IoT: a panorama

SophiaConf 2014

30-Jun-2014
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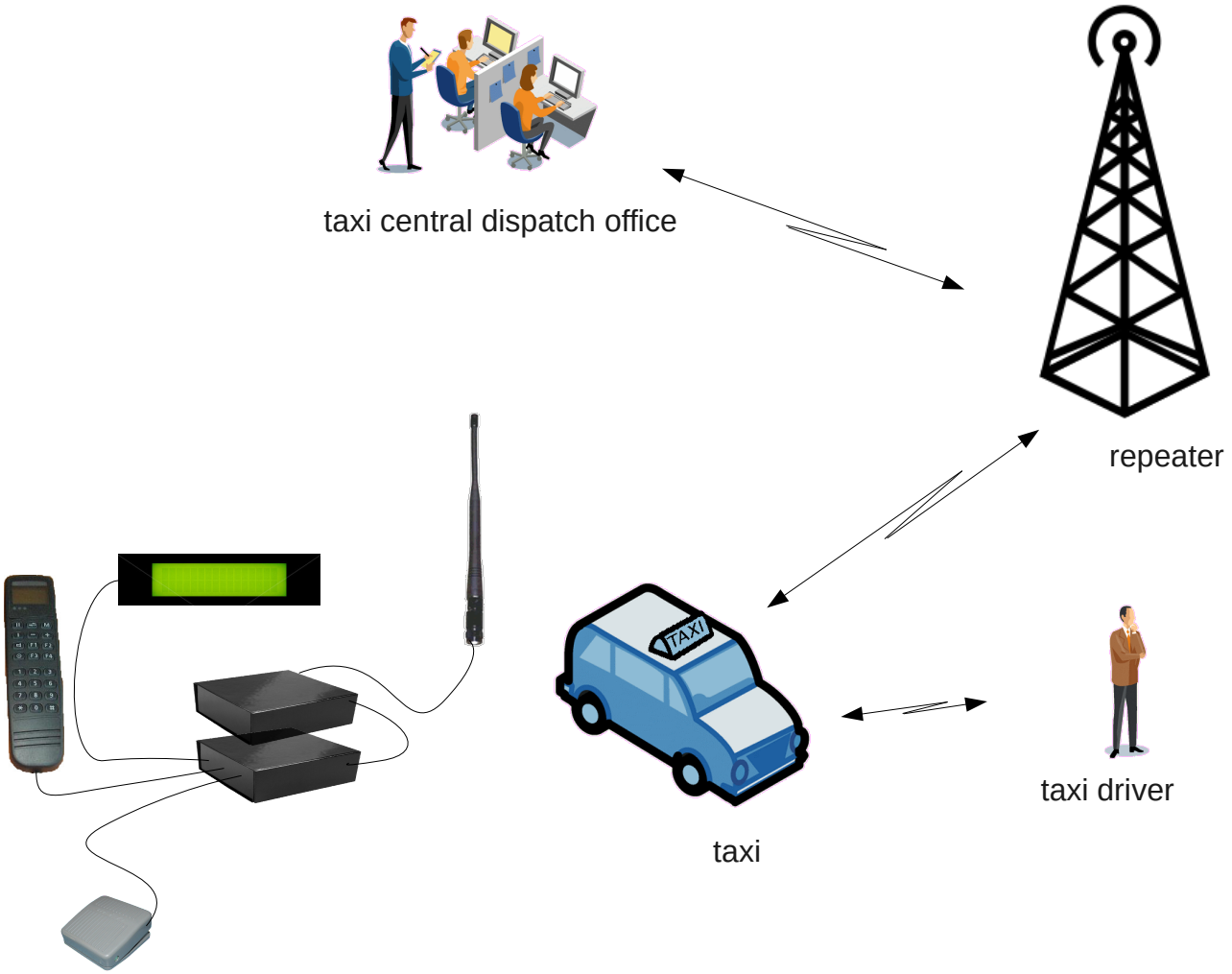
Once upon a time...

- 1990:

  - no GSM
  - no ADSL
  - no easy access to the Internet

  - first version of Linux kernel, GNU GPL
  - Windows 3.0
  - high cost of electronics prototyping
  - no easy access to Venture Capital

Nevertheless...



Today's technology... just for wireless communications

Today's examples - container tracking

http://www.logisticsarena.eu/real-time-container-tracking-is-ready-to-take-off/
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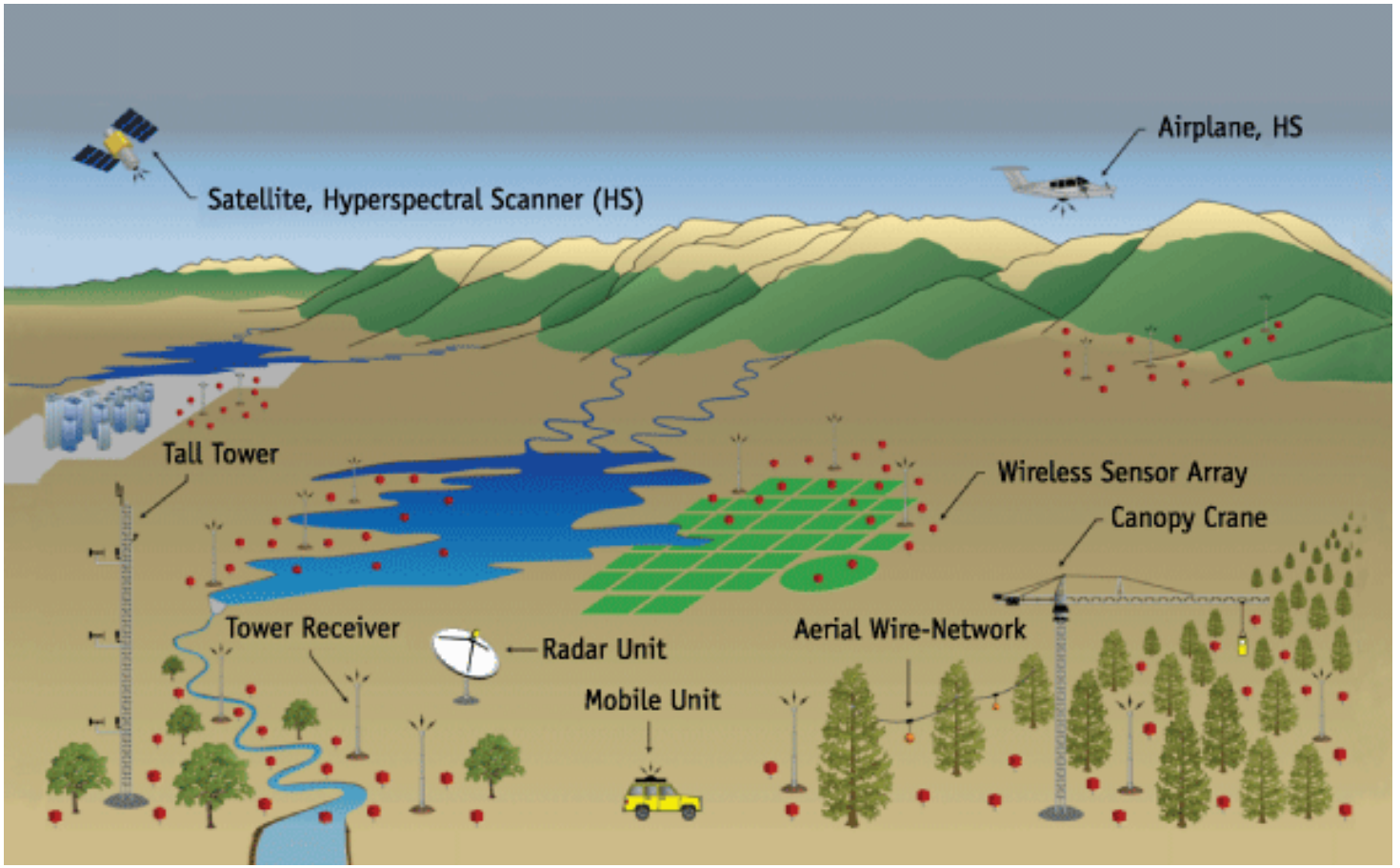
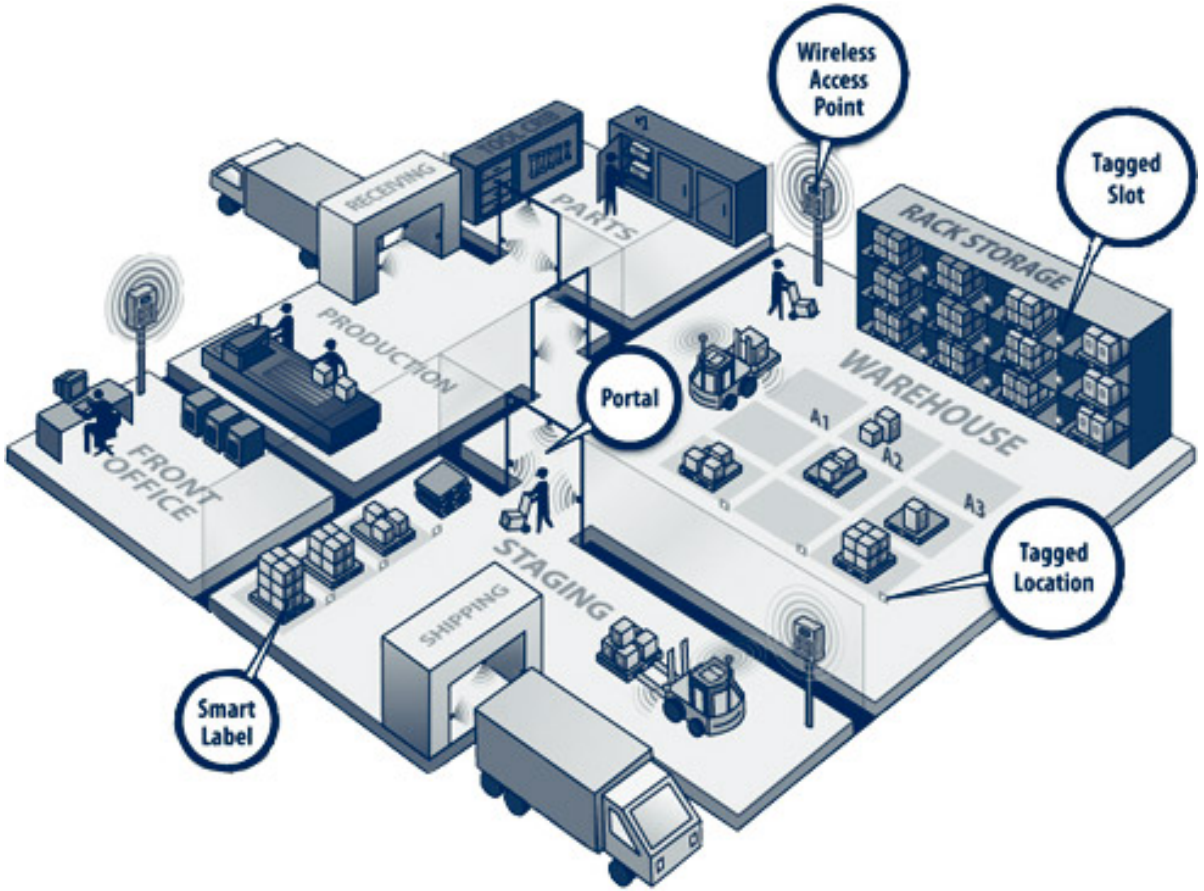
Today's examples - environmental monitoring



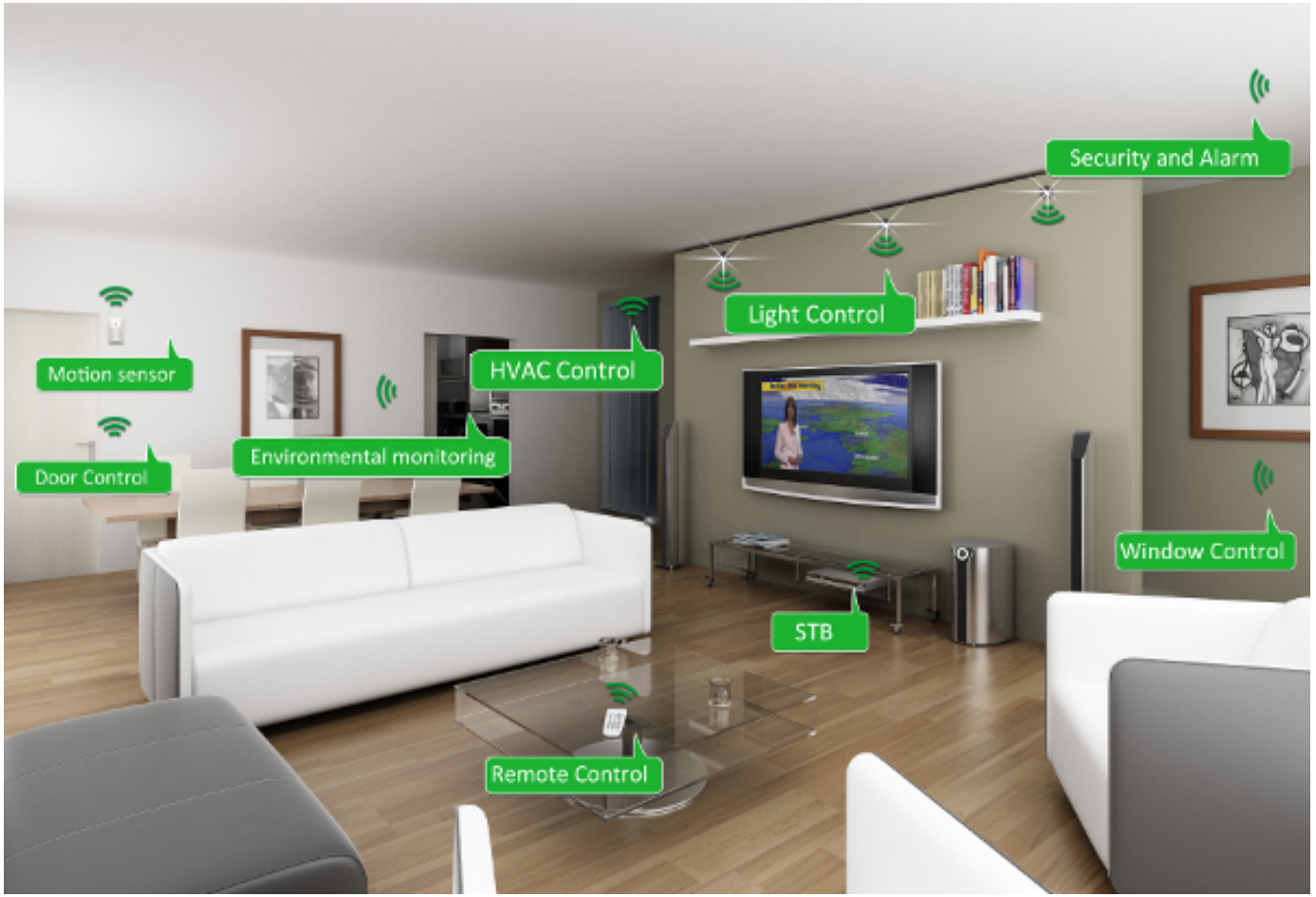
http://www.environment.ucla.edu/reportcard/article.asp?parentid=1506

Today's examples - logistics



http://radiofrequencyidchip506.wordpress.com/deliverables/

Today's examples – home automation



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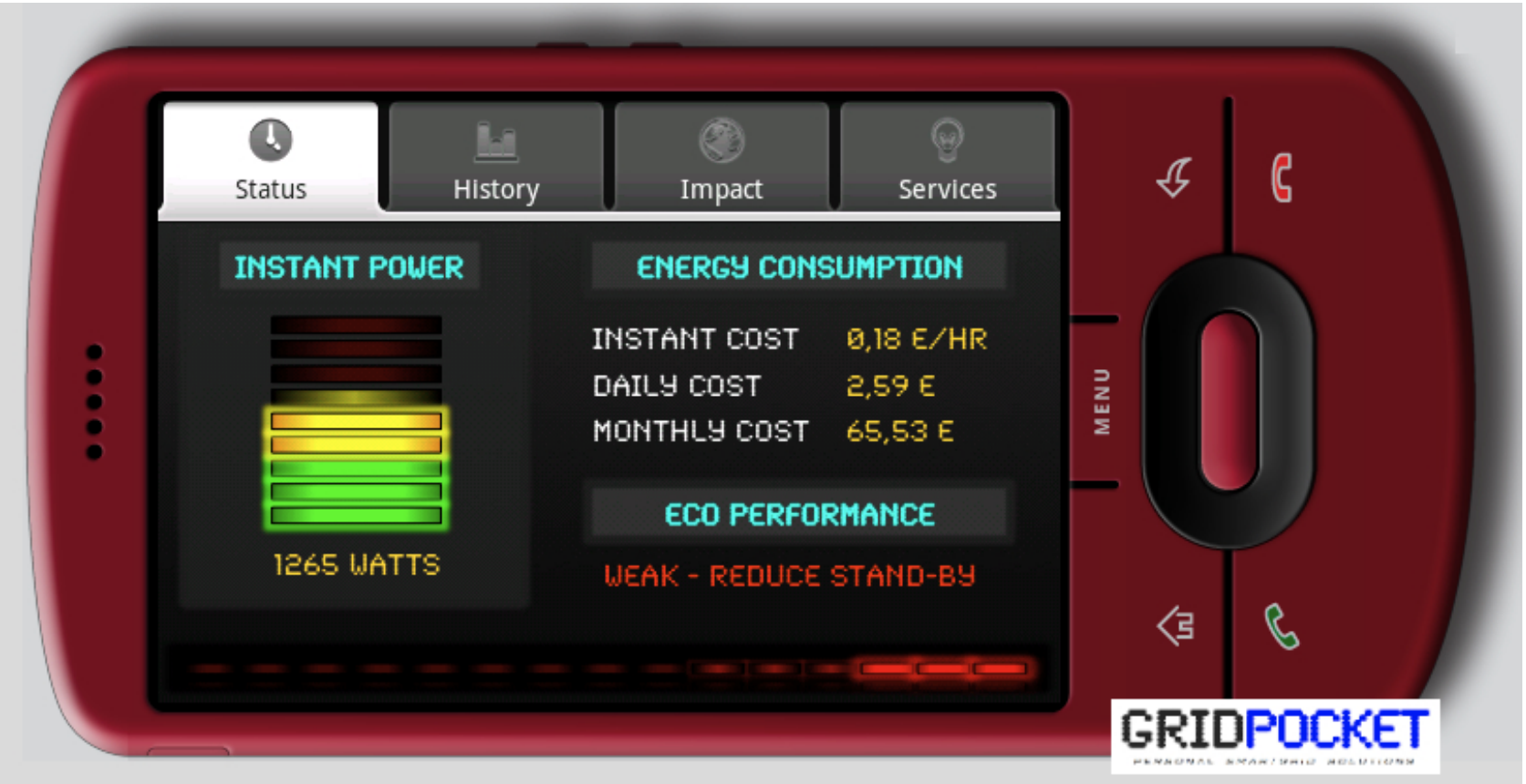

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Summary

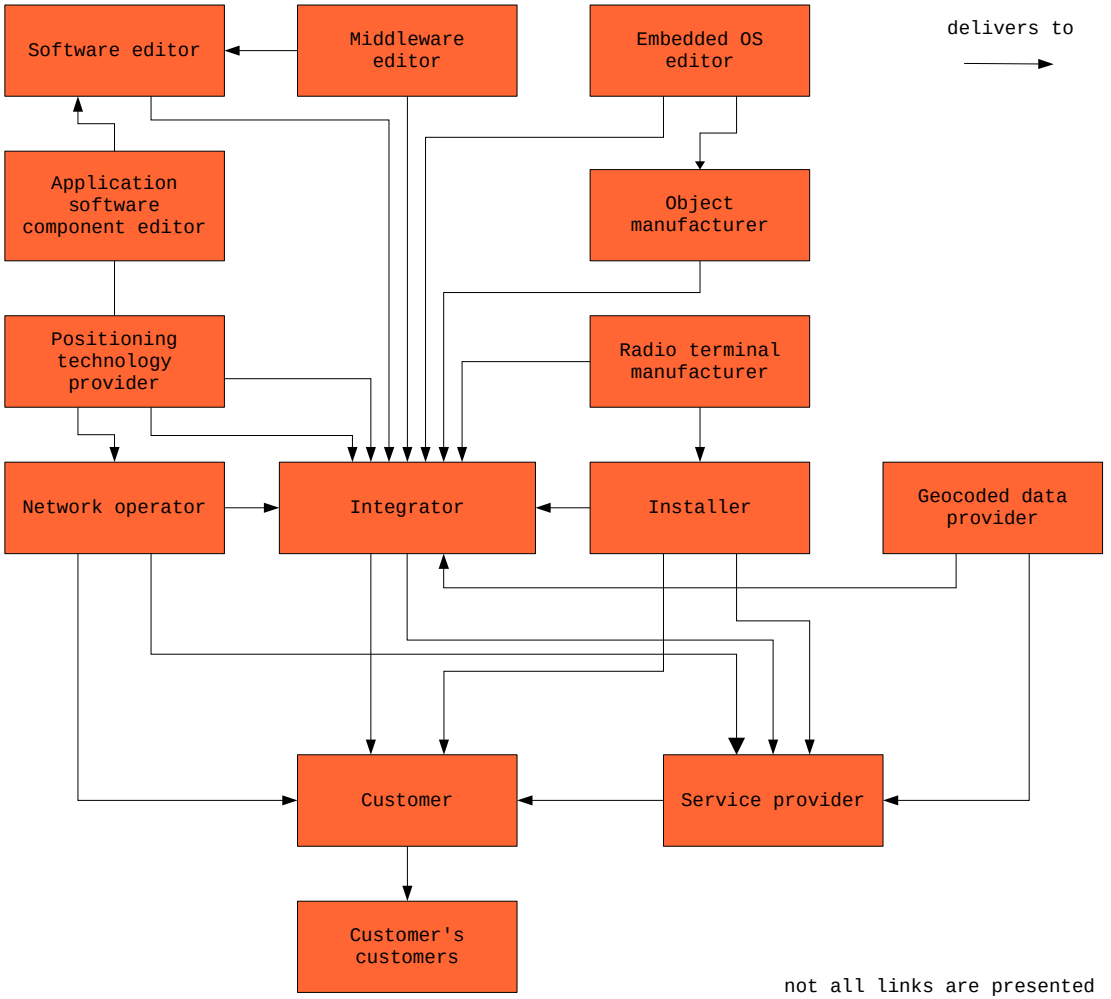
- Myriads of different requirements
- Consequently, myriads of different systems
- Mix of three main technology domains:
  - electronics + embedded computing
  - telecommunications
  - application software
    - embedded
    - back office / front office

Ecosystem

- Several technology domains means complex ecosystem
- Value chain as usually presented:

Ecosystem

- More realistic value chain:



Some usual difficulties

- technical ones:
  - data transmission over a non reliable/non permanent link
  - global view
  - ...
- functional ones:
  - talking about technology with users, instead of talking about their needs
  - ...
- project management:
  - experienced mixed team (software, hardware, telecommunications)
  - ...

Open source and standards

- Open source helps **a lot**:
  - open source software
  - open source hardware
  - open data
  - fab lab
- You can help open source as well!

Open source and standards

- Standards can help as well:

  - ETSI M2M
  - oneM2M
  - 3GPP
  - IETF
  - OASIS
  - ISO
  - IEEE
  - CEN
  - IEC
  - CENELEC
  - SGIP
  - HGI
  - OSGi
  - dlna
  - uPnP
  - etc.

Some anecdotes

- a tracking system for waste-collection trucks
- a defective design (hardware AND software) for an embedded equipment, from our supplier
- a device exhibiting freezes in the field

Remember our 1994 taxi dispatch system?

- Embedded code:
  - drivers: LCD, transceiver and handset serial buses, GPS receiver, data storage, I/O
  - cell-roaming
  - application-layer protocol stack
  - ride handling
  - lists of busy and free taxis per sector
  - lists of booked rides per sector
  - alarm handling (data + voice)
  - start and end of service
  - alarm pedal, taximeter
  - etc.

Remember our 1994 taxi dispatch system?

- 68HC11 microcontroller + 32 KB Flash + 8 KB RAM
- Hardware evolution

	1994	2014
	Freescale 68HC11E1	NXP LPC1837JET256
Flash	external 32 KB memory	1024 KB
RAM	external 8 KB memory	136 KB
Architecture	8 bits	32 bits, 3-stage pipeline, modified Harvard arch.
Clock	2 MHz	180 MHz
Price	US$ 7 + 2 + 3 (?)	US$8

Definitions

- So, now, what is IoT (and M2M)?

IoT

- **Wikipedia**: The Internet of Things (IoT) refers to uniquely identifiable objects and their virtual representations in an Internet-like structure.

  [http://en.wikipedia.org/wiki/Internet_of_things - 21-Jun-2014]

- **Cisco**: The Internet of Things (IoT) is the network of physical objects accessed through the Internet, as defined by technology analysts and visionaries. These objects contain embedded technology to interact with internal states or the external environment. In other words, when objects can sense and communicate, it changes how and where decisions are made, and who makes them.

  [http://www.cisco.com/web/solutions/trends/iot/overview.html - 21-Jun-2014]

M2M

- **Wikipedia**: Machine to Machine (M2M) refers to technologies that allow both wireless and wired systems to communicate with other devices of the same type. M2M is a broad term as it does not pinpoint specific wireless or wired networking, information and communications technology. This broad term is particularly used by business executives. M2M is considered an integral part of the Internet of Things (IoT).

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- **Orange**: Exchange of information between machines that is established between the central control system (server) and any type of equipment, through one or several communication networks.

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- **Digi**: Machine-to-Machine (M2M) technology allows organizations to gather data from the edge of the enterprise and apply it in ways that positively impact the business.

  [http://www.digi.com/business/ - 21-Jun-2014]

Conclusion - 1

A term with so many different definitions can't refer to an existing concept

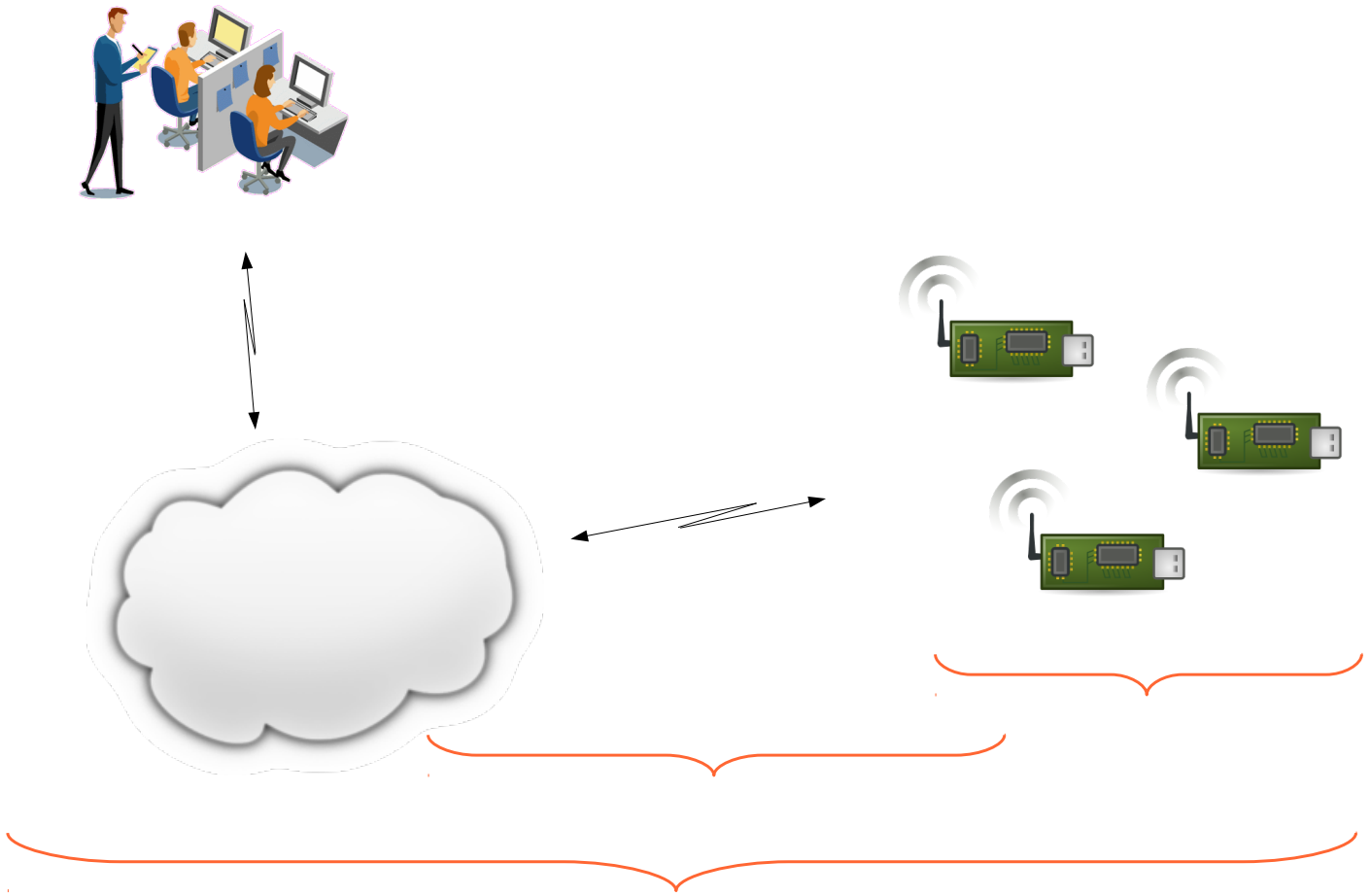
=> IoT does not exist 

What is real is:

- user needs
- technologies to be used to fulfill those needs

Conclusion - 2

Well, OK, IoT exists. But it exists only if things exist.



Thanks for your attention!
Questions?

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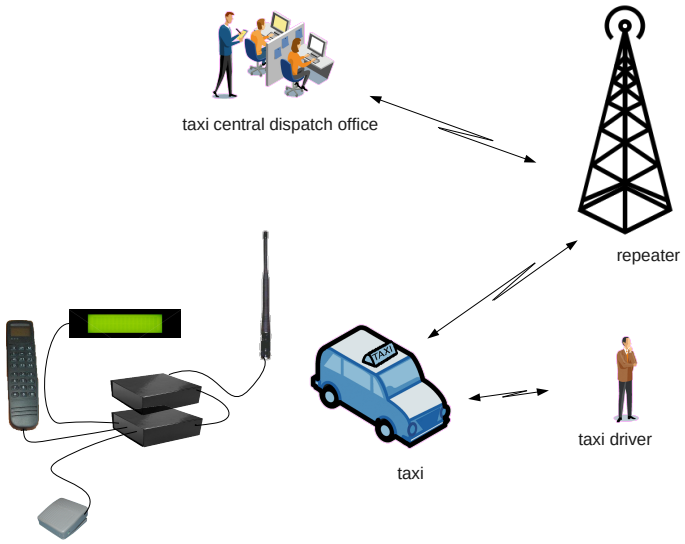
- no GSM - analog cellular networks + Professional Mobile Radio (PMR)
- no ADSL - analog modems
- no easy access to the Internet - first web site (CERN) - Bulletin Boards - Minitel in France

Nevertheless...



- Anyway, designing professional real-time systems for connected vehicles was possible
- For instance:
  - 1994: low-cost system for real-time dispatch of taxi rides
- Technology:
  - data over PMR network (two cells)
  - low cost, dedicated on-board device + radio transceiver + handset + LCD + alarm pedal
  - integration of one of the first OEM GPS receivers
  - data + voice
  - central side: networked PCs

Today's technology... just for wireless communications

- some of the listed names refer to radio technologies / standards, some other ones refer to operators
- no strong meaning in relative positions, excepted that transmission distance increases from left side to right side
- when choosing a wireless technology, think about resource sharing, range, latency, connection setup time, addressability, power consumption, radio module cost, communication cost, throughput (usually not so important)
- thanks to these wireless technologies, systems presented in following pages can be more easily produced

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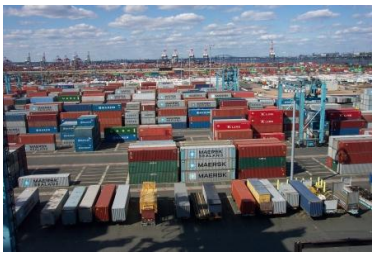

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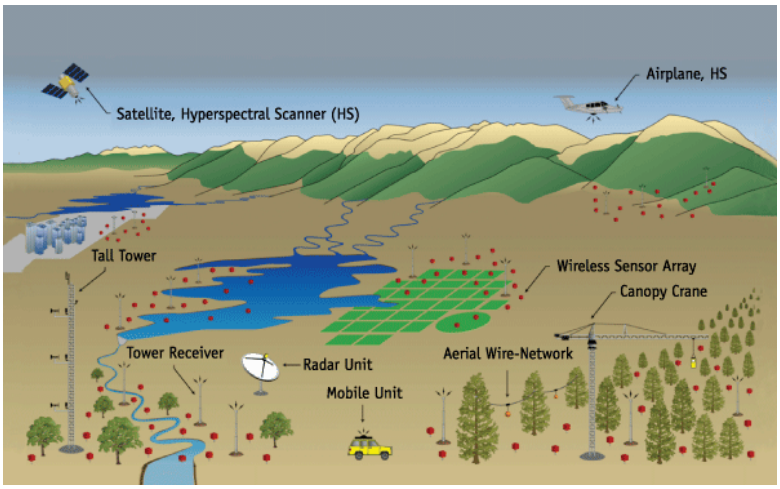

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Today's exam

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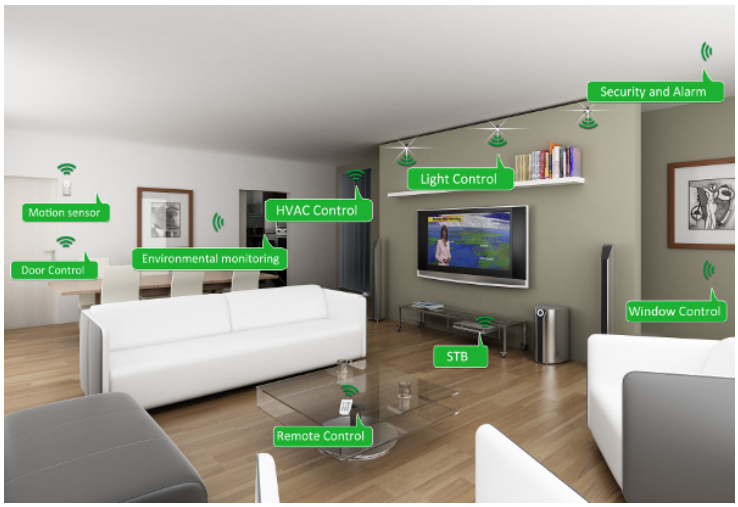

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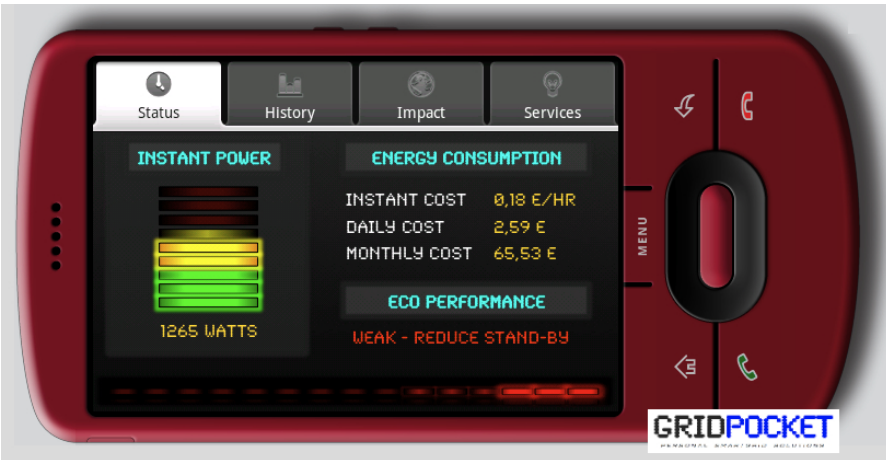

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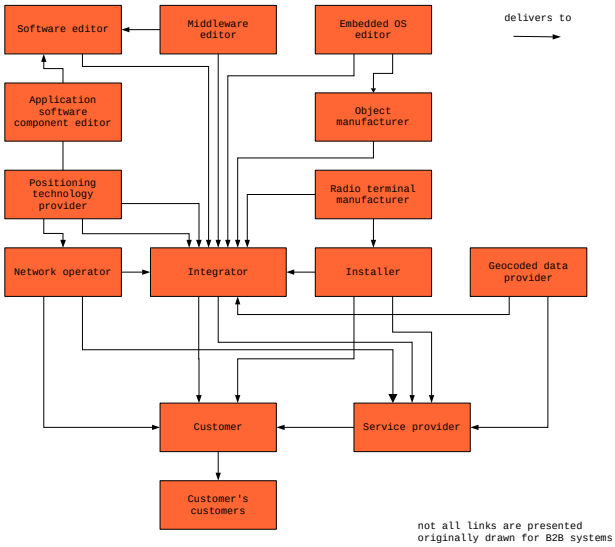

- many different type of activities. It's quite common that one company runs several activities
- important activity: integration. The integrator assembles various components and tries to get a working system
- another important activity, often forgotten about: installation. A bad installation (at home, in a vehicle, in a factory...) can generate lot of glitches very difficult to diagnose

Some usual difficulties

- technical ones:
  - data transmission over a non reliable/non permanent link
  - global view
  - ...
- functional ones:
  - talking about technology with users, instead of talking about their needs
  - ...
- project management:
  - experienced mixed team (software, hardware, telecommunications)
  - ...

- technical ones:
  - data transmission over a non reliable/non permanent link
  - unreliable third party components (hard and/or soft)
  - software development for an "object" is not software development for the web
  - closed interfaces
  - global view
  - low quality installation
  - different types of actors: hardware, low-level software, telecommunications, application software...
  - specific (test) tools have to be used (software + hardware)
  - ...
- functional ones:
  - [real-time] connectivity => new paradigm
  - talking about technology with users, instead of talking about their needs
  - generated data => potential user privacy threat
  - ...
- project management:
  - agility is a must for software development. But what about hardware?
  - experienced mixed team (software, hardware, telecommunications)
  - ...
- How to face these difficulties: Agility (for software) + involvement in electronics and telecom + experience

Open source and standards

- Open source helps **a lot**:
  - open source software
  - open source hardware
  - open data
  - fab lab
- You can help open source as well!

- example of open source software offer: Eclipse IoT. See Benjamin Cabé's presentation.
- open source hardware and fab lab: fantastic recent way to accelerate design of new products / systems

Open source and standards

- Standards can help as well:

  - ETSI M2M
  - oneM2M
  - 3GPP
  - IETF
  - OASIS
  - ISO
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  - etc.

Some anecdotes

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- a tracking system for waste-collection trucks:
  - competitors tried to sell a system with GPRS connectivity
  - we sold a system using a cable (no real-time requirement expressed)
- tunneling a time-sensitive protocol over a GPRS TCP connection
- design of a low-power sensing device
  - low-power communication module + low-power microcontroller
  - but FTP used to transmit small amounts of data (a few tens of KB) => large communication overhead
- a defective design (hardware AND software) for an embedded equipment, from our supplier
  - we requested source code and electronic schematic
  - we spent lot of time finding a way to hide the defect
  - we designed the next version!
- a device exhibiting freezes in the field
  - embedded software had been written by a senior (web) software developer

Remember our 1994 taxi dispatch system?

- Embedded code:
  - drivers: LCD, transceiver and handset serial buses, GPS receiver, data storage, I/O
  - cell-roaming
  - application-layer protocol stack
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Architecture	8 bits	32 bits, 3-stage pipeline, modified Harvard arch.
Clock	2 MHz	180 MHz
Price	US$ 7 + 2 + 3 (?)	US$8

- Flash memory size is 30 times what we had. And memory is INSIDE the processor.
- Clock is 90 times what we had.
- Peripherals: USB, Ethernet, LCD, SD...
- impressive evolution of hardware, nothing equivalent for software yet
- do not waste these resources by trying to duplicate the environment of a desktop computer!
- good embedded software/hardware team => real product differentiation (delivering more functions for less memory and processing power)

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- “uniquely”: that's a target, not current state
- Internet-like structure: this can be limitating
- “as defined by technology analysts and visionaries”: indirect definition, good trick :-)
- importance of embedded technology

- many more definitions exist

M2M

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- “to communicate with other devices of the same type”: far too limiting
- “an integral part of the IoT”: according to definition on the slide before, this is not the case
- “exchange of information”: not only, there is also embedded processing.
- “from the edge of enterprise”: what is “edge”?

- many more definitions exist

Conclusion - 1

A term with so many different definitions can't refer to an existing concept

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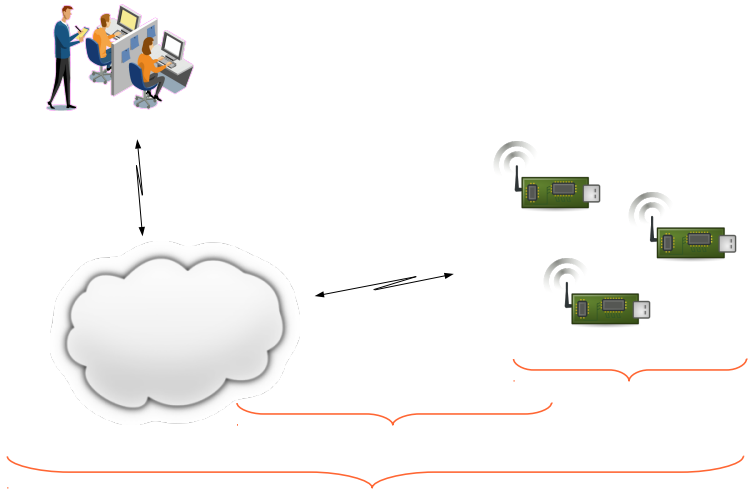

- designing, implementing and running a cloud platform is quite easy, thanks to existing software tools.
- just look at what is going on today: many, many IoT and M2M platforms (just took me one hour to create this list: http://www.monblocnotes.com/node/1979)
- differentiation is far from being only at platform level, it is more at things level, at communication level and at global offer level.

Thanks for your attention!
Questions?

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