

Random Access Protocols for Wireless  
Networks  
(Report to the department for evaluation and  
feedback)  
2012-2016

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# Outline

Collaborators

The challenge: Channel access

Our favorite tool: A decentralized CSP solver

First Results

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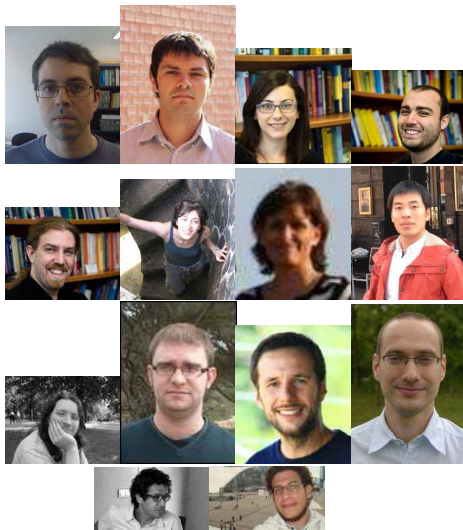
Next Steps

Projects

Teaching

External Evaluation

# Collaborations



- Boris Bellalta
- Alex Bikfalvi
- Cristina Cano
- Alessandro Checco
- Ken Duffy
- Azadeh Faridi
- Nuria Garcia
- Ruizhi Liao
- David Malone
- Gabriel Martorell
- Joan Melia
- Simon Oechsner
- Miquel Oliver
- Luis Sanabria-Russo

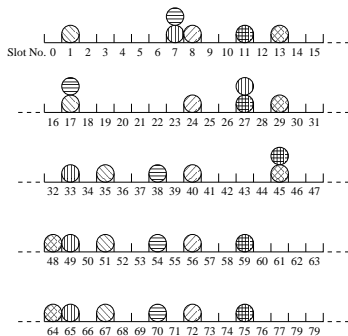
# Challenges



- EPC Gen2 RFID: Identification and tracking of tags. Read all the tags in a short time.
- IEEE 802.11 WiFi WLANs: High speed cost efficient Internet access for mobile devices. Support many devices and offer high throughput. Increase coverage using multi-hop. Efficient use of multiple antennae and channel bonding.
- IEEE 802.15.4 ZigBee WSN: Simple, low-power battery devices. Save energy and prevent packet loss.

# Our favorite tool: A decentralized CSP solver

- Decentralized resource allocation problems.
- A decentralized constraint satisfaction solver.
- The only information available to me, as a participant, is whether the constraints I am involved in are satisfied.
- Simple. Change your choice if you are not satisfied.



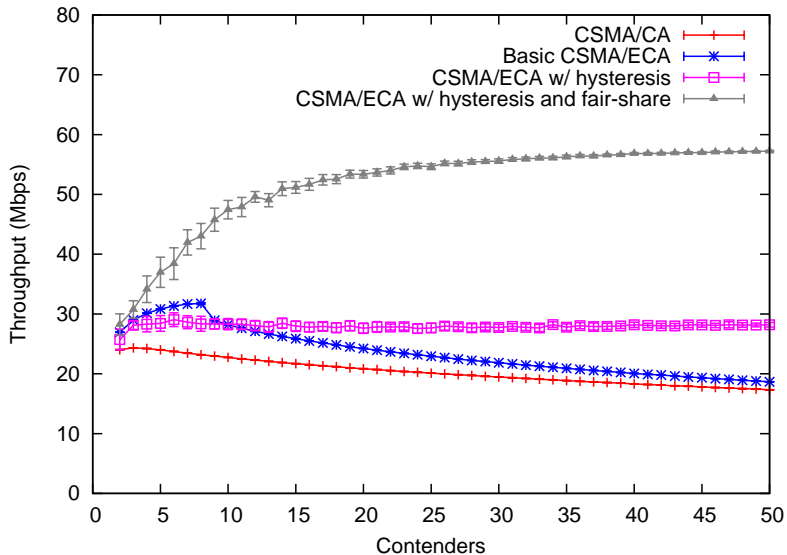
# First Results

- A subtle modification of the IEEE 802.11 protocol to allow collision-free operation in crowded scenarios (backward compatibility preserved, need for more exhaustive evaluation).
- A first solution to achieve collision-free operation in multi-hop wireless mesh networks (still room for improvement).
- A model for a simple solver for decentralized constraint satisfaction problems.
- Assessment of the performance improvement by collision-free operation when ARF is taken into account.
- Evaluation of the impact of queueing processes on MAC protocols supporting MU-MIMO.
- USRP spectrum occupancy sensor.

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# First Results





## Next Steps

- Evaluation of proposed “Hysteresis” and “Fair-share” in non-saturated scenarios with channel errors and slot drift.
- Modeling of link activation problem in mesh networks as a decentralized constraint satisfaction problem with sensing restrictions.
- Collision-free techniques in RFID contention protocols.
- Prototyping with the “Demo tag”.
- Trade-offs of frame aggregation.
- Collaboration in the “Wireless MAC Processors” front.
- QoS in next-gen MAC protocols.
- Construction of a collision-free schedule of beacons (WSNs, 802.11s, 802.11p)

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# Projects

- Commons for Europe. Bottom-up Broadband for Europe.
  - Create a pool of common resources to be shared by European cities (and citizens).
  - Grassroots networking initiatives.
  - High educational value.
  - Move from a market/competition economy to a commons/collaboration economy (think of wikipedia, open source, creative commons ...).
  - Shift from profit to benefit.
  - Four pilots: Free Europe WiFi, Fiber From The X, Mobile Node, Open Sensor Network.
- CISNETs: Collaboration in WSNs.

# Teaching, coordination and promotion

- Opened two undergrad courses. Renewed one.
  - QoS
  - WSN (with Luis)
  - Networking Laboratory (with Ray and Alex)
- Graduate seminar on contention protocols.
- Two undergrad thesis (Alejandro and Fernando), one Ph.D. thesis (Luis).
- Escolab (with Luis and Alejandro).
- School's promotional talk.
- Degree teaching coordinator (School appointment).
- Teaching commission (Department's appointment).

# External Evaluation

- Positive evaluation (“Acreditacio de Recerca”) by the Catalan university quality agency (Agencia per a la Qualitat del Sistema Universitari, AQU).









# Summary

- Integrated in a research team.
- Some early research results. More to be done.
- Participation in projects and technology transfer.
- Teaching and backing the school and the department.

Thank you for your attention.