

Business from technology



CORE+ Summary

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CORE+ basic information

CORE+ (Cognitive Radio Trial Environment +) project in 2013
2014 belongs to Finnish Trial program funded by Tekes including:

Three research organisations

- VTT Technical Research Centre of Finland, Centria and University of Oulu;

Five industry companies:

- Nokia Siemens Networks, EXFO, Elektrobit, PehuTec and Rugged Tooling

Two governmental organisations:

- The Finnish Defence Forces
- Finnish Communications Regulatory Authority (FICORA).

Total budget 2013-2014

Summary of whole project

- Publications
 - Four magazine papers published and two submitted.
 - 15 conference papers published.
 - Three book chapters published and one accepted.

- Trials
 - Six public LSA trials in international fora.
 - Four public WARP trials in international fora.

- Regulatory contributions
 - Six contributions on CRS to ITU-R WP5A.
 - Five contributions on LSA to ECC FM52 and FM53.

Journal papers

- P. Ahokangas, M. Matinmikko, S. Yrjölä, H. Okkonen & T. Casey, "'Simple rules" for mobile network operators' strategic choices in future cognitive spectrum sharing networks," *IEEE Wireless Communications*, vol.20, no.2, pp. 20-26, April 2013.
- M. Matinmikko, M. Palola, H. Saarnisaari, M. Heikkilä, J. Prokkola, T. Kippola, T. Hänninen, M. Jokinen & S. Yrjölä, "Cognitive Radio Trial Environment: First Live Authorized Shared Access-Based Spectrum-Sharing Demonstration," *IEEE Vehicular Technology Magazine*, vol.8, no.3, pp.30-37, Sept. 2013.
- M. Matinmikko, H. Okkonen, M. Palola, S. Yrjölä, P. Ahokangas & M. Mustonen, "Spectrum sharing using Licensed Shared Access (LSA): The concept and its work flow for LTE-Advanced networks". *IEEE Wireless Communications Magazine*, vol.21, no.2, pp. 72-79, April 2014.
- M. Mustonen, T. Chen, H. Saarnisaari, M. Matinmikko, S. Yrjölä & M. Palola, "Cellular architecture enhancement for supporting European Licensed Shared Access (LSA) concept". *IEEE Wireless Communications*, vol 21, pp. 37-43, June 2014.

Conference papers

- M. Matinmikko, M. Palola, H. Saarnisaari, M. Heikkilä, J. Prokkola, H. Tuomivaara, T. Kippola, M. Jokinen & T. Hänninen, "CORE - Cognitive Radio Trial Environment," in Proceedings of Wireless World Research Forum (WWRF) meeting 30, Oulu, Finland, 23-25 April 2013.
- P. Ahokangas, M. Matinmikko, S. Yrjölä, M. Mustonen, H. Posti, E. Luttinen & A. Kivimäki, "Business models for mobile network operators in Licensed Shared Access (LSA)," IEEE DySPAN, McLean, VA, 1-4 April 2014.
- M. Palola, M. Matinmikko, J. Prokkola, M. Mustonen, M. Heikkilä, T. Kippola, S. Yrjölä, V. Hartikainen, L. Tudose, A. Kivinen, J. Paavola & K. Heiska, "Live field trial of Licensed Shared Access (LSA) concept using LTE network in 2.3 GHz band," IEEE DySPAN, McLean, VA, 1-4 April 2014.
- M. Palola, M. Matinmikko, J. Prokkola, M. Mustonen, M. Heikkilä, T. Kippola, S. Yrjölä, V. Hartikainen, L. Tudose, A. Kivinen, J. Paavola, K. Heiska, T. Hänninen & J. Okkonen, "Description of Finnish Licensed Shared Access (LSA) Field Trial Using TD-LTE in 2.3 GHz Band," IEEE DySPAN, McLean, VA, 1-4 April 2014.
- P. Ahokangas, M. Matinmikko, I. Atkova, L. F. Minervini, S. Yrjölä & M. Mustonen, "Coopetitive Business Models in Future Mobile Broadband," 6th Workshop on Coopetition Strategy - "Coopetition Strategy and Practice", Umeå, Sweden, 22-23 May 2014.

Conference papers

- M. Mustonen, M. Matinmikko, M. Palola, S. Yrjölä, J. Paavola, A. Kivinen & J. Engelberg, "Considerations on the Licensed Shared Access (LSA) Architecture from the Incumbent Perspective," CrownCom 2014, Oulu, Finland, 2-4 June 2014.
- P. Ahokangas, M. Matinmikko, S. Yrjölä, M. Mustonen, E. Luttinen & A. Kivimäki, "Business Scenarios for Incumbents in Licensed Shared Access (LSA)," CrownCom 2014, Oulu, Finland, 2-4 June 2014.
- P. Ahokangas, K. Horneman, H. Posti, M. Matinmikko, T. Hänninen, S. Yrjölä & V. Gonçalves, "Defining "Co-Primary Spectrum Sharing"— A new Business Opportunity for MNOs?," CrownCom 2014, Oulu, Finland, 2-4 June 2014.
- M. Mäkeläinen, Z. Khan, T. Hänninen & H. Saarnisaari, "Algorithms for Opportunistic Load Balancing Cognitive Engine," CrownCom 2014, Oulu, Finland, 2-4 June 2014.
- J. Niemelä, M. Jokinen & T. Hänninen, "Linux enriched design in second generation wireless open-access research platform," CrownCom 2014, Oulu, Finland, 2-4 June 2014.
- M. Palola, T. Rautio, M. Matinmikko, J. Prokkola, M. Mustonen, M. Heikkilä, T. Kippola, S. Yrjölä, V. Hartikainen, L. Tudose, A. Kivinen, J. Paavola, J. Okkonen, M. Mäkeläinen, T. Hänninen & H. Kokkinen, "Licensed Shared Access (LSA) trial demonstration using real LTE network," Trial workshop at CrownCom 2014, Oulu, Finland, 4 June 2014.

Conference papers

- P. Ahokangas, M. Matinmikko, L. F. Minervini, S. Yrjölä, V. Gonçalves & Miia Mustonen, "Incentives for incumbent spectrum users in Licensed Shared Access (LSA): A dynamic capabilities view," EUCNC 2014, Bologna, Italy, 23-26 June 2014.
- M. Heikkilä, T. Kippola, J. Jämsä, A. Nykänen, J. Keskimaula & M. Matinmikko. Active Antenna System for Cognitive Network Enhancement. IEEE 5th International Conference on Cognitive Infocommunications – CogInfoCom 2014, Vietri sul Mare, Italy, 5-7 November 2014.
- M. Mustonen, M. Matinmikko, D. Roberson and S. Yrjölä. Evaluation of recent spectrum sharing models from the regulatory point of view. 1st International Conference on 5G for Ubiquitous Connectivity, Levi, Finland, 26-27 November 2014.
- M. Heikkilä, T. Kippola, P. Kärsämä, A. Nykänen, P. Tuuttila & M. Matinmikko. Active antenna system (AAS) capabilities for 5G systems: A field study of performance. 1st International Conference on 5G for Ubiquitous Connectivity, Levi, Finland, 26-27 November 2014.

Conference papers

- E. Luttinen, M. Matinmikko, P. Ahokangas, M. Katz & S. Yrjölä. Feasibility assesment of Licensed Shared Access (LSA) concept – Case of a Finnish mobile network operator (MNO). 1st International Conference on 5G for Ubiquitous Connectivity, Levi, Finland, 26-27 November 2014.
- E. Luttinen, M. Matinmikko & M. Katz. Assesment of Channel Interference for Licensed Shared Access (LSA) in the 2.3-2.4 GHz band. 1st International Conference on 5G for Ubiquitous Connectivity, Levi, Finland, 26-27 November 2014.
- M. Katsigiannis, A. Basaure & M. Matinmikko. Cost comparison of Licensed Shared Access (LSA) and MIMO scenarios for capacity growth in Finland. 1st International Conference on 5G for Ubiquitous Connectivity, Levi, Finland, 26-27 November 2014.

Book chapters

- M. Mustonen & M. Matinmikko, “Scenarios for CRS from ITU-R”. In A. Medeisis & O. Holland (eds.) “Cognitive Radio Policy and Regulation: Techno-Economic Studies to Facilitate Dynamic Spectrum Access”. Springer, 2014.
- M. Matinmikko & J. Paavola (Turku University of Applied Sciences), “Scenarios for CR deployment: Visions from research projects”. In A. Medeisis & O. Holland (eds.) “Cognitive Radio Policy and Regulation: Techno-Economic Studies to Facilitate Dynamic Spectrum Access”. Springer, 2014.
- U. Löwenstein (Telefonica Germany) & M. Matinmikko: Mobile communications and need for CR. In A. Medeisis & O. Holland (eds.) “Cognitive Radio Policy and Regulation: Techno-Economic Studies to Facilitate Dynamic Spectrum Access”. Springer, 2014.
- M. Matinmikko, H. Okkonen, S. Yrjölä, P. Ahokangas, M. Mustonen, M. Palola, V. Gonçalves, A. Kivimäki, E. Luttinen & J. Kemppainen, “Business benefits of Licensed Shared Access (LSA) for key stakeholders”. In O. Holland, H. Bogucka & A. Medeisis (eds.) “Opportunistic Spectrum Sharing and White Space Access: The Practical Reality”. John Wiley & Sons, 2015.

Contributions to spectrum regulation

- Cognitive Radio System (CRS) work at ITU-R WP5A
 - NSN & VTT, "Update proposal to Working Document towards a preliminary draft new report ITU-R M.[LMS.CRS2]," ITU-R WP5A meeting, May 2013.
 - Finland, "Update proposal to the work plan for future studies on cognitive radio systems (CRS)," ITU-R WP5A meeting, May 2013.
 - Finland, "Editorial update proposal for the finalisation of the preliminary draft new report ITU-R M.[LMS.CRS2]," ITU-R WP5A meeting, November 2013.
 - NSN & VTT, "Text proposal for sections 7, 8, and 9 of the preliminary draft new report ITU-R M.[LMS.CRS2]," ITU-R WP5A meeting, November 2013.
 - NSN & VTT, "Update proposal of the preliminary draft new Report ITU-R M.[LMS.CRS2]," ITU-R WP5A meeting, May 2014.
 - NSN & VTT, "Editorial Update of the Preliminary Draft New Report ITU-R N[LMS.CRS2]," ITU-R WP5A meeting, October/November 2014.

Contributions to spectrum regulation

- Licensed Shared Access (LSA) work at ECC FM52 and FM53
 - NSN & VTT, "Update proposal for section 4.6 of Draft ECC report on LSA framework," ECC FM53 meeting, July 2013.
 - NSN & VTT, "Update proposals to the draft ECC report 205," ECC FM53 meeting, September 2013.
 - Finland, comments to Draft ECC Report 205. December 2013.
 - VTT, "Update of the draft CEPT Report B1-description of the Finnish LSA trial". ECC FM52 meeting, September 2014.
 - VTT, "Update proposal of the Draft Recommendation on sharing framework between MFCN and PMSE," ECC FM52 meeting, January 2015.

Public LSA trials

- Live LSA trial demonstration. Wireless World Research Forum (WWRF) meeting 30, Oulu, Finland, 25 April 2013.
- Live LSA trial demonstration. LSA Trial Workshop, Helsinki, Finland, 3 September 2013.
- Live LSA trial demonstration. IEEE DySPAN, McLean, VA, 1-4 April 2014.
- Live LSA trial demonstration. Trial workshop at CrownCom 2014, Oulu, Finland, 4 June 2014.
- Live LSA trial demonstration. Mobile Asia Expo (MAE) and GTI workshop, Shanghai, China, 9-13 June 2014.
- Live LSA trial demonstration. ETSI RRS Workshop, Sophia Antipolis, France, 3-4 December 2014.

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CORE+ project WWW page

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