to an Ubiquitous Network of Things

Research & Development in the France Telecom Group

March 07

Roland AIRIAU “Smart Environment” research program

content

1 France Telecom's posture

France Telecom's posture

Today, France Telecom: a Strategic positioning on M2M market and m-payment

- Leader in Europe, addressing BtoB actors
- Wide service offer:
  - from consulting to development / integration / deployment
  - OBS: An international and big BU to support this M2M ambition (+ Silicomp)
- Main service already launched: Fleet-management
  - Classical SIM+GPS-based services
  - Extension to sensors inside car / truck
- Preparing the next wave: bespokes
  - Enterprise services but domestic or BtoBtoC one too
- Developing m-payment services (NFC, SIM …)
- Deep R&D investment
  - Technologies
  - Solutions
  - Services

Current M2M activities: preparing the next wave

6 main bespoke offers

➔ Health

- monitoring patients with high blood pressure
-

Supply chain management

- tracking of parcels
- tracking of money bags
- tracking of the refrigeration chain

➔ Business process optimization

- - truck tachograph data transfer
- (internal cockpit data capture)

Tele-monitoring

- in-house boiler monitoring

RFID: opportunities for France Telecom ?

A multitude of objects to communicate:

- ➔ 85 billion of objects all around the world
- ➔ Less than 5% represent machines that conform to the definition of a machine (process, stock and communicate information) and are ready to be integrated into M2M systems
- ➔ 10% are machines in-the-making (able to process and stock information, but require a communication interface) : partnerships to develop (R&D and industrial) – need of standardization
- ➔ 85% are objects which can be addressed with tags

2

Our Vision / Ambition

Research Ambition in one sentence

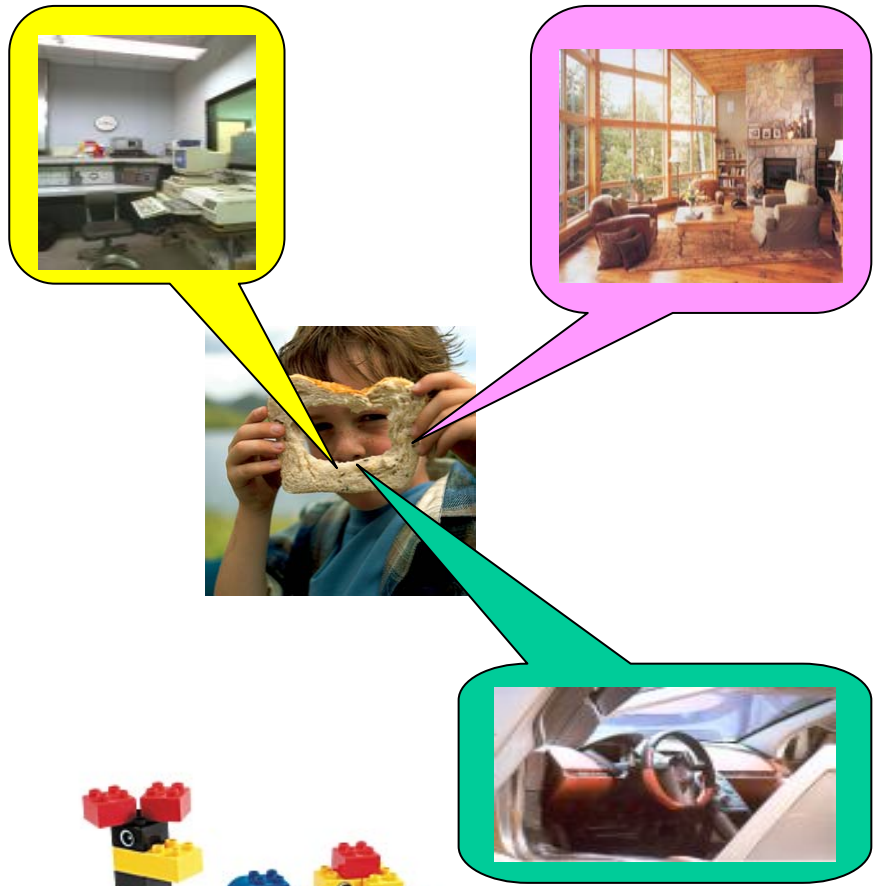
By 2010: the promises ….

- we'll launch new **connected Things** and **Devices** offering daily services and leveraging Orange assets (connectivity through telco-managed gateway and seamless multi-devices services)
- Thanks to our solutions, the **Installation, Management** and **Customization** of these things and devices will be **simple, user-friendly, secure** and with mastered **end-to-end QoS**

Value proposition and customer experience …

➔ **My Environments & my Communities** always **follow me** and I **keep control** on them

- Home, Building, Office : towards a Virtual Personal Environment
- Remote control for daily needs & services
- Assistance (helps, health monitoring, infotainment…)
- M2M applications: efficiency, automation



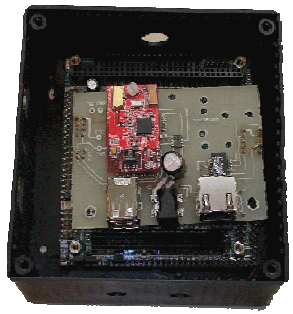
➔ **Personalized & Adaptative** Environments

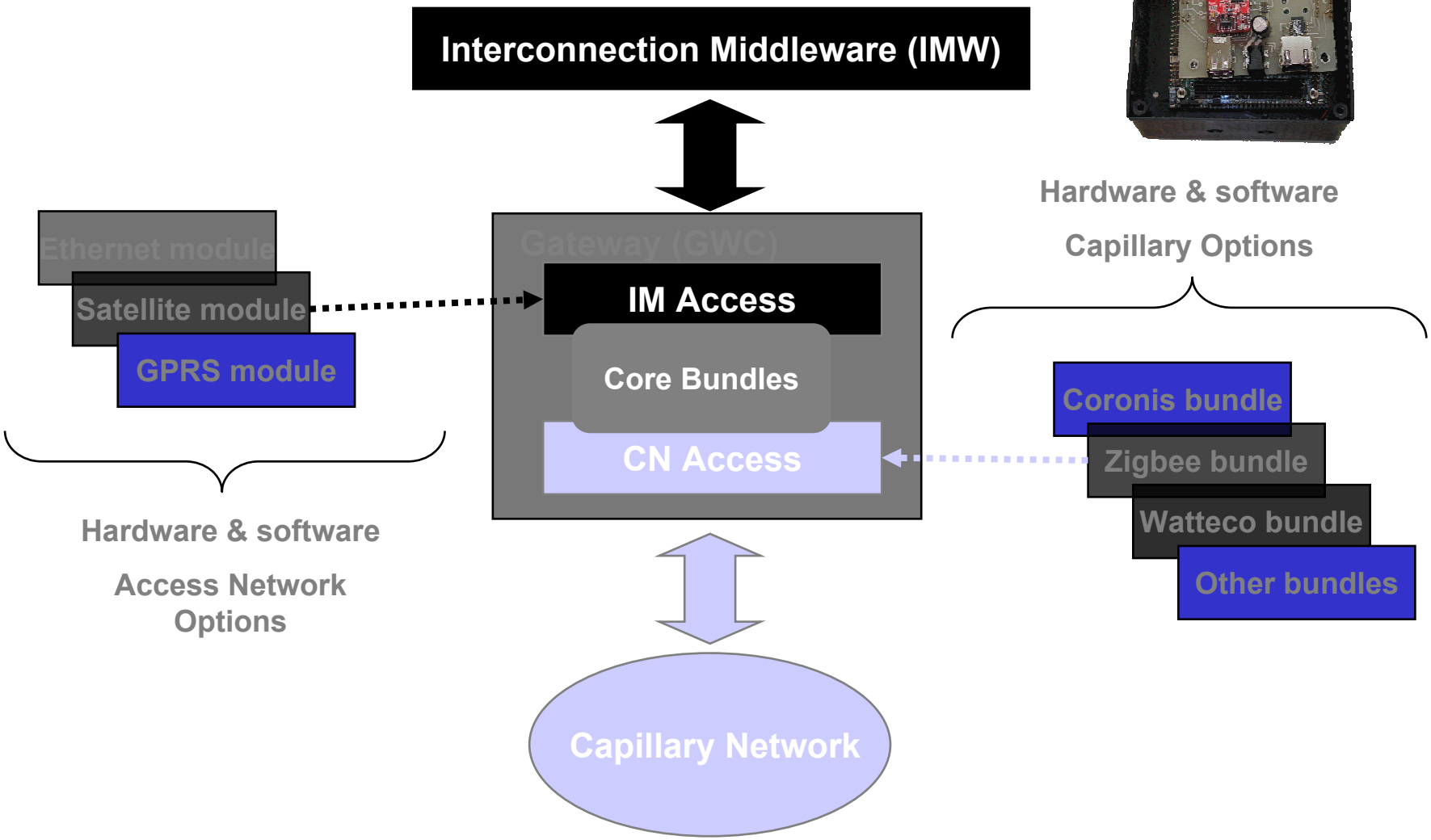
- Context-awareness – thanks to:
  - ✓ Sensor networks / actuators
  - ✓ pervasive communication solutions
- New Interfaces: come-back to a real (physical) world
  - ✓ Tings become true interfaces
  - ✓ The entire environment as in Interface

Connecting thing: the main challenges

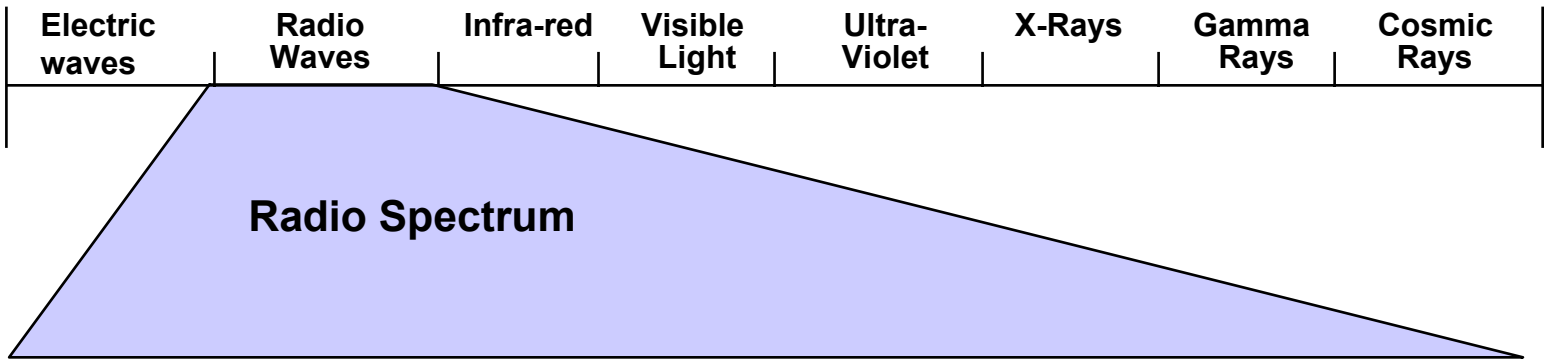
- Select the best set of RFID standards (passive and active)
  - Interaction range
  - Propagation constraints
  - RF Compatibility
- Add low cost indoor location
- Manage heterogeneity and, consequently, think “adaptability”
  - RFID or capillary solutions
  - WAN / LAN entry points
- Master end-to-end QoS, including:
  - Security
  - Identity
  - Performances: date rate, delays …
- Offer “high quality” advanced device management

Capillary Gateway: functional view





RFID: sure, but which one ?



9kHz	30kHz	300kHz	3MHz	30MHz	300MHz	3GHz	30GHz	300GHz	…THz
VLF	LF	MF	HF	VHF	UHF	SHF	EHF		THF
	Long	Medium	Short						

RFID frequencies

125 kHz
134 kHz
6-8 Mhz
13.56 Mhz
433 MHz,
860-960 MHz
2.45GHz
5,8 GHz
24.125 GHz
60.65 GHz

LF Low Frequency
VLF Very Low Frequency
MF Medium Frequency
HF High Frequency

VHF Very High Frequency
UHF Ultra High Frequency
SHF Super High Frequency
EHF Extremely High Frequency
THF Extremely High Frequency

- Passive and active tags / sensors
- Don't forget other wired connectivity solutions: PLT

3
Concrete work

NExT vision

NExT: offer a New Experience in Telecom services to our clients

Give acccess to a new world of services, enriched and simplified services that leverage convergence.

Offer simplicity and reduce complexity.

2 means to complete its mission

To be the source of innovation for the Group

Research

- Detect disruptive technologies
- Develop critical skills
- Produce high level IP
- Explore technologies, services, usage
- Reduce technical risk

Development

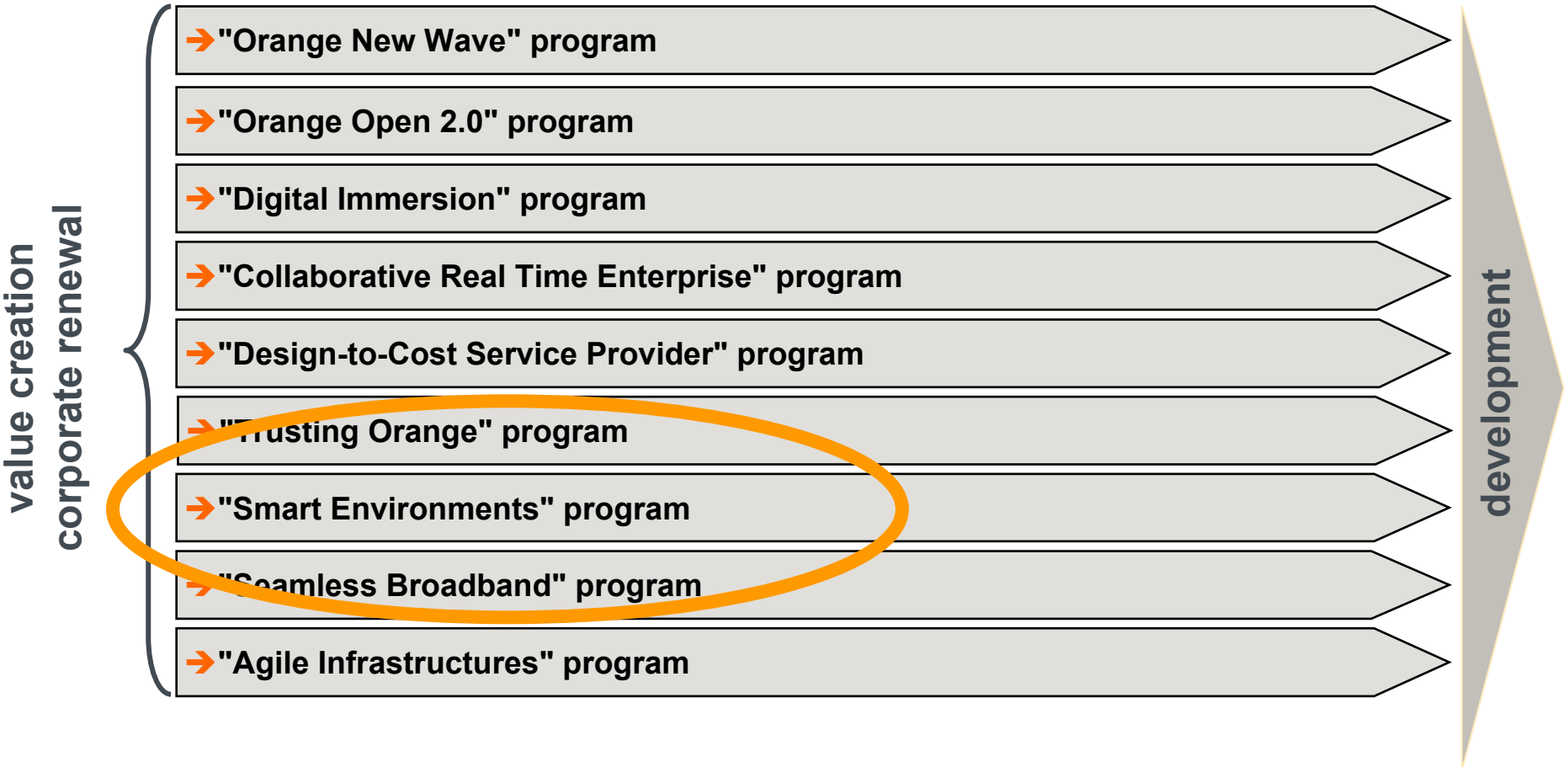
- Reduce Time to Market
- Build Integrated Services
- Industrialization of products, services, network evolution
- Partnerships with manufacturers for more efficiency
- Contribute to standardization

From R&D to the Customer





9 research programs



Research Activities

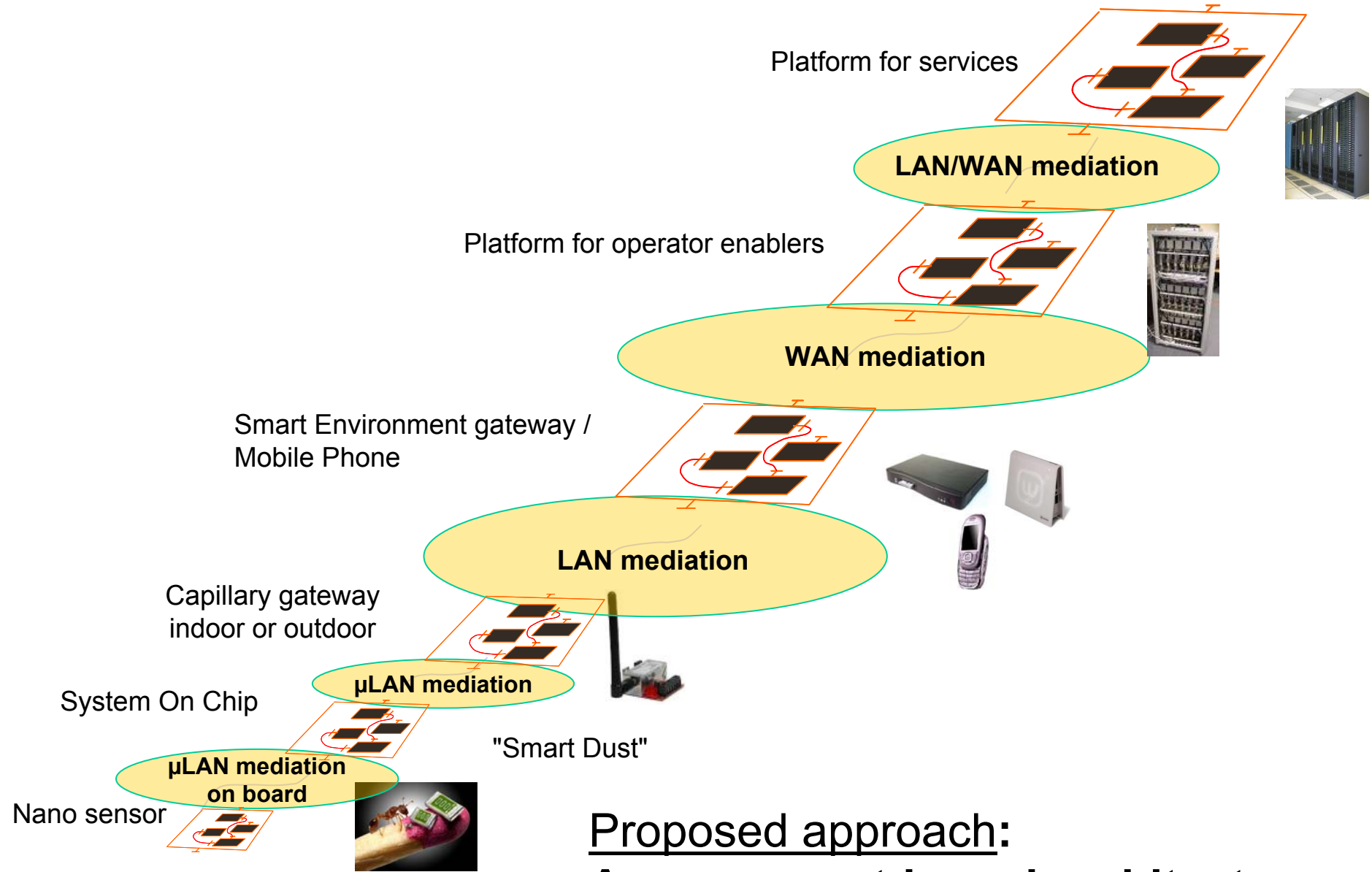
Objective ***develop nets of things promoting FT solutions & services and prepare future Ubiquitous Network Sensor domain***

- ➔ Strategy and characterization for M2M connectivities
- ➔ Capillary networks & gateways
  - Integration of low cost/rate connectivity (RF & PLC)
  - Proof-of-Concept : Life services using smart things
  - M2M services (metering, inventory, monitoring & tracking, automation …)

Key Technologies

- ➔ Low cost/rate connectivity solutions (Zigbee, RF proprietary, PLT …) – *FT -> integrator*
- ➔ Location (UWB IEEE 802.15.4a) – *FT -> Actor*
- ➔ Capillary networking solutions: go to “autonomic” Wireless Sensor Networks – *FT -> actor*
  - Energy-efficient MAC and routing protocols
  - Modeling of large-scale WSNs
  - Self-organization of WSNs
  - In-network data processing
- ➔ Mixed hardware/software design – *FT -> integrator*
- ➔ Distributed systems: Open OS and middleware – *FT -> actor*
- ➔ Embedded software development for limited-resource devices – *FT -> actor*

A global vision: an end-to-end architecture



Proposed approach:

A component-based architecture

Some enabler developments

- TINK: a Open OS solution for high constrained embedded systems
  - optimize implementation
  - abstract hardware level as component
  - life cycle, inter-connection, hot-swapping

  → Technology recommended for embedded gateway and smart sensors

- AMISEC: A middleware to implement dynamic policies of privacy
  - Distributes security services according to a topology of security authorities.
  - Manage certificates, security policies become service centric

  → Required Security and Privacy for large ad-hoc networks

- AMICOM: A distributed middleware allowing spontaneous interoperation between devices and services
  - Support multi discovery and binding technologies
  - Interoperability by service semantic descriptions (ontology)

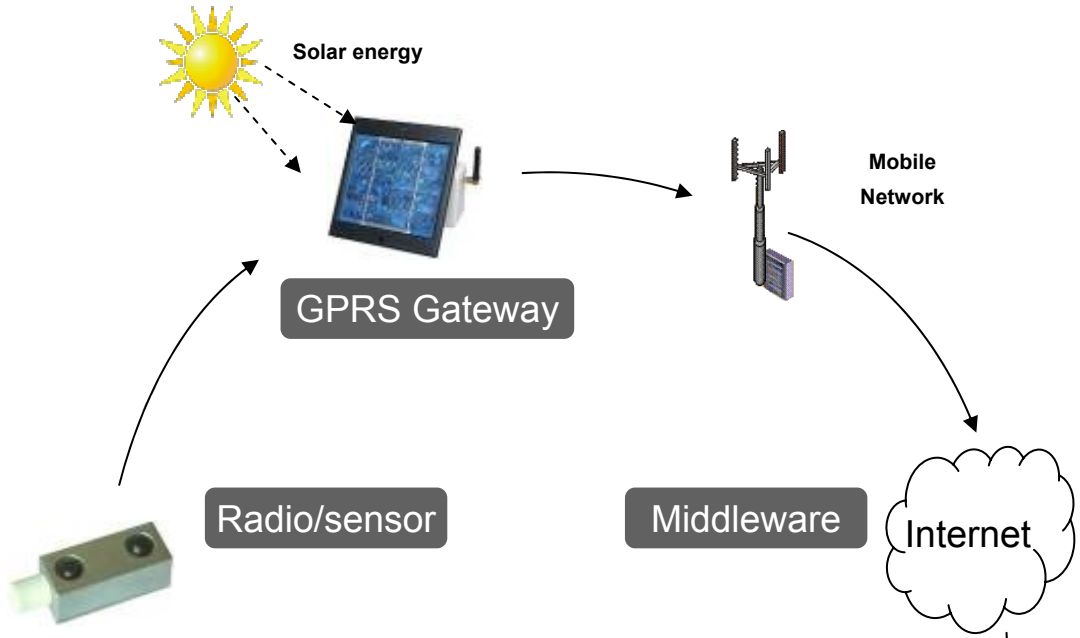
  → Recommended for middleware behind a gateway

R&D Experimentations

- Retirement home
  - implementation of a Zigbee-based network sensors
  - capitalization, lessons learned from the experiment (eldery people security, medical staff help), acceptability
- Recycling containers
  - low and autonomous energy power
  - cost estimation (invest et ROI)
- Sensor@Home
  - zigbee or proprietary solution
  - first domestic services pushed by regulation (ex: smoke and water detection)
- Noise detection / capture
  - noise pollution cartography and notification (cities > 100 000 hab.)
  - cost estimation for local administrations

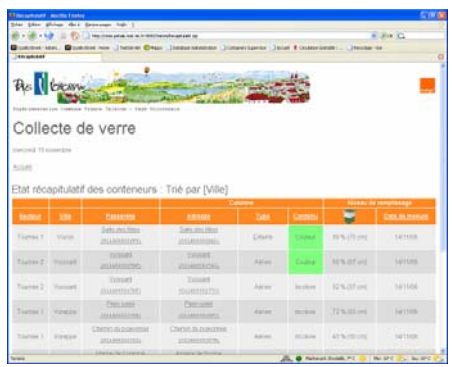
Recycling container management

Near “Grenoble" agglomeration
- 34 towns et 87000 inhabitants
- Colored and colorless glass gathering (400 containers)
- 33km between farthest containers and dump



- Detect full containers
- Optimize the collect of garbage
- Alert of incidents
- Level history
- Deployed since December 2006

Containers



Client
Web browser

Gateway and tags installation

➔ Ultra-sonic sensors deployment

➔ Gateway installation

Main messages to RFID community

- Prepare next RFID generation:
  - 5.8 GHz – now, the best short-term opportunitie
  - 24.125 GHz – 5 years
  - … 60.65 GHz – 8 years
- Design antennas “ready multi-frequency / multi-protocols”
- Introduce asap low-cost location solution inside tags
- Work on auto-organization features (promise of low cost installation / maintenance / real-time operations and robustness)
- Design capillary gateways (link between things and Telco’s networks)
- Specify the good “architecture models” in order to support heterogeneity (connectivity, protocols, hardware, distributed processing …)
  - Our proposition: a component-based model
- RFID / SIM card / device marriage !

Annexes

RFID… @where_2_search_4.com?

➔ Frequencies

f	125 kHz	13.56 MHz	433.92 MHz	~900 MHz	2.45 GHz	5.8 GHz	24.125 GHz
λ/2	1.2 km	11 m	35 cm	16 cm	6 cm	2.5 cm	0.6 cm
Physical Reading length	0 – 30 cm	0 – 30 cm	0 – 30 cm	> 1 m	> 1 m	> 1 m	> 1m

Near Field (magnetic field - coil)

Far field (EM field – antenna)