



CISTER - Research Centre in
Real-Time & Embedded Computing Systems

IoT: Hype or Research Opportunities?

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ICCCN 2018, Hangzhou, China, July 30 2018

Who am I

- professor of informatics engineering at ISEP, Polytechnic of Porto, Portugal
 - you might not have heard about Port Wine or the city of Porto (aka Oporto)
 - but you might have heard about Cristiano Ronaldo ;-)
- research director of CISTER (Research Centre on Real-Time and Embedded Computing Systems), Porto, Portugal
 - one of the largest research centers in Europe focusing of real-time and embedded systems
- related IoT activities
 - obviously, embedded systems with timeliness as a concern
 - ACM SIGBED Vice-Chair; CG IEEE RTAS 2014; Local Organizer IEEE RTSS 2016
 - wireless sensor networks
 - CG EWSN 2015, Porto, leader DEWI (dependable wireless EU Artemis Project); and SCOTT (secure connected things, EU ECSEL project); OpenZB initiative;
 - cyber-physical systems
 - CG CPSWeek 2018, Porto; scalable computations exploiting dominance-protocols
 - as RTS background, was willing to set theoretical foundations able to achieve scalable (independent of number of nodes collecting information) computations such as MIN, COUNT, AVERAGE, approximate interpolation, etc.

Is IoT an Hype?

- really very few (if any) killing applications, still, a few nice examples
 - Amazon Go (really cool); people want to go to a shop and buy the products
 - but, how many people is behind the scenes training the algorithms and making validation?
- is it really new?
 - internet is there connecting things since long time; ES and CPS are/were also about integration and are interdisciplinary
 - today, the IoT itself is a thing; a Thing worth talking about; **IoT sells better (...to politicians ;-))**
 - urban sensing; opportunistic sensing with (smart)phones
 - opportunistic routing with the public vehicles (Veniam's technology in Porto, Singapore, etc.)
- how far Intelligent will be common consumer electronics?
 - “it seems every kind of thing from dishwashers to doorknobs require an Internet connection, since after all, we all know our dishwashers have long grown a desire for scintillating conversation with our doorknobs” **Really?**
- obstacles
 - security (RFIDs are one of the most basic devices; where is security one those?)
 - privacy (why still lots of money being poured into the IoT hope-to-be-market: **big data**)
 - corporations don't expect big money from the devices; they want to know about me and the nasty habits I hide from my neighbors ;-)
 - **e.g., my car says to my thermostat to turn on the hot tube when I'm arriving home; however nobody cares about it; they would care about my hot date (if I had one)**
 - difficult to get useful mean/use for large/complex/uncorrelated data sets
 - good opportunity for research in data analytics, machine learning, AI, etc.



Research Opportunities

- what are the theoretical foundations of the IoT, and how they differ from networked sensed, mobile systems, etc.?
 - networked sensing (**non disruptive**)
 - industrial IoT (our MANTIS project on predictive maintenance for instrumented factory-floor; or the application for noise reduction – Swedhood/IKEA)
 - interoperability of technologies (use of WiFi)
 - SmartSkins with scalable sensing technology (**disruptive**)
 - mobile systems (**non disruptive**)
 - participatory sensing and opportunistic routing in intelligent transportation systems (Veniam's case in the City of Porto with buses)
 - interoperability of technologies (use of WiFi) **as an important drive for penetration;**
 - data analytics, machine learning AI
 - Urban Sensing project (in Porto)
 - difficult to get useful mean/use of large/complex/uncorrelated data sets
 - » good opportunity for research in data analytics, machine learning, AI
 - actually lots of colleagues publishing like in other non-CS domains; skills of civil engineers, sociologists, etc. are put together to filter, correlate, learn about data, by running experiments, **lots of them!**
 - Security
 - SCOTT Project; however it essentially an (EU Project) Innovation Action, aiming at transferring best practices to different industry domains
 - **but, as we know, if you want to have security -> don't connect!**

