

## Activities and achievements in the area of commercialization of quantum communication

### Patent protection of research results:

1. **UPRP patent P.424145 [WIPO ST 10/C PL424145]** - J. Jacak, W. Jacak, W. Donderowicz, L. Jacak, *Entanglement Quantum Random Number Generator with public randomness certification*
2. **UPRP patent P.424146 [WIPO ST 10/C PL424146]** - J. Jacak, W. Jacak, *The One-Qubit Pad (OQP) for entanglement encryption of quantum information*
3. **UPRP patent P.424142 [WIPO ST 10/C PL424142]** - W. Jacak, J. Jacak, W. Donderowicz, L. Jacak, *Quantum Entanglement Currency (QEC)*
4. **UPRP patent P.424143 [WIPO ST 10/C PL424143]** - M. Jacak, J. Jacak, W. Jacak, W. Donderowicz, L. Jacak, *BANQOMAT – QKD secured ATM system*
5. **UPRP patent P.424144 [WIPO ST 10/C PL424144]** - J. Jacak, W. Jacak, W. Donderowicz, L. Jacak, *Quantum Entanglement Digital Signature (QEDS)*
6. **WIPO patent PCT/PL2017/000133** - J. Jacak, W. Jacak, W. Donderowicz, L. Jacak, *Entanglement Quantum Random Number Generator with public randomness certification*
7. **WIPO patent PCT/PL2017/000134** - J. Jacak, W. Jacak, *The One-Qubit Pad (OQP) for entanglement encryption of quantum information*
8. **UPRP patent P.355071 / PL203033** - L. Jacak, J. Krasnyj, D. Jacak, L. Bujkiewicz *Quantum dots device for generation of coherent far-infrared radiation achieving population inversion in a QD matrix*

### Industrial designs registered in UPRP:

1. **Industrial design Wp.26153 (2018)** Stacja nadawcza kwantowej dystrybucji klucza seQre Crystal / Quantum key distribution system seQre Crystal transmitting station
2. **Industrial design Wp.26154 (2018)** Stacja odbiorcza kwantowej dystrybucji klucza seQre Crystal / Quantum key distribution system seQre Crystal receiving station

### Projects for industrial research and development works co-funded by the European funds:

(publications, conference presentations, research results gathered on the <https://segre.net> platform)

1. *"Prace badawczo-rozwojowe w kierunku komercjalizacji kryptografii kwantowej w układach bezsplątaniowych i splątaniowych" / „Research and development towards commercialization of non-entanglement and entanglement quantum cryptography”*, PO IG PARP, UDA-POIG.01.04.00-02-043/11-00, 2012-2014
2. *"Badania nad nowymi protokołami kwantowej dystrybucji klucza w układach splątaniowej kryptografii kwantowej" / „Research and development on the new quantum key distribution protocols for entanglement-based quantum cryptography”*, Innotech Hi-tech, NCBiR, INNOTECH-K1/HI1/20/159087/NCBR/12, 2013-2015
3. *"Wsparcie procedur patentowych i ochrony praw własności przemysłowej w obszarze komercjalizacji kryptografii kwantowej" / „Support for patent and intellectual protection procedures in the area of commercialization of quantum cryptography”*, Patent+ NCBiR, PP3/W-32/D-2223/2014, 2015-2017
4. *"JURAND - Narodowy Kwantowy Generator Liczb Losowych" / "JURAND – National Quantum Random Number Generator”*, PO IR NCBiR, POIR.01.01.01-00-0173/15-00, od 2016 (project in progress, completed 1st stage, two prototypes of randomness generators, PhD thesis)

### Technical implementation in the area of quantum communication and related activities:

1. First national entanglement-based QKD systems co-implemented with AIT (2013), prototypes of randomness generators (2017)
2. **September 2013 – now:** Participation in the works of the QKD ISG standardization group under ETSI and the EITCI QKD panel
3. **December 2013 – February 2014:** The first Polish pilot implementation of QKD systems (in the form of entanglement and non-entanglement systems) as part of the **Wrocław QKD Network** (3-node network within a real backbone telecommunication fiber optic infrastructure, third in the world pilot metropolitan implementation of entanglement QKD in Wrocław after Vienna and Tokyo, description of technical details on the website: <https://segre.net/segre2014/wroclaw.php>)
4. **January 2014 – December 2015:** Research collaboration with AIT as part of the Austrian project **QKD-TELCO** on the development of entanglement QKD systems in backbone telecommunications networks (dark fiber)

### Awards and recognitions:

1. Gazeta Prawna Award *Innovative Company of the Year 2012* for CompSecur sp. z o.o.
2. First prize in the technological category at the *International Conference on Advanced Communications 2014* in Paris
3. Selection of the *Wrocław QKD Network* entanglement-based network as one of the "7 wonders of Wrocław" in the Science category as part of the exhibition within the celebration of Wrocław as the European Capital of Culture in 2016
4. Recognition within the *Feynman: Quantum information and computation at the International Symposium on Quantum Technology 2018* session in Aberdeen UK for the presentation of a semiconductor quantum randomness generator prototype

**Research infrastructure:** KTK/NLTK PWr.: KTK / NLTK PWr. : quantum cryptography laboratory, quantum optics components, SPDC quantum entanglement generation systems (BBO), single-photon detectors and sources, optical and semiconductor components, computational cluster, IdQantique Clavis non-entanglement QKD kit (phase coding in the Mach-Zehnder interferometer), Q12 AIT Quelle entanglement system (polarization entanglement); CompSecur sp. z o.o.: SPDC quantum entanglement generation systems (BBO), single-photon detectors and sources, computational cluster, entanglement and non-entanglement QKD systems, prototype QRNG systems