

EMPIR JRP 17RPT03 DIG-AC
A digital traceability chain for AC voltage and current

Notes from the Kick-off Meeting and Workshop

Dates: June 6-7, 2018
 Venue: NPL, Teddington, United Kingdom
 Based on the records made by Jane Ireland (JI)

Day 1, June 6, 2018

	<p>Welcome & project introduction - DI</p> <p>DI thanked partners for hard work in bid writing. Partners introduced themselves.</p>
	<p>Project reporting and impact - MS from MSU</p> <ul style="list-style-type: none"> • MS gave an overview. • Project is entered into the force after 30 days of putting into force • Boost industrial takeup • Impacts should link with EMPIR top level objectives • Evidence of early impacts required: e.g. calibration / consultancy on new capabilities, new networks NMIs • High level needs / user needs impact diagram. • Reporting schedule. • Payment schedule. Partner can move funds within own share, between categories. • Publishable summary demonstrates value of public funding. Non technical audience. • Data management plan (DMP), which is something new, should be provided. DMP guide available on website. • Letter of agreement: advised to use if sharing intellectual property (IP) with new collaborators. Template available. • The presentation from Mara should be disseminate to all partners
	<p>General aspects and overview of the project - DI</p> <ul style="list-style-type: none"> • Signing of Annex 3 – wait for the date of the signature of our dean + 30 days • We do not have to wait for GA to conclude consortium agreement, and this could be done fast (at least within 2 months)
<p>WP1</p>	<p>WP1: Digitiser Evaluation - NK (on behalf of MA), all</p> <ul style="list-style-type: none"> • NK gave a presentation. Selection of digitiser and plan validation. • AC traceability rms only via thermal converters and step up / down. • What is voltage requirements for digitiser: <ul style="list-style-type: none"> ○ 1 mV to 100 V ○ 10 Hz – 1 MHz ○ 10 ppm ○ 1 Mohm input impedance ○ External synchronisation • Requirements for current (CEM), impedance (PTB), power, other dynamic measurements. • Note the limits given in this project 100V etc. • Survey: <ul style="list-style-type: none"> ○ In 2-3 weeks list of stakeholders updated for survey. ○ Also survey partners for NMI requirements (i.e. for using the digitiser as new ref standard in voltage) ○ TUBITAK / WP6 responsible: single survey covering all application areas (tasks 1.1.1 to 1.1.4) ○ CPEM is opportunity to talk to stakeholders (next month).

	<ul style="list-style-type: none"> • Circulate to all stakeholders, including users for various applications. • Suggestion to have different sets of requirements for different applications ie some require less voltage range wide freq range and vice versa. • New Fluke digitiser in September available? • CPEM expo stand on new digitiser? • Jeff Gust Fluke chief metrologist, TUBITAK to ask to characterise new digitiser, or work with us in project? <p><u>Survey parameter discussion:</u></p> <ul style="list-style-type: none"> • Stability: how long instrument retain calibrate value (this is important for using digitiser as reference standard in new chain) Note this is not in spec sheet so we need to measure this. At the moment NMIs have to calibrate these devices each time for metrology use. NI5922 not intended as metrological device so has poor stability. • Short term stability: • Long term stability: • Compared with Fluke calibrator values for 90 days and 3 years; i.e. how often need to recalibrate • step up / down 100 V, 1 A, 1 kHz maximum, minimums: harmonics at very low voltages compared to signal. Noise level in digitiser and resolution set minimum level achievable. • Current measurements: similar requirements to thermal converter applications. New quality standard, has driven requirement to measure it. • Signal to noise • Number of bits • Phase difference: need to use external guard. Digitiser should have capability to provide external guard or be isolated power supply. • Dynamic measurements where ADCs used (force pressure temperature etc.): <ul style="list-style-type: none"> ○ Non-sinusoidal signals, small voltage levels ○ Instrument manufactures, non electrical. Need to find out from them what is required. • Calibration over certain values ie higher voltage over smaller frequency range. Not possible to cover everything at all values. • Suggestion to focus mostly on audio range (see results from survey). • Input impedance: frequency dependant, depends on loading. • Survey information can be updated at later point but need first version M2. <p><u>Digitiser selection:</u></p> <ul style="list-style-type: none"> • At least 3 digitizers should be selected: Keysight 3458A, NI5922, and Holland company Applicos (JI to forward email contact, they are partner in EMPIR QuADC); or new Fluke DMM with ADC? <ul style="list-style-type: none"> ○ ** Applicos can advise what their customers need ○ ** esz advise on calibration ranges etc • Best to choose those available at partner labs. • Deliverable: Report on digitiser selection and how they meet user needs. • A1.2.4 digital impedance bridge, this should not have been PTB? Note that this is not a measurement, just written text. • Question: legal problem in saying this digitiser is “best”, have to say it is suitable for this application, give results etc. disclaimer not endorsing this. Compare to previous EMRP projects. • Question: which parts of results are public? ie digitiser selection.
<p>WP2</p>	<p>WP2: Wide Range Dynamic Digitizing - AS, all</p> <ul style="list-style-type: none"> • AS gave an overview presentation. • WP2 concerns step up / down techniques for current and voltage. <p><u>2.1 Study of existing devices.</u></p> <ul style="list-style-type: none"> • Survey partners. Classify techniques. Use CMCs / uncertainties. Output is report summarising digital scaling ranges. <ul style="list-style-type: none"> ○ Can existing techniques from thermal convertor methods be extended for digitiser traceability? ○ Literature on thermal converters gives information on step up / step down methods. ○ Thermal converter linear with amplitude scaling. Digitiser may not be. May need different

	<ul style="list-style-type: none"> ○ methods for scaling. ○ Use of external guard for the comparison of current shunts (CPEM 20014 paper by Svensson, Rydler and Taraso) ○ Loading effect due to input impedance of sampling voltmeter (IEEE I&M 2017, Crotti and all) <ul style="list-style-type: none"> • Best to avoid changing range on digitiser to minimise uncertainties. • In this project will scale up only with current shunts and digitisers (not voltage dividers) • AS to email partners to ask for information on existing techniques. • Output: summary of most suitable ranges and techniques • Need the ranges for WP4 validation activities. Define what the ranges of new digital traceability chain will be, i.e. where can replace thermal method. • For the task 2.1 it is important to study the existing devices and techniques, and to see how digitizers and quantum standards can be applied (if the range, for instance, 1 V is to best choice?) • We also have to examine what would be the lowest values of voltage and current which will be taken into the consideration <p><u>2.2 Integration with quantum standards.</u></p> <ul style="list-style-type: none"> • Scaling to PJVS: • Scaling to JAWS: cable issues • Eg temperature effects in scaling devices may now become more significant when working at lower uncertainty levels. • Use of digitiser as the standard vs short term calibration of digitiser against quantum standard then use of divider to scale up voltage to calibrate source. • Customers: internal vibrations measurement want digitisers calibrated, need certificate of corrections don't need as good as 3458A can provide. Power quality require NI5922 but at level where calibration is not actually required. • Choice of digitiser from WP1. • Question: calculate frequency dependence of magnitude from phase measurement? • Voltage dividers and current transducers: presentation by AP. • Guarded voltage dividers, 1 kV, 20 kHz required for power measurements. • Phase displacement measurements of voltage dividers and current shunts. • Question: how to scale ac voltage? • Comparison of DMM method. Tested at low frequencies. • 2.2.5 Has no frequency given in description? CEM to produce shunt-digitiser calibration up to 1 A. Use voltage source. Does not require input from digitiser calibration (WP4). Question, what combination of shunt digitiser needed? • At PTB use calibrator to shunt then measure voltage vs quantum standard. Use NI5922. • Output: guidelines for most suitable methods.
<p>WP3</p>	<p>WP3: Data processing and uncertainty estimation for quick integration - JD, MŠ, JS, all</p> <ul style="list-style-type: none"> • JD gave an overview presentation. • Previous projects overlap a lot with this WP. Need to use output from other projects to avoid duplication. Need plan of what will be used from previous work. • Presentations by MS and JS. <p><u>3.1 Common data format</u></p> <ul style="list-style-type: none"> • Q-Wave ToolBox (QWTB) from TracePQM project • Discussion on how partners store digitiser results at the moment. Mostly text files. No standard way of noting system parameters e.g. voltage range. Useful to have a common format to share data in this project. Should be "human readable" i.e. we don't need to install extra software to read it. • Various formats investigated. • Decide on structure. Decide which partners to develop which parts. Develop test plans. <p><u>3.2 Algorithms</u></p> <ul style="list-style-type: none"> • QW Tool Box. Additional ones from IEC standards. • Rado Lapuh possibly to collaborate on this.

	<p>3.3 Uncertainty estimation</p> <ul style="list-style-type: none"> software also gives contribution to uncertainty <p>3.4 Software for data processing and uncertainty</p> <ul style="list-style-type: none"> Module or overlay onto QW Tool Box Question: what do users expect? What parameters do they want to extract from data and is this already available? Different waveforms are required for e.g. gain and INL i.e. require different measurement data. Software e.g. to tell user to apply certain waveform etc. then analyse. Software to be open source. Only end of project verified. Changes by others after that, use without verification. Suggestion to make open source code available during project e.g. halfway through so others can test / give feedback on it. Deliverable: Output is a report.
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Day 2, June 7, 2018

WP4	<p>WP4: Validation of new traceability chain - JI, all</p> <ul style="list-style-type: none"> Ji gave an overview presentation. Action: review journal choice and open access policy. Need to pay for access. Suggestion to complete 4.1.3 before 4.1.2 to use information for 4.1.2 Action: NPL and PTB to plan visits of partners as part of 4.1.1 and 4.1.2. Deliverable D5 will be a paper with open access 1 Hz frequency range important to vibration applications, TCV comparison to show benefits of quantum traceability for this applications
WP5	<p>WP5: Strategy for capacity development and basis for coordinated approach - RB, all</p> <ul style="list-style-type: none"> RB gave an overview presentation Use ACQ-PRO plan and extend it for DIG-AC project. AS to convene working group for collaboration across Europe. Most of strategy will be defined towards the end of the project. RB will send out forms to partners to gather the information. Proposal to have new group to cover DCLF, quantum, power and energy. Awaiting response from Euramet. Subcommittee meeting will be at CPEM. TCEM to meet in September, this proposal will be discussed. Meetings to be on subsequent days to encourage cross over between sub committees. Euramet Quantum Network: does not include any quantum electrical? Each institute to prepare own strategy.
WP6	<p>WP6: Creating Impact - MO, all</p> <ul style="list-style-type: none"> MO gave a presentation. Stakeholder initial list. MO to contact partners by email to ask for more stakeholders. Partners can contact stakeholders in own country. WP1 surveys prepared by the three organisations. Surveys to be sent to stakeholders. Electronic vs telephone Publishable summary to send to stakeholders Stakeholders to input values into WP1, to give applications and future requirements. Ideal to have involvement in project. Info on website to send to potential stakeholders. Letter of agreement with stakeholder in stakeholder committee (they have access to some restricted files) <p><u>Project website.</u></p> <ul style="list-style-type: none"> Digac.gum

	<p><u>Logo</u></p> <ul style="list-style-type: none"> Choice via email vote <p><u>Dissemination</u></p> <ul style="list-style-type: none"> Plans for papers and conference presentations. Inform standard bodies Good practice guide Use research gate for good practice guide to get DOI Poland can get ISBN code for free (usually have to pay). Poland to submit BPG. Partners to update if any info on conference submissions / open access Question: How will project influence standards committees? Project will inform standards committees of new data / information. Need clear information about how this is undertaken. <p><u>Training</u></p> <ul style="list-style-type: none"> Final meeting at CEM. IPQ workshop WP4 visits are part of secondment in WP6 There is also a budget for an extra secondment / training visit not detailed in the WPs. <p><u>Exploitation</u></p> <ul style="list-style-type: none"> CMCs Narrow gap between NMI / Dis
<p>WP7</p>	<p>WP7: Management and coordination - DI, all</p> <ul style="list-style-type: none"> DI discussed main points: Grant agreement date will be emailed to partners this week. Partners to put date after this, sign and return. Prepare consortium agreement before CPEM. Meeting locations / dates are defined in protocol. M9 meeting will be via telephone conference in Feb 2019. No formal meeting at CPEM 2018 or 2020. Partners can attend (on this project) if they want to. Partners to update email list with added / deleted members. DI to circulate latest list.

Abbreviations:

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Naylan Kanatoglu (NK)

Mehedin Arifović (MA)

Andrea Sosso (AS)

Javier Díaz (JD)

Martin Šira MŠ

Jose Salinas (JS)

Ralf Behr (RB)

Marcin Orzepowski (MO)

Patryk Bruszewski (PB)

Data management plan (DMP)

intellectual property (IP)

Euramet Quantum Network (EMN)

Workshop on digital traceability chain for AC voltage and current

Notes

June 7, 2018

Welcome & workshop introduction
Open Source SW developed at INRIM to control PJVS - Andrea Sosso <ul style="list-style-type: none">• Based on Python, and runs on almost all OSs• Open-source approach• In a new version of LabVIEW some Python connectivity will be possible
Lab tour at NPL (leaded by JI)