of instruments used for high-frequency electromagnetic measurements have introduced entirely new ranges of products aimed at meeting the needs of today's end-users in industry and academia. These new instruments have introduced new measurement quantities and evolved existing measurement quantities to enable end-users to gain maximum insight into their target applications. However, at least 80 % of the parameter space of these new instruments is not backed-up by traceability mechanisms providing linkage to the SI.

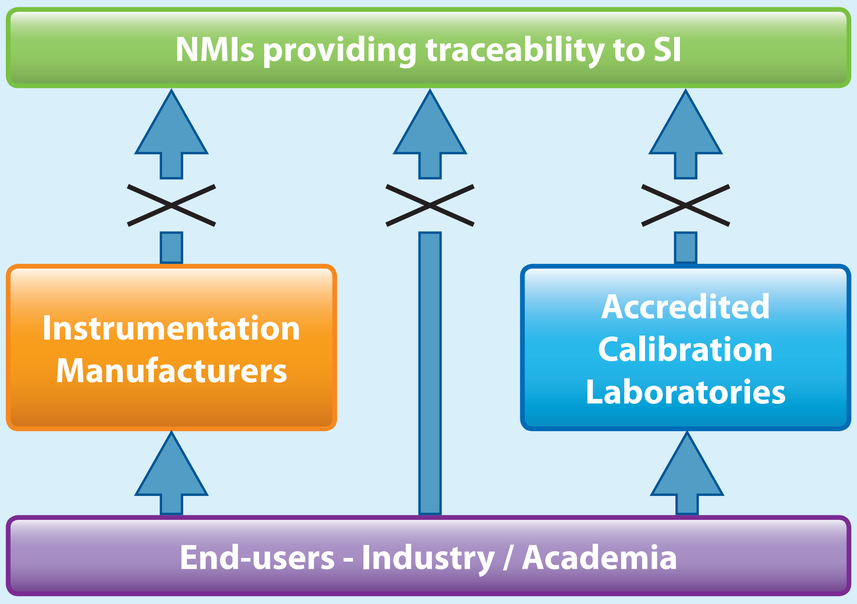
The scope of the SI needs to be broadened in order to enable traceability to be established for these new instrument developments



A state-of-the-art Vector Network Analyser – these instruments offer:

- S-parameter measurement to 1100 GHz
- multi-port calibration using electronic calibration units
- differential S-parameter capability
- nonlinear analogues of S-parameters for large-signal active devices.

None of these parameters are currently traceable to the SI



Traceability Diagram showing the dislocation in traceability routes to SI (the blue arrows) for users and providers of new high-frequency electromagnetic quantities

2. Application areas

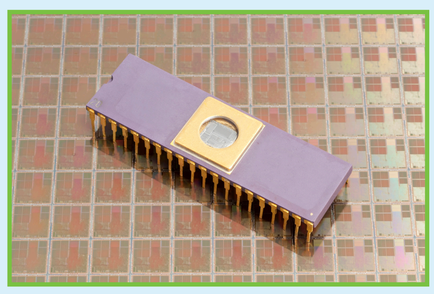
Consumer electronics:
Laptops and smartphones using microwave digital signals

Security:
Airport security scanners using millimetre-waves

Climate change monitoring:
Environmental sensing using millimetre-waves

Medical:
RF scanners for breast cancer detection

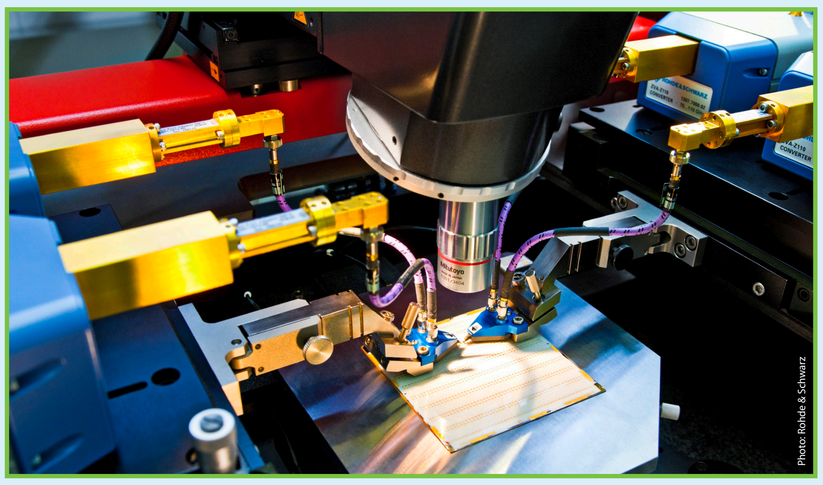
Next generation electronics and communications using nano-technology and/or THz/submillimetre-waves



3. The solution / approach

The solution / approach is to provide the required traceability for four application areas:

Work Package 1	**S-parameters at millimetre- and submillimetre-waves (to 110 GHz in coaxial lines and to 1100 GHz in waveguides)**
Work Package 2	**Multi-port measurements and Electronic Calibration Units**
Work Package 3	**Differential S-parameters for planar circuits (e.g. Printed Circuit Boards) with application to Signal Integrity**
Work Package 4	**Nonlinear measurements Extreme impedance measurement**
Work Package 5	**Generic resources affecting all four application areas: • Vector measurement uncertainty techniques and verification processes • A EURAMET Guide and International (IEEE) Standards**



Differential S-parameters for planar circuits

4. Impact

The dislocations in the traceability routes to SI, shown in the Traceability Diagram, will be removed

- Set up a new Europe Technology Forum and hold six public meetings;
  - 3 Workshops
  - 3 Training Courses
- New EURAMET Guide for VNAs
- Two IEEE Standards for coaxial connectors and waveguides
- Conferences – European Microwave Conference and International Microwave Symposium
- Published Papers – in IEEE Transactions and Microwave Magazine

5. Consortium/Management

	Funded Partners							Unfunded Partners		REGs			
	NPL	CMI	EJPD	LNE	PTB	SP	VSL	AGILENT	R&S	CTU	FBH	KU Leuven	UoL
WP1	●	●	●	●	●		●		●		●		●
WP2	●		●	●	●	●			●				
WP3	●	●		●	●				●	●	●		
WP4	●	●						●		●		●	
WP5	●		●	●	●	●	●		●				

Table showing the consortium of partners and their involvement in each Technical Work Package (WP). Red dots indicate the Leader for each WP.

The consortium includes:

- Funded Partners: The seven leading European NMIs in these areas
- Unfunded Partners: The world's top two instrumentation manufacturers in these areas (Agilent Technologies and Rohde & Schwarz)
- REGs: Four world-class academic institutes for these areas (Czech Technical University – extreme impedance measurement / FBH electromagnetic modelling / KU Leuven – nonlinear measurement / University of Leeds – submillimetre-wave measurements)

The total cost for this JRP will be 3.3 M€. This is in line with the EMRP expectation that '*any proposal received for this SRT is expected to be significantly above the 2.7 M€ guideline for proposals in this call*'.

NPL National Physical Laboratory · CMI · METAS Federal Office of Metrology · LNE Sharing a passion for progress · PTB Physikalisch Technische Bundesanstalt · SP your Science Partner · VSL

Agilent Technologies · ROHDE&SCHWARZ · Leibniz Ferdinand-Braun-Institut · UNIVERSITY OF LEEDS

1024/OCT2012