



Mobile Communications Towards 2020

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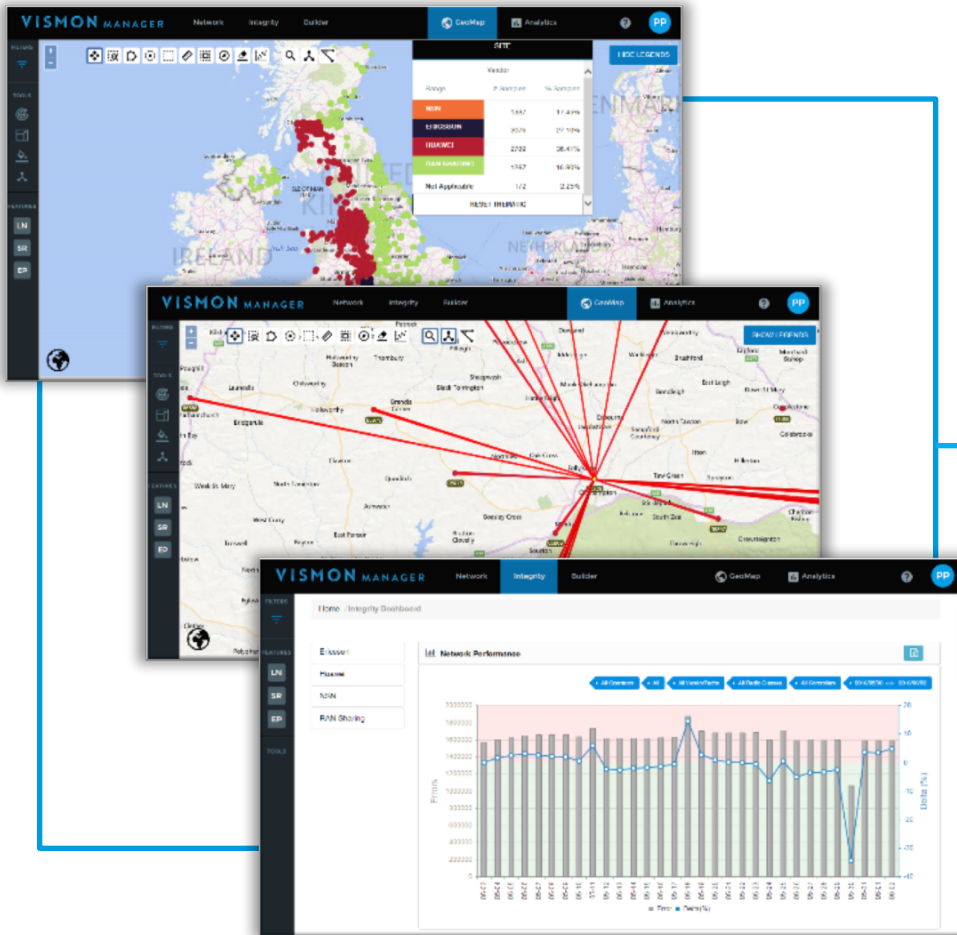
Evolution towards 5G

› Mobile Networks Complexity
Continuously Increasing

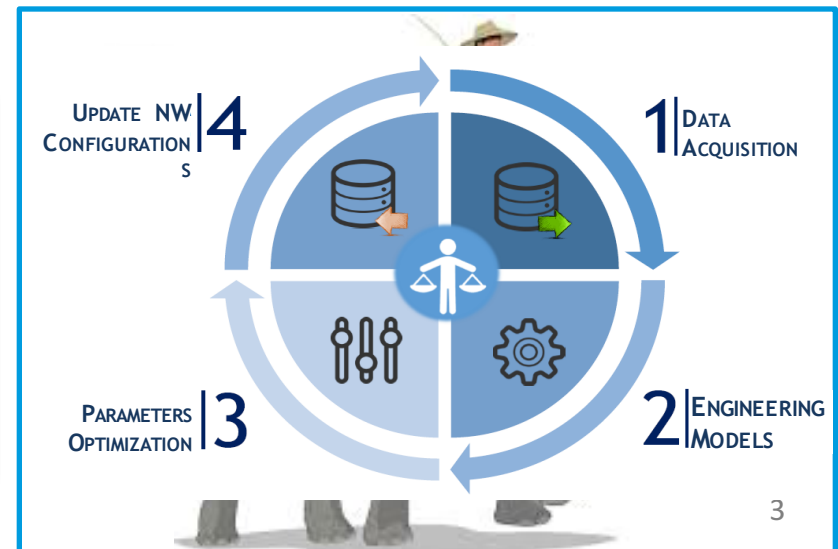


MULTI-TECH
MULTI-BAND
MULTI-LAYER
MULTI-VENDOR
MULTI-OPERATOR RAN SHARE



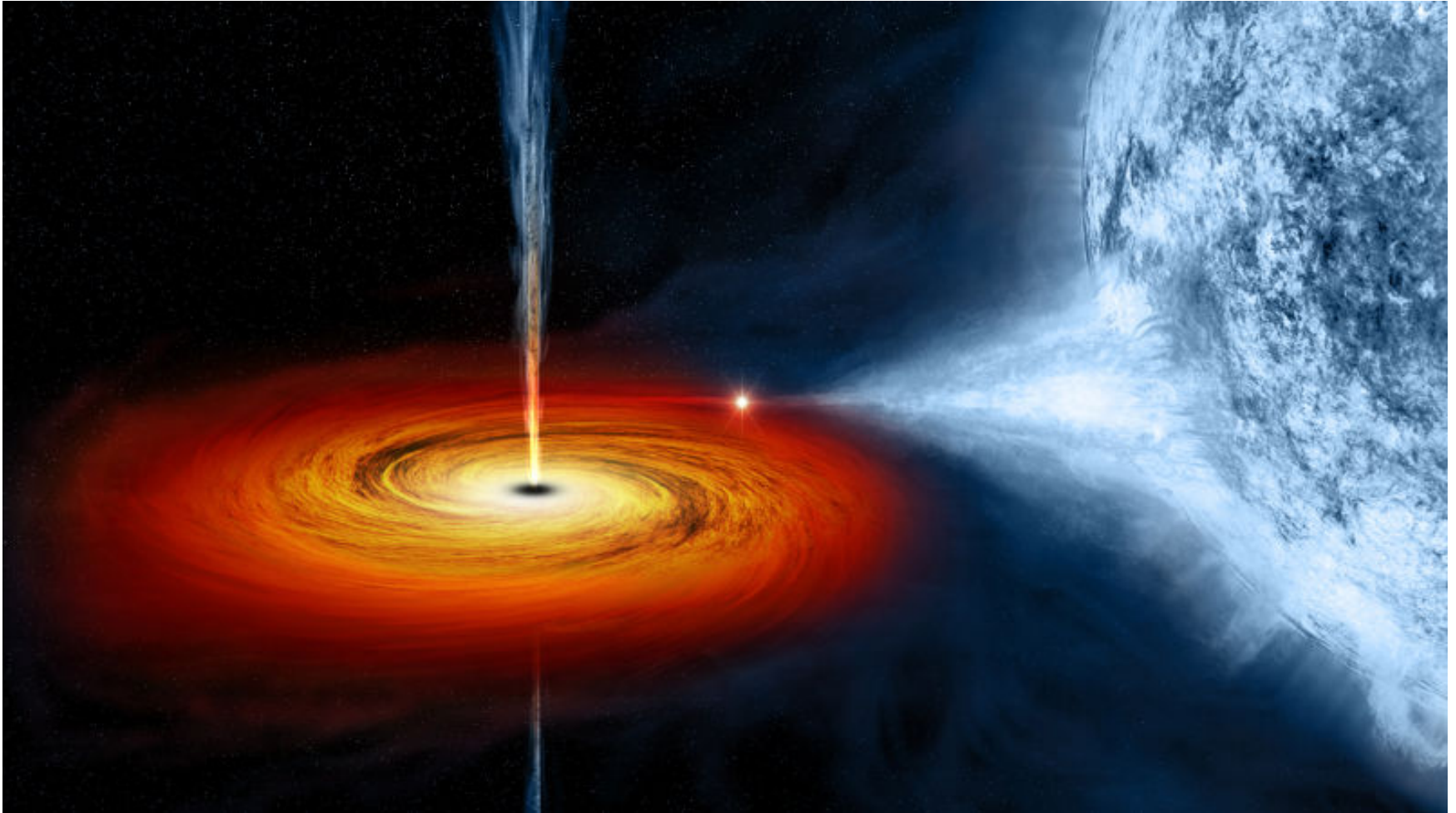


RAN Management Virtualization
Configuration Auditing
Automatic Configuration
(Not limited to SON!)

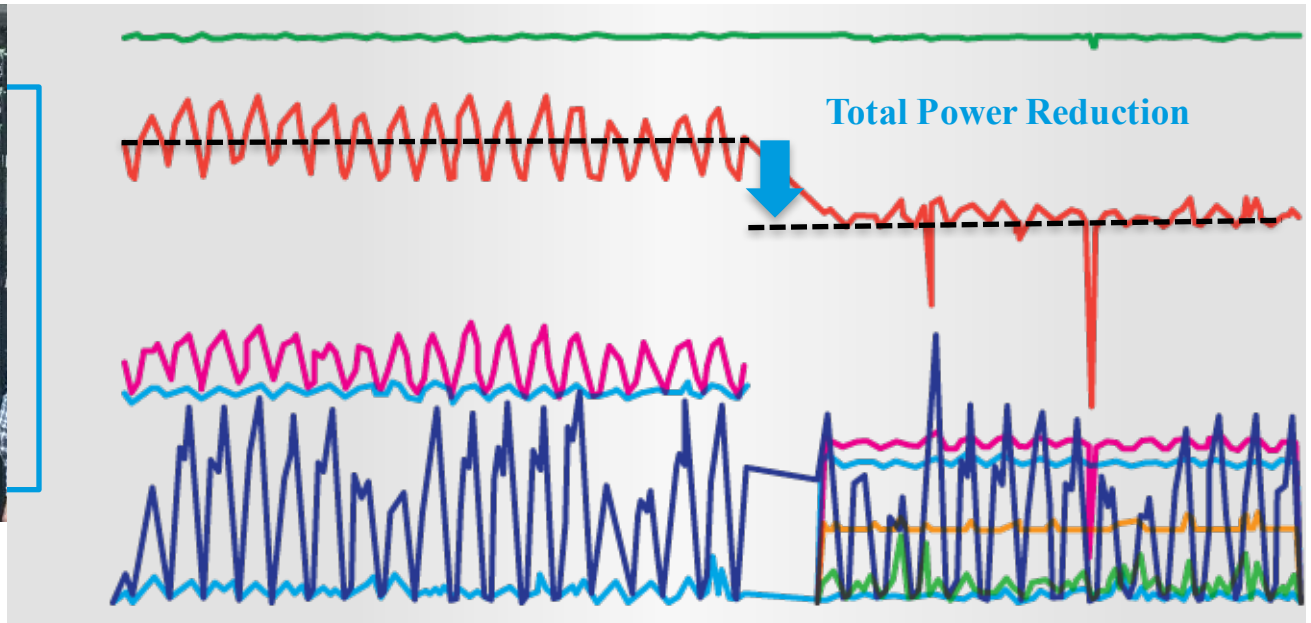
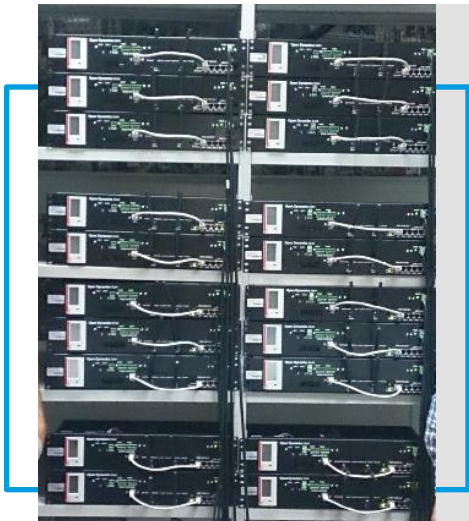


Challenge

› Power Efficiency is as a Key 5G Optimization Parameter



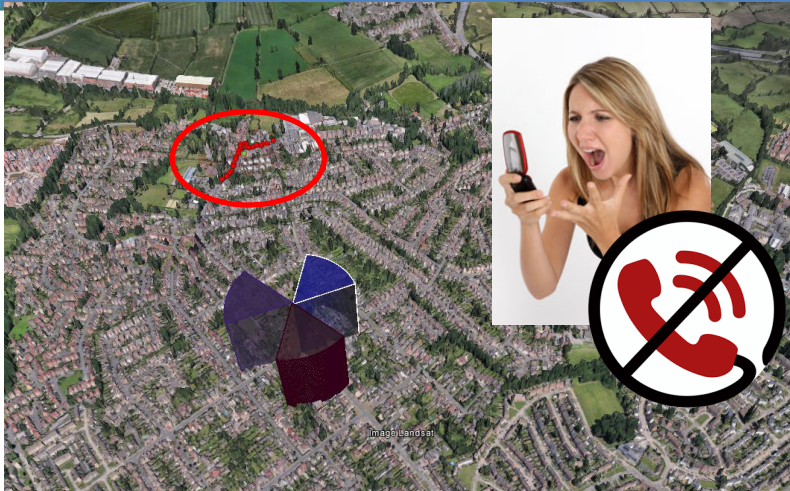
› Power Efficiency is as a Key 5G
Optimization Parameter



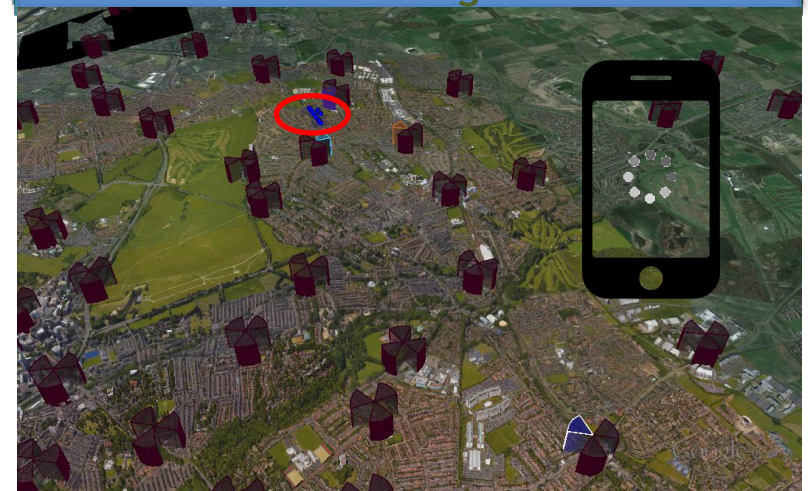
DISRUPTIVE
Technology

Managing Network Configuration for
Power Efficiency

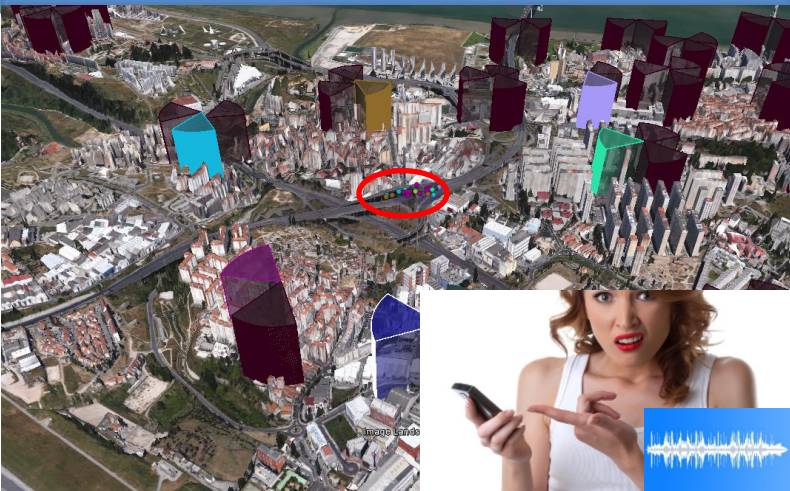
Coverage Hole



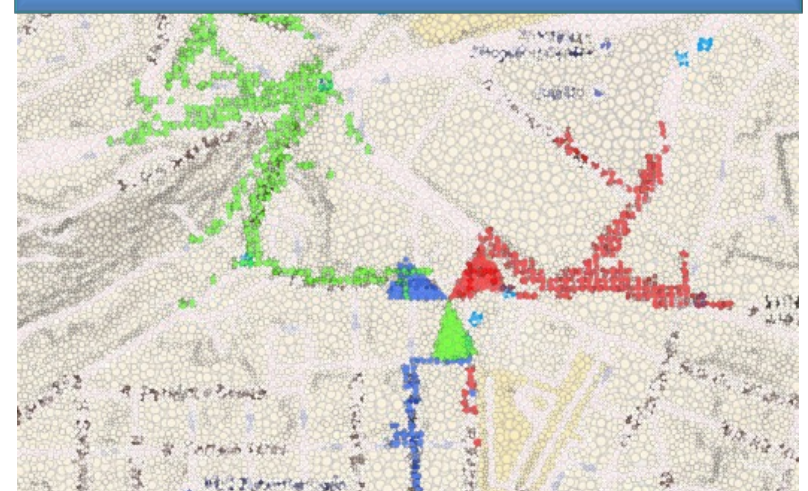
Overshooting Cells



Interference



Crossed Sectors



Quality of Service Monitoring

Effective Troubleshooting

Smart Algorithms

Machine Learning

Big Data



UNIQUE
Benchmarking
Platform

1. PRELIMINARY RESEARCH



2. RESEARCH (THESIS/INTERNAL)



4. PRODUCT INTEGRATION

VISMON



3. PROTOTYPING



R&D

› Academic Partnership



- **ACADEMY PARTNERSHIP WITH IST, ISEL/IPL AND IT (INSTITUTO DE TELECOMUNICAÇÕES) PROVIDES SCIENTIFIC VALIDATION AND PRODUCES STATE OF THE ART ALGORITHMS**

- **QUICK FIGURES**

- 11 TELECOM ALGORITHMS (R/D)
- 7 TELECOM PROTOTYPES (IN LABS)
- 3 R/D PROJECT PROPOSALS
- 11 MASTER THESIS (SINCE 2014)
- 19 PUBLICATIONS IN NATIONAL AND INTERNATIONAL CONFERENCES (SINCE 2014)
- 3 BEST STUDENT PAPER AWARDS IN 2016



David Duarte (ISEL/CFN), NCL Optimization

Cláudio Franco (ISEL/CFN), Crossed Sectoring

Tiago Cunha (IST), Energy Savings

Hugo Café (IST), IoT Smart Grid

Tiago Pedro (IST), 3G Dual Layer Load Balancing

Marco Sousa (ISEL/CFN), Coverage and Interference Optimization

Miguel Monteiro (IST), Forecasting and Load Balancing

Marta Veríssimo (IST), Capacity Planning

Bruno Roque (IST/CFN), Propagation Modeling and 4G Geopositioning

Rúben Boralho (IST), L3 Trace Mapping

1. DUARTE D., MARTINS A., VIEIRA P., RODRIGUES A., “A HYBRID NEIGHBOR OPTIMIZATION ALGORITHM FOR SON BASED ON NETWORK TOPOLOGY, HANDOVER COUNTERS AND RF MEASUREMENTS”, 13TH INTERNATIONAL CONFERENCE ON WIRELESS NETWORKS AND MOBILE SYSTEMS (WINSYS 2016), LISBON, PORTUGAL, JULHO DE 2016.
2. PEDRO T., MARTINS A., RODRIGUES A. VIEIRA P., “AN EFFICIENT APPROACH FOR CAPACITY SAVINGS USING LOAD BALANCING IN DUAL LAYER 3G WIRELESS NETWORKS”, 13TH INTERNATIONAL CONFERENCE ON WIRELESS NETWORKS AND MOBILE SYSTEMS (WINSYS 2016), LISBON, PORTUGAL, JULHO DE 2016.
3. VIEIRA P., MARTINS A. CUNHA T., “INTRODUCING REDUNDANCY IN THE RADIO PLANNING OF LPWA NETWORKS FOR INTERNET OF THINGS”, 13TH INTERNATIONAL CONFERENCE ON WIRELESS NETWORKS AND MOBILE SYSTEMS (WINSYS 2016), LISBON, PORTUGAL, JULHO DE 2016.
4. SOUSA M., MARTINS A., VIEIRA P., “SELF-DIAGNOSING LOW COVERAGE AND HIGH INTERFERENCE IN 3G/4G RADIO ACCESS NETWORKS BASED ON AUTOMATIC RF MEASUREMENT EXTRACTION”, 13TH INTERNATIONAL CONFERENCE ON WIRELESS NETWORKS AND MOBILE SYSTEMS (WINSYS 2016), LISBON, PORTUGAL, JULHO DE 2016.
5. D. DUARTE, P. VIEIRA, A. RODRIGUES, A. MARTINS, AND N. OLIVEIRA, “A NEW APPROACH FOR CROSSED SECTOR DETECTION IN LIVE MOBILE NETWORKS BASED ON RADIO MEASUREMENTS,” IN WIRELESS PERSONAL MULTIMEDIA COMMUNICATIONS (WPMC), 2015 INTERNATIONAL SYMPOSIUM ON, 2015;
6. MOURATO, A., P. VIEIRA, A. RODRIGUES, A. MARTINS, CUNHA, T, PINTO, I., “GEO-POSICIONAMENTO PARA REDES UMTS, USANDO TÉCNICAS DE FINGERPRINTING SOBRE MEDIDAS DE RÁDIO,” 9.º CONGRESSO DO COMITÉ PORTUGUÊS DA URSI, LISBOA, PORTUGAL, DEZEMBER 2015;
7. CAFÉ, H., P. VIEIRA, A. RODRIGUES, A. MARTINS, “PLANNING WIRELESS MESH NETWORKS FOR IOT SMART GRID APPLICATIONS”, 9.º CONGRESSO DO COMITÉ PORTUGUÊS DA URSI, LISBOA, PORTUGAL, DEZEMBER 2015;
8. SOUSA, M, MARTINS, A, VIEIRA, P., OLIVEIRA, N., RODRIGUES, A. “CARACTERIZAÇÃO DA FIABILIDADE DE MEDIDAS RÁDIO EM LARGA ESCALA PARA REDES AUTO-OTIMIZADAS”, 9.º CONGRESSO DO COMITÉ PORTUGUÊS DA URSI, LISBOA, PORTUGAL, DEZEMBER 2015;
9. D. DUARTE, A. MARTINS, P. VIEIRA, A. J. RODRIGUES, NS SILVA, “AN ENHANCED PROPOSAL IN NEIGHBOR LIST PLANNING FOR LTE SON RADIO ACCESS NETWORKS”, URSI ATLANTIC RADIO SCIENCE CONFERENCE - URSI AT-RASC, MASPALOMAS, SPAIN, MAY 2015;
10. T. CUNHA, A. MARTINS, P. VIEIRA, A. J. RODRIGUES, NS SILVA, L. VARELA, “ENERGY SAVINGS IN 3G USING DYNAMIC SPECTRUM ACCESS AND BASE STATION SLEEP MODES”, URSI ATLANTIC RADIO SCIENCE CONFERENCE - URSI AT-RASC, MASPALOMAS, SPAIN, MAY 2015;
11. A. MARTINS, C. FRANCO, P. VIEIRA, A. J. RODRIGUES, NS SILVA, “CROSSED SECTOR AUTOMATIC DETECTION IN 4G RADIO ACCESS NETWORKS”, URSI ATLANTIC RADIO SCIENCE CONFERENCE - URSI AT-RASC, MASPALOMAS, SPAIN, MAY 2015;
12. T. CUNHA, P. VIEIRA, A. MARTINS, A. J. RODRIGUES, “ENERGY SAVINGS IN 3G USING BASE STATION SLEEP MODES”, 8.º CONGRESSO DO COMITÉ PORTUGUÊS DA URSI, LISBOA, PORTUGAL, NOVEMBRO 2014;
13. C. FRANCO, P. VIEIRA, A. J. RODRIGUES, A. MARTINS, N. SILVA, L. VARELA, “DETEÇÃO DE SECTORES CRUZADOS EM REDES LTE”, 8.º CONGRESSO DO COMITÉ PORTUGUÊS DA URSI, LISBOA, PORTUGAL, NOVEMBER 2014;
14. D. DUARTE, P. VIEIRA, A. J. RODRIGUES, A. MARTINS, N. SILVA, L. VARELA, “OTIMIZAÇÃO DA LISTA DE CÉLULAS VIZINHAS EM REDES LTE”, 8.º CONGRESSO DO COMITÉ PORTUGUÊS DA URSI, LISBOA, PORTUGAL, NOVEMBER 2014;
15. P. VIEIRA, N. SILVA, N. FERNANDES, A. RODRIGUES, L. VARELA, “IMPROVING ACCURACY FOR OTD BASED 3G GEOLOCATION IN REAL URBAN/SUBURBAN ENVIRONMENTS,” IN WIRELESS PERSONAL MULTIMEDIA COMMUNICATIONS (WPMC), 2014 INTERNATIONAL SYMPOSIUM ON, SEPT 2014, PP. 362-366;
16. P. VIEIRA, A. J. RODRIGUES, A. MARTINS, N. SILVA, L. VARELA, “NEIGHBOR LIST OPTIMIZATION FOR REAL LTE RADIO NETWORKS”, ASIA-PACIFIC OPTICAL AND WIRELESS COMMUNICATIONS CONF. - APOC, KUTA, INDONESIA, VOL. 1, PP. 1 - 1, AUGUST, 2014;

