China-Finland Collaborative Research Project on Future Wireless Access Technologies

International Center for Wireless Collaborative Resear

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Innopoli, Espoo, 9 March 2012

NETS2020 Project Facts

- Tekes funded strategic research project
  - Duration: 2009 – 2012
  - Volume 118 person months
- Research partners:
  - University of Oulu, Department of Communications Engineering (DCE) & Centre for Wireless Communications (CWC)
  - Aalto University, School of Science and Technology, Department of Communications and Networking
  - Members of Sino-Finland ICT Alliance
- Funding companies: Nokia, Nokia Siemens Networks, Ericsson Finland, Renesas Mobile Europe, Elektrobit, Nethawk

NETS2020 Project Summary

NETS2020 Work Ppackages

WP1 Research Program Plan Creation	**WP2** New paradigm for networks of the future	**WP3** System simulations	**WP0** Administration and Co-Ordination
T1.1 Joint research plan creation (UOulu&AU)	**T2.1** Resource management for new network topologies (UOulu)	**T3.1** Implementation study of cognitive relay based communication (UOulu)	**T0.1** Administration and general project management in University of Oulu (UOulu)
T1.2 Working assumptions (Uoulu&AU)	**T2.2** Layerless communication in relay based networks (UOulu)		**T0.2** Administration and general project management in Aalto University (AU)
	T2.3 Self-organization in dynamic networks (AU)		**T0.3** Conclusions and results dissemination (Uoulu&AU)

University of Oulu (UOulu)
Aalto University (AU)

Oulu-China Researcher Exchange

- Feng Hu (double-degree student of UOulu and Southeast University) in Tshingua University Oct-Nov 2011
- Prof. Lihua Li from BUPT in UOulu 2010-2011
- Lei Song from BUPT in UOulu Sept-Nov 2011
- Several shorter visits

NETS2020 and Cooperation Outputs

- **Publications**
  - F. Ahmed and O. Tirkkonen, ``Local Optimum Based Power Allocation Approach for Spectrum Sharing in Unlicensed Bands," Proc. 4th Internat. Workshop Self-Org. Systems; Lect. Notes in Computer Science 5918, p. 238--243, Dec 2009.
  - C.-H. Yu and O. Tirkkonen, ``Multiple Relay Selection with Stochastic Geometry," submitted to IEEE Transactions on Wireless Communication, Oct 2010.
  - C.-H. Yu and O. Tirkkonen, ``Device-to-Device Communication Underlaying Cellular Networks Based on Rate Splitting," submitted to IEEE Transactions on Wireless Communication.
  - Z. Zheng, J. Hämäläinen, Y. Yang: 'Practical Resource Scheduling and Power Control Optimization for LTE Femtocell Networks', submitted to 8th International Workshop on Multi-Carrier Systems & Solutions 2011 (MCSS 2011), November 20101
  - Z. Zheng, J. Hämäläinen, Y. Yang, 'On Uplink Power Control Optimization and Distributed Resource Allocation in Femtocell Networks', IEEE VTC Workshop (BeFemto), November 2011.
  - Z. Zheng, A. Dowhuszko, J. Hämäläinen: “Study on Resource Allocation in OFDMA Macro- and Femtocellular Networks” journal level paper draft.
  - G. Venkataram, A. Tölli & M. Juntti, " 'User allocation and precoder design for coordinated relaying". Proceedings of IEEE Global Telecommunications Conference (GLOBECOM 2011), Houston, Texas, USA, December 5–9, 2011.
  - M. Leinonen, J. Karjalainen & M. Juntti, "Distributed routing and power optimization in wireless sensor networks". Proceedings of European Signal Processing Conference (EUSIPCO 2011), Barcelona, Spain, August 29 – September 2, 2011.
  - J. Kaleva, A. Tölli & **M. Juntti**, “Zero-forcing throughput maximization for regenerative multi-user relaying”. Proceedings of EEE International Workshop on Signal Processing Advances in Wireless Communications (SPAWC 2012), Cesme, Turkey, June 17–20, 2012, submitted.
  - J. Kaleva, A. Tölli & M. Juntti, “Coordinated downlink precoder design for regenerative multi-user relaying”. Proceedings of IEEE International Conference on Communications (ICC 2012), Ottawa, Ontario, Canada, June 10–15, 2012, to appear.
  - Feng Hu, Nandana Rajatheva, Matti Latva-aho, “Sensor Integration to LTE/LTE-A Network through MC-CDMA and Relaying,” IEEE Transactions on Vehicular Technology, submitted.
  - J. Kaleva, A. Tölli, G. Venkataram & M. Juntti, ”Downlink precoder design for coordinated regenerative multi-user relaying”. IEEE Transactions on Signal Processing, submitted , February 2012.
  - H. Wang, L. Li, Y. Zhang, M. Juntti & T. Puotinen, “Unitary precoder design for MIMO spatial multiplexing systems with limited feedback”. Proceedings of IEEE Consumer Communications and Networking Conference (CCNC 2012), Las Vegas, Nevada, USA, January 14–17, 2012, to appear.

- **Joint special issue proposal**
  - IEEE Journal on Selected Areas in Communications: Spectrum and Energy Efficient Design of Wireless Communication Networks

Joint Advanced Development Enabling Next Generation Energy-Efficient Wireless Networks

Status Report

9 March 2012

Overview of JADE

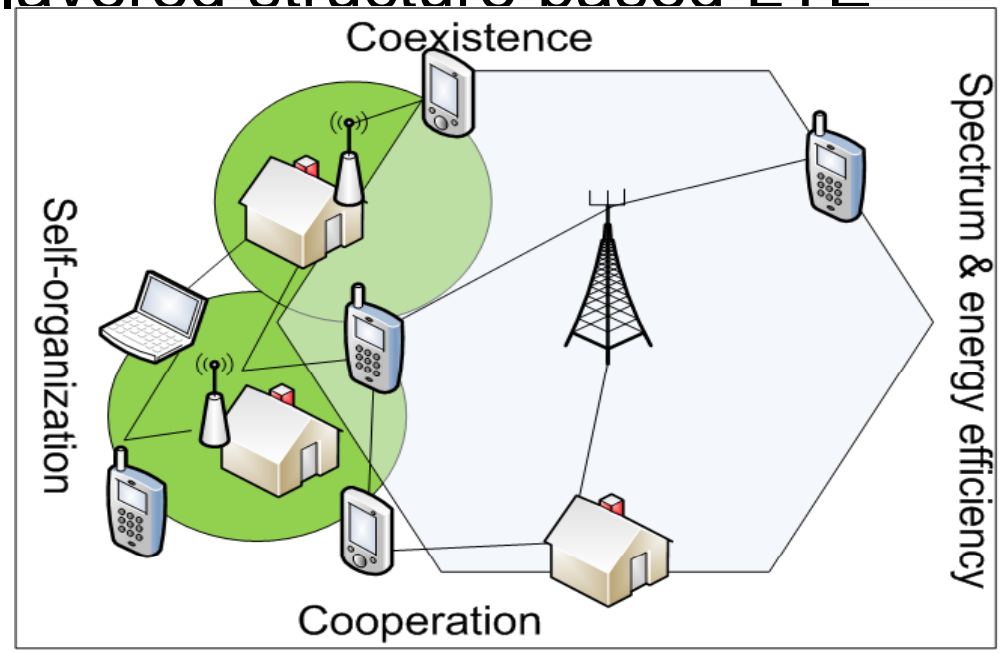
- Joint Advanced Development Enabling Next Generation Energy-Efficient Wireless Networks (JADE) is a 3-year research project jointly funded by Tekes, VTT, and several industry companies.
- Technical objective of JADE is to design and develop link and network layer energy efficient solutions for IMT-Advanced networks, with special efforts on applying cognitive techniques to improve energy and spectrum efficiency in layered structure based LTE networks.

Facts of JADE:

- Under Tekes GIGA programme
- Under Sino-Finland ICT Alliance
- Duration: 1.2010 – 12.2012
- Person months: 70
- Consortium:

Tekes VTT NOKIA Connecting People Nokia Siemens Networks (Until 12.2011)

(Until 12.2010)



Cooperation in JADE

- Scholar exchange: 2 students from Beijing University of Posts and Telecommunications (BUPT) to VTT for 3 months, starting from August 2011
- 2 times visits to Wireless Technology Innovation Institute at BUPT
- Joint publications with Shanghai Research Center of Wireless Communications (WiCo) and BUPT
- Idea exchange and discussion with University of Electronic Science and Technology of China (UESTC)

Cooperation results from JADE

- Joint publications
  - J. Zhang, Y. Zhang, T. Chen, “Enabling Techniques and Energy Efficiency Analysis for Green Radios,” CMC 2012, Guilin, China, May, 2012
  - T. Chen, Y. Yang, H. Zhang, H. Kim, K. Horneman, “Network Energy Saving Technologies for Green Wireless Access Networks,” IEEE Wireless Communications Magazine, Oct 2011
  - T. Chen, H. Zhang, Y. Yang, K. Horneman, “Network Energy Saving Techniques In Wireless Access Networks,” Book Chapter, *Green Radio Communication Networks*, Cambridge University Press, to be appear
  - T. Chen, H. Kim, Y. Yang, “Energy Efficiency Metrics for Green Wireless Communications,” WCSP 2010, Suzhou, China, Oct. 2010
  - J. Xu, C. Liu, Y. Yang, T. Chen, “An Overview of Energy Efficiency Analytical Models in Communications Networks,” WCSP 2010, Suzhou, China, Oct. 2010
- Joint proposal idea with BUPT
  - “Spectrum and Energy Efficient Technologies for Intelligent Heterogeneous Radio Networks”

Plan for 2012

- Joint book chapter with WiCo
- Joint conference/journal paper with BUPT
- Possible scholar exchange from VTT to Chinese partner

Collaboration Themes

Research Themes – 1

- **Green Communications (Spectrum and Energy Efficiency Algorithms)**
  - **Coordinators: VTT and WiCO; interested partners: all**
  - **Joint publications: 3**
  - **Joint standard proposals: 1**
  - **Joint special issue proposals: 1**

Research Themes – 2

- **Channel Modelling (Measurement, characterization, and High-Speed Vehicular Networks)**
  - **Coordinators: EB and BJTU; interested partners: BJTU, TJU, EB, BUPT, THU, WiCO**
  - **Joint publications: 2**
  - **Joint standard proposals:**

Research Themes – 3

- **Cognitive Radio, Dynamic Spectrum Access, and Cooperative Communications (including Relay Technologies)**
  - **Coordinators: Oulu and BUPT, interested partners: Aalto, VTT, BUPT, Nokia, BJTU Oulu, TJU, WiCO**
  - **Joint publications:**
  - **Joint standard proposals: 5**

Research Themes – 4

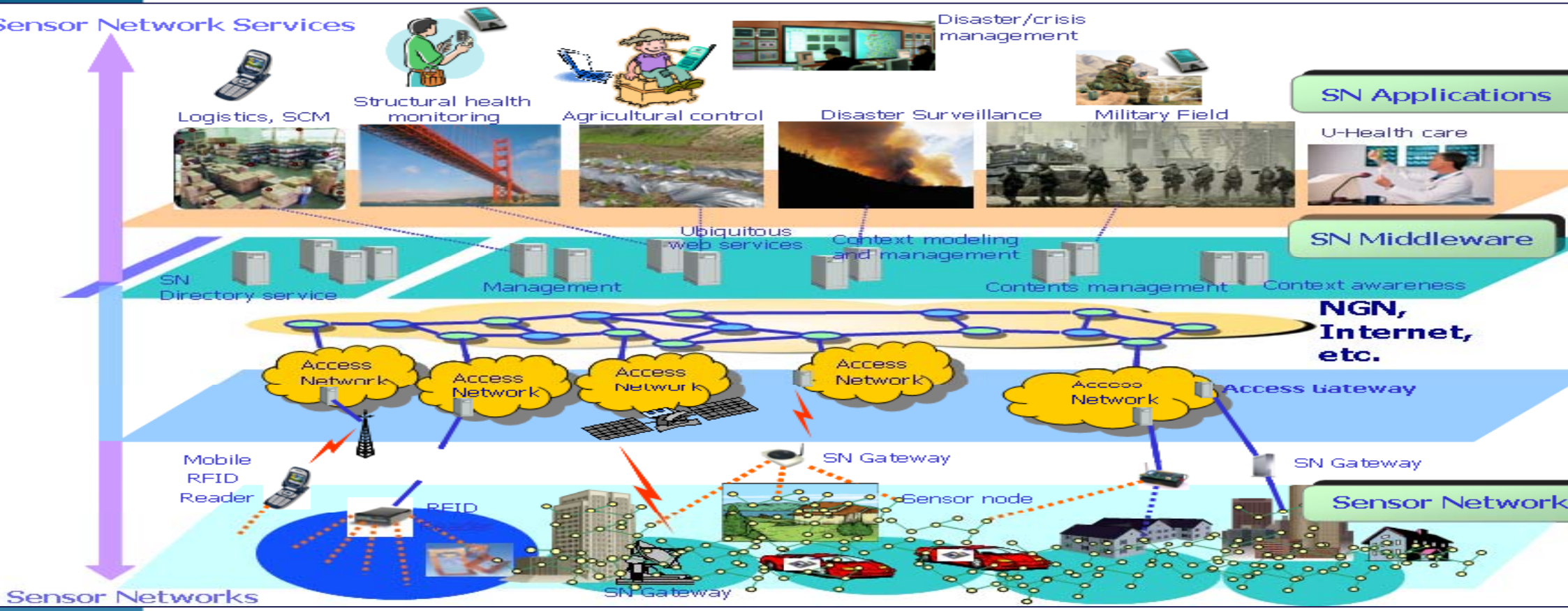
- **Network Convergence (including wireless sensor networks and Internet of Things)**
  - **Coordinators: Nokia and WiCO, interested partners: Nokia, Oulu**
  - **Joint publications:**
  - **Joint standard proposals:**
  - **Joint projects: 3**

Research Themes – 5

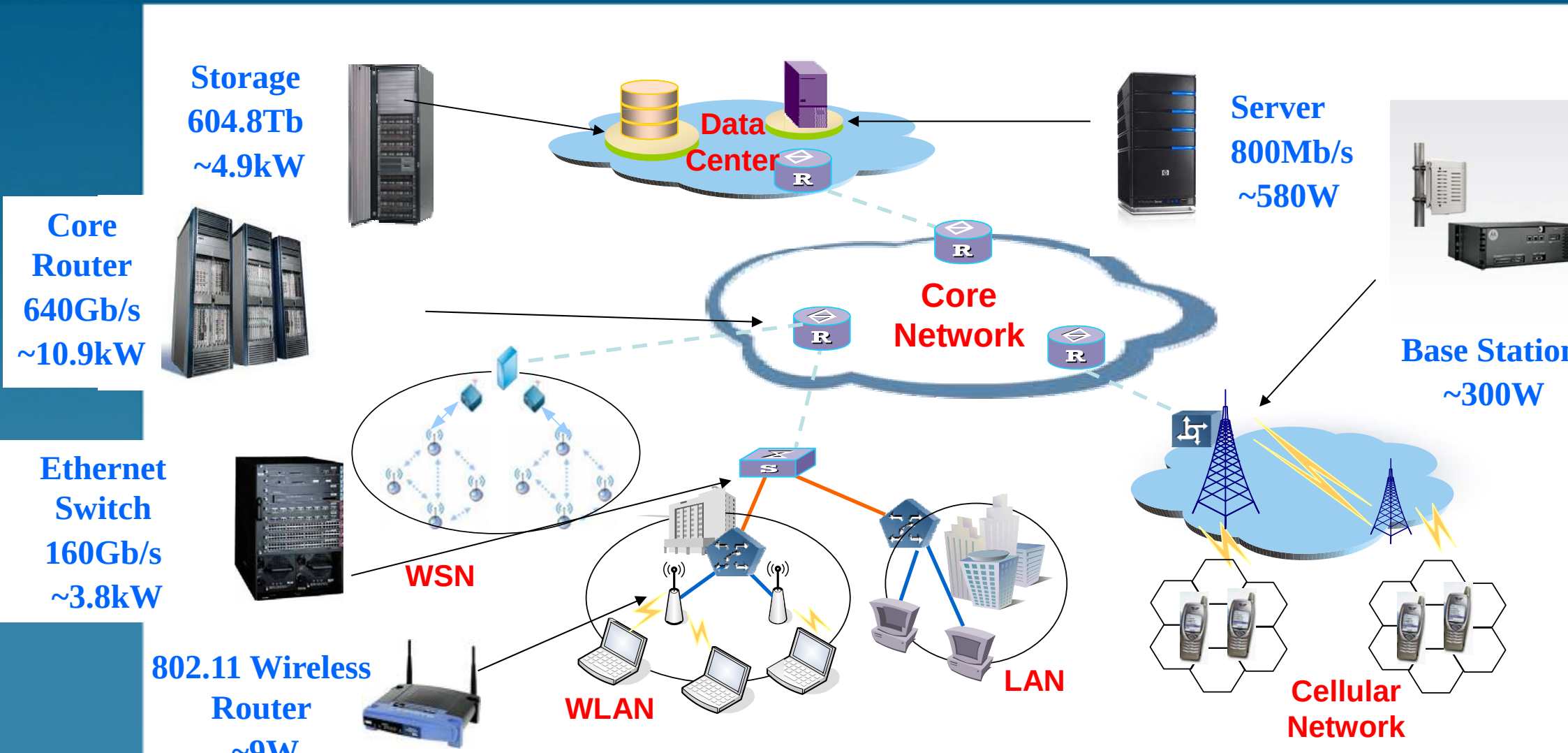
- **Self-organization Networks, Network Planning and Interference Management (including Femtocell, Network Automation)**
  - **Coordinators: Aalto and DT Mobile, interested partners: VTT, Aalto, DT Mobile, BJTU, WiCO**
  - **Joint publications:**
  - **Joint standard proposals: 1**

Collaboration Roadmap

New Era of the Internet of Things



Green ICT for Climate Change



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