UNIVERSITY OF CAGLIARI

DIEE - Department of Electrical and Electronic Engineering

Can the Wearable be Social?

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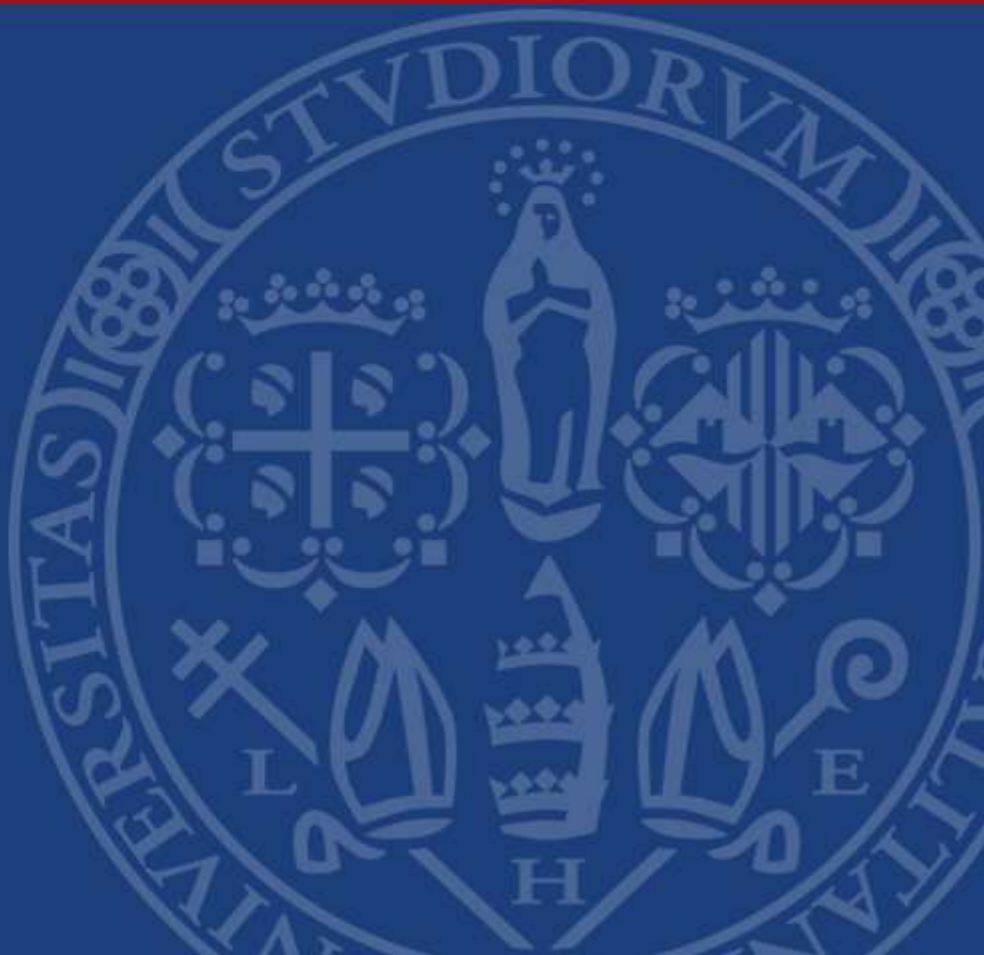
At MCLab

http://mclab.diee.unica.it/



Outline

- **How** the wearable can be social?
  - Concept and types of friendships
- **Why** the wearable should be social?
  - Navigability and Trustworthiness
- **What** could social wearables offer to the IoT?
  - Context awareness
- Conclusions and further challenges

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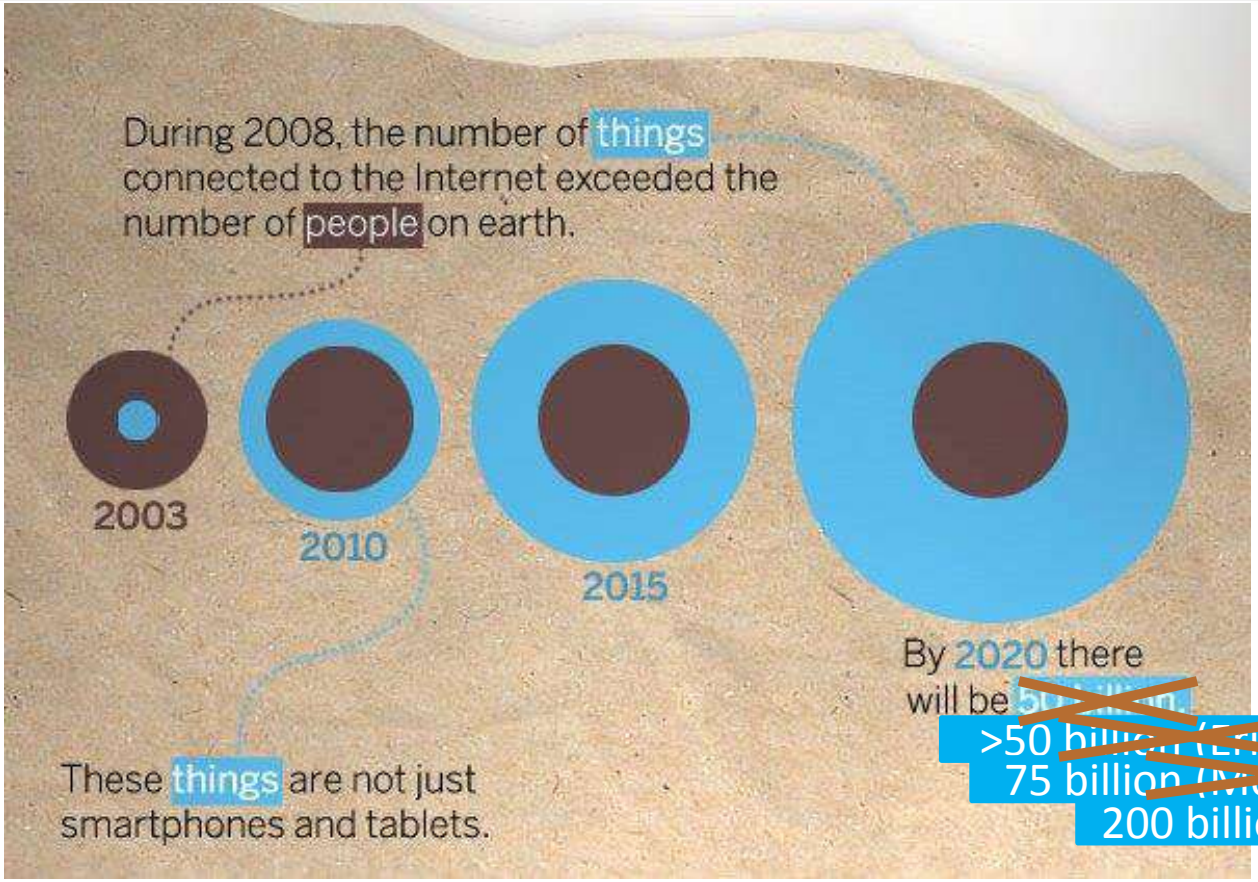
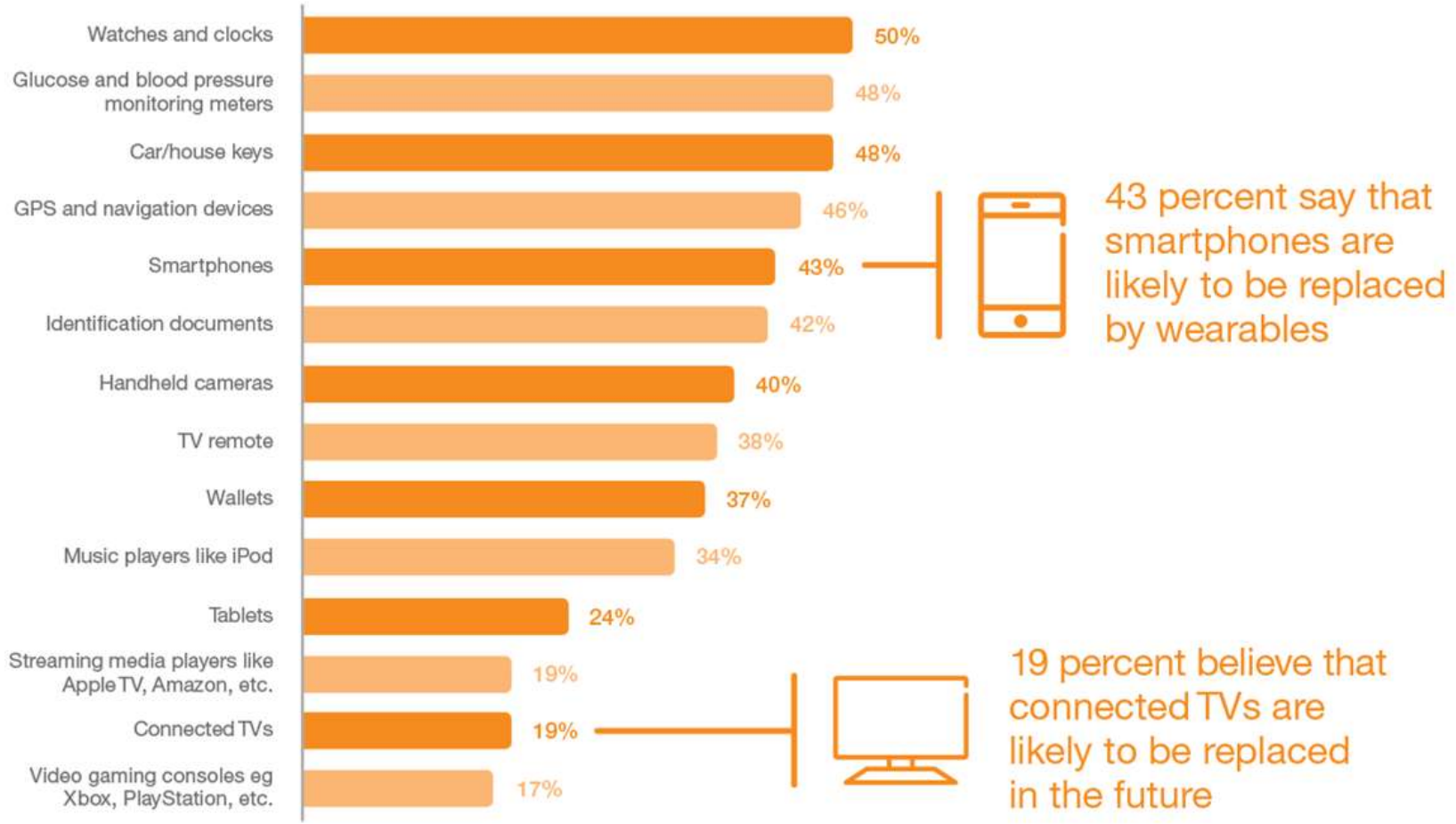
IoT: number of devices



Source: Cisco IBSG, Jim Cicconi, AT&T, Steve Leibson, Computer History Museum, CNN, University of Michigan, Fraunhofer. Available at:
http://readwrite.com/2011/07/17/cisco_50_billion_things_on_the_internet_by_2020

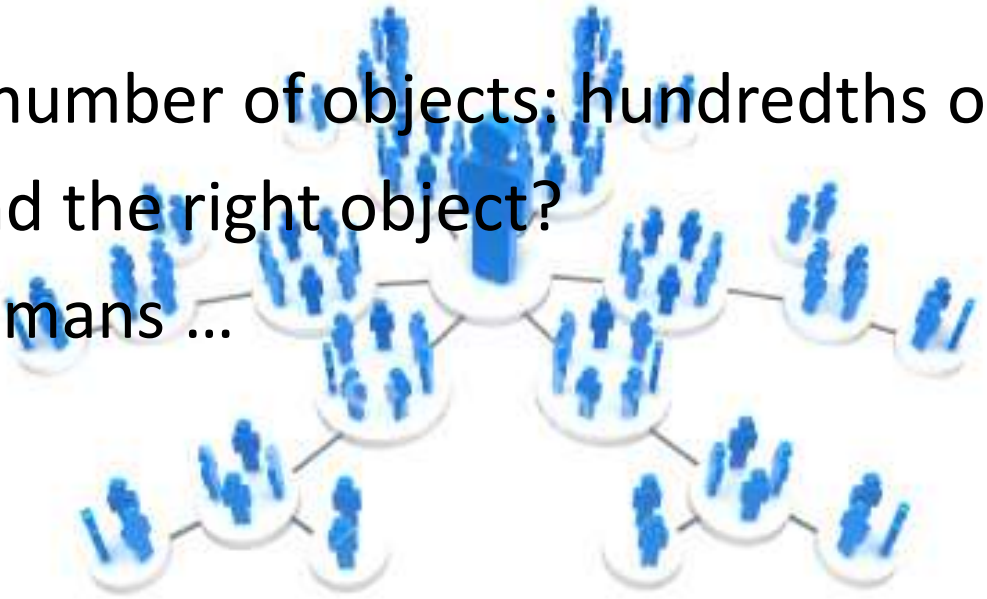
Internet of Wearable Things



Source: Ericsson ConsumerLab, Wearable Technology and the Internet of Things, 2016
Base: Smartphone users across Brazil, China, South Korea, UK and the US

How difficult is to cooperate!

- Total number of humans in the world: around 7 billions
- Expected number of objects: hundredths of billions
- How to find the right object?
- Among humans …



Social networks! **Why not the same for objects?**

•*L. Atzori, A. Iera, G. Morabito, M. Nitti, "*The Social Internet of Things (SIoT) – When social networks meet the Internet of Things: Concept, architecture and network characterization*", Computer Networks*

Social Internet of Things

SIoT (Social Internet of Things)
a paradigm of "social network of intelligent objects",
based on the notion of social relationships among objects

Advantages

- Navigability
- Scalability
- Trustworthiness

Reason	Humans	Things
Become visible	Increase popularity	Publish information/services
Find resources	Find old friends	Find information/services
Obtain context information	Get filtered information	Get environment characteristics
Discover new resources	Find new friends	Find new services/updated information

SIoT – Types of Relationships

Parental object relationship

Co-location object relationship and **co-work object relationship**

Social object relationship

Ownership object relationship

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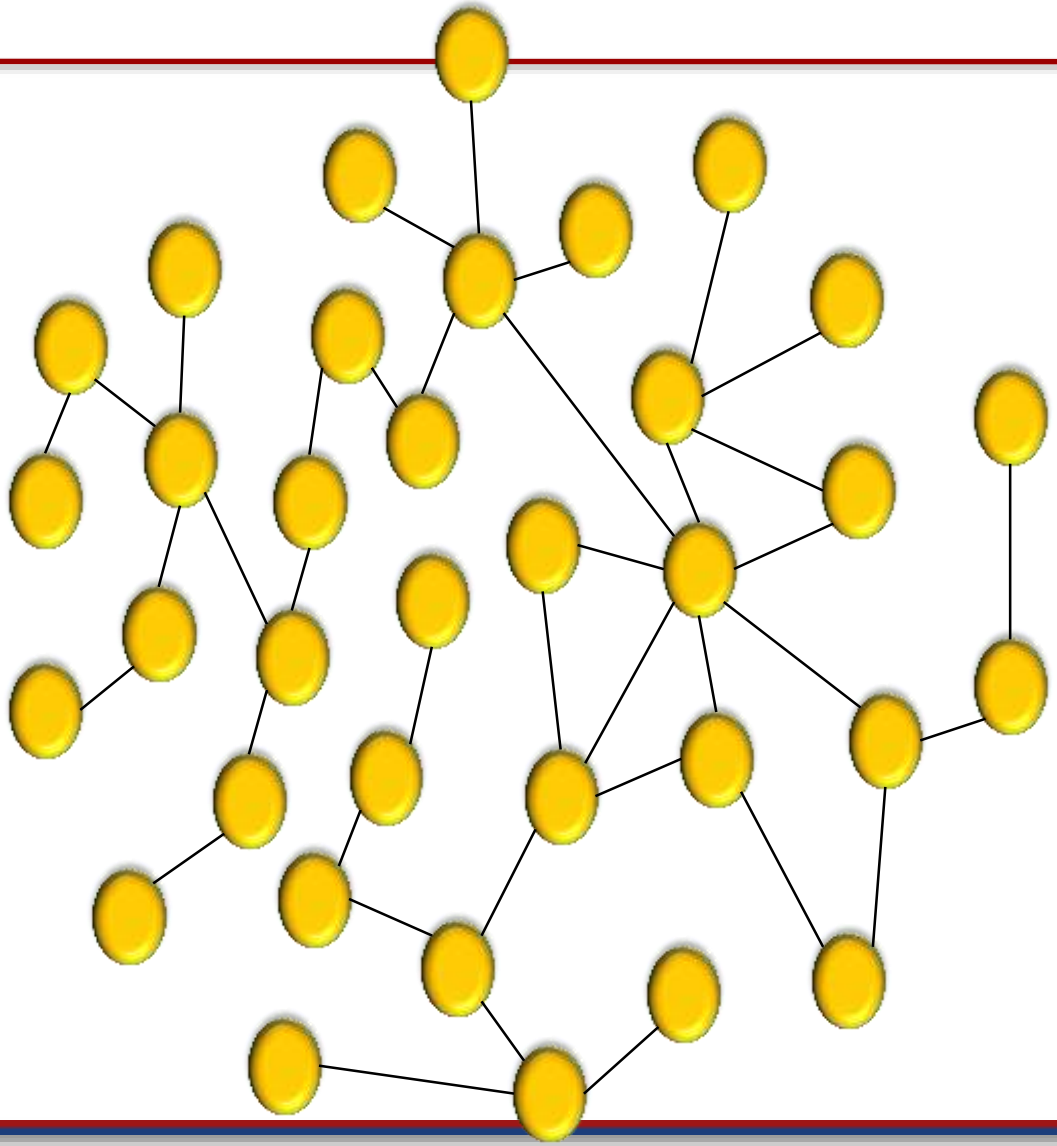
Reference scenario



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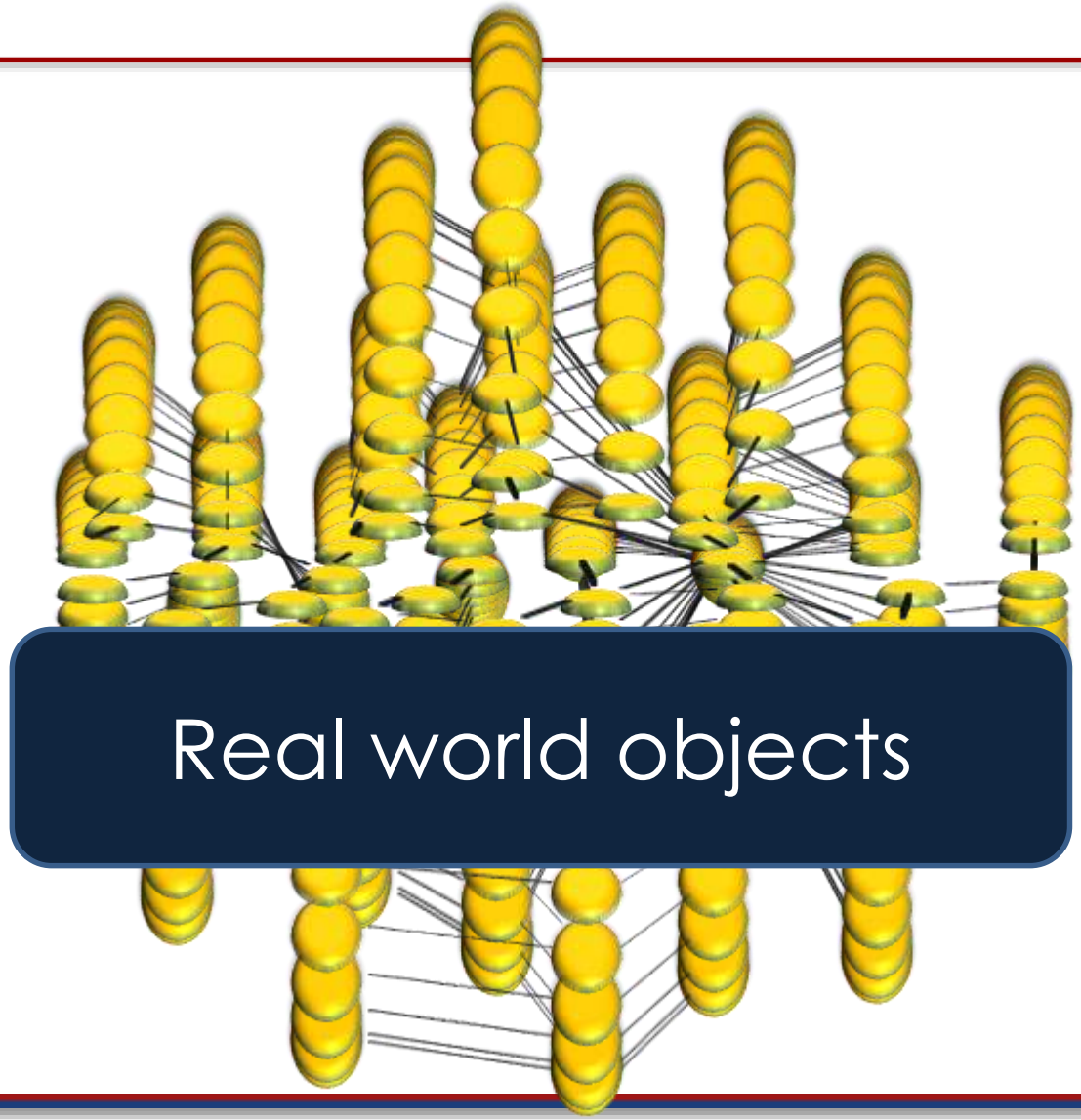
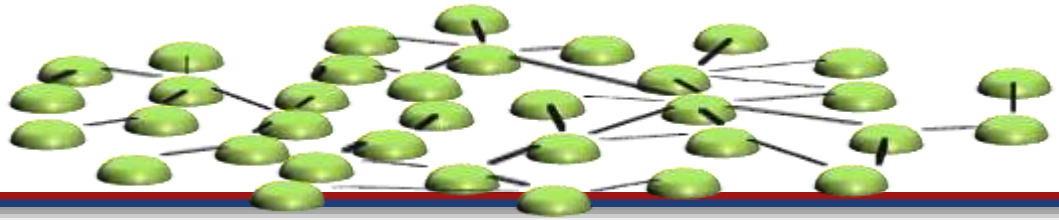
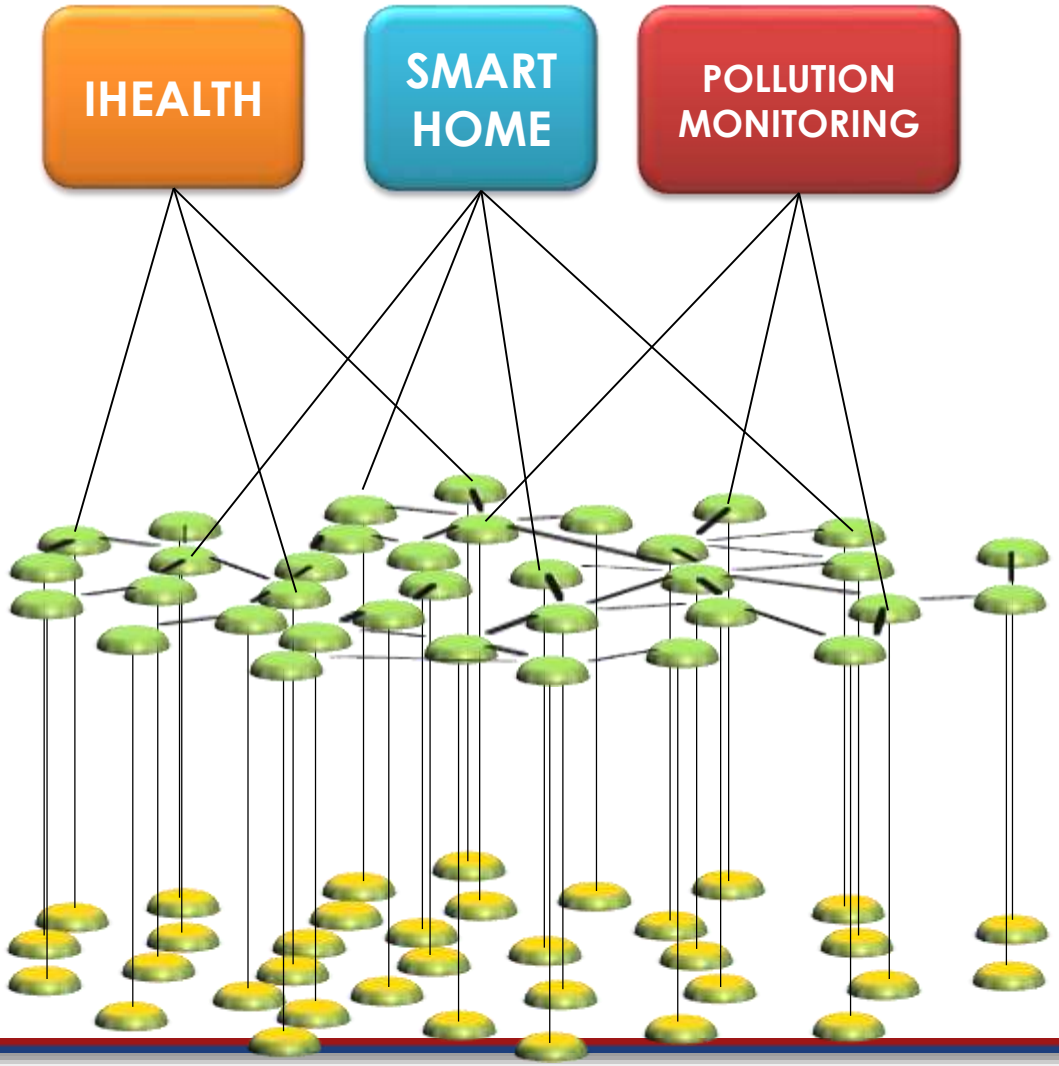


Reference scenario

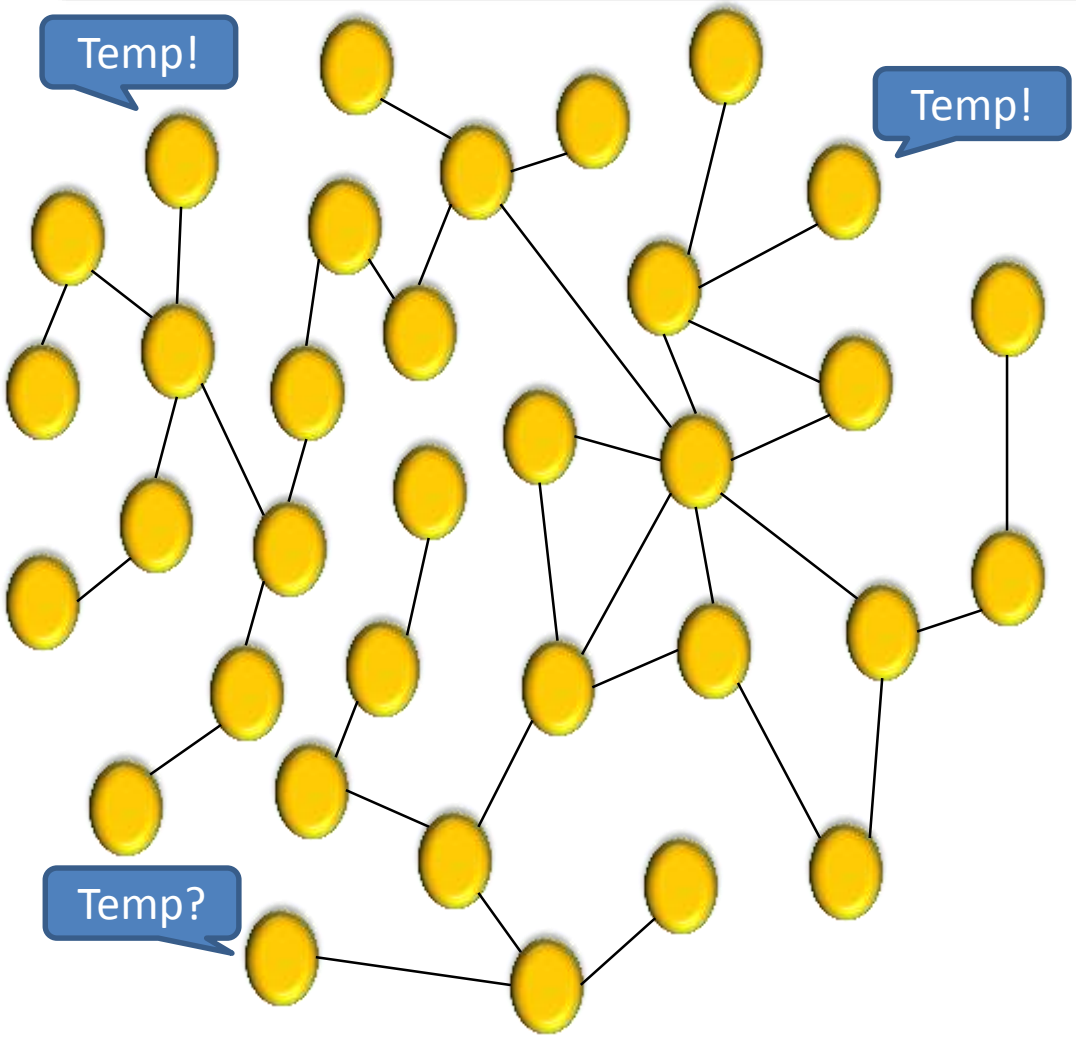
Virtual world objects



Reference scenario



Reference scenario: distributed information search



Objects use the social network to:

- Navigate the network
- Look for services

Social IoT - Navigability

- "A network is navigable if and only if there is a short path between all or almost all pairs of nodes in the network"*

- Formally:
  - There exist a giant component
  - The effective diameter is low – bounded by $\log_2(n)$

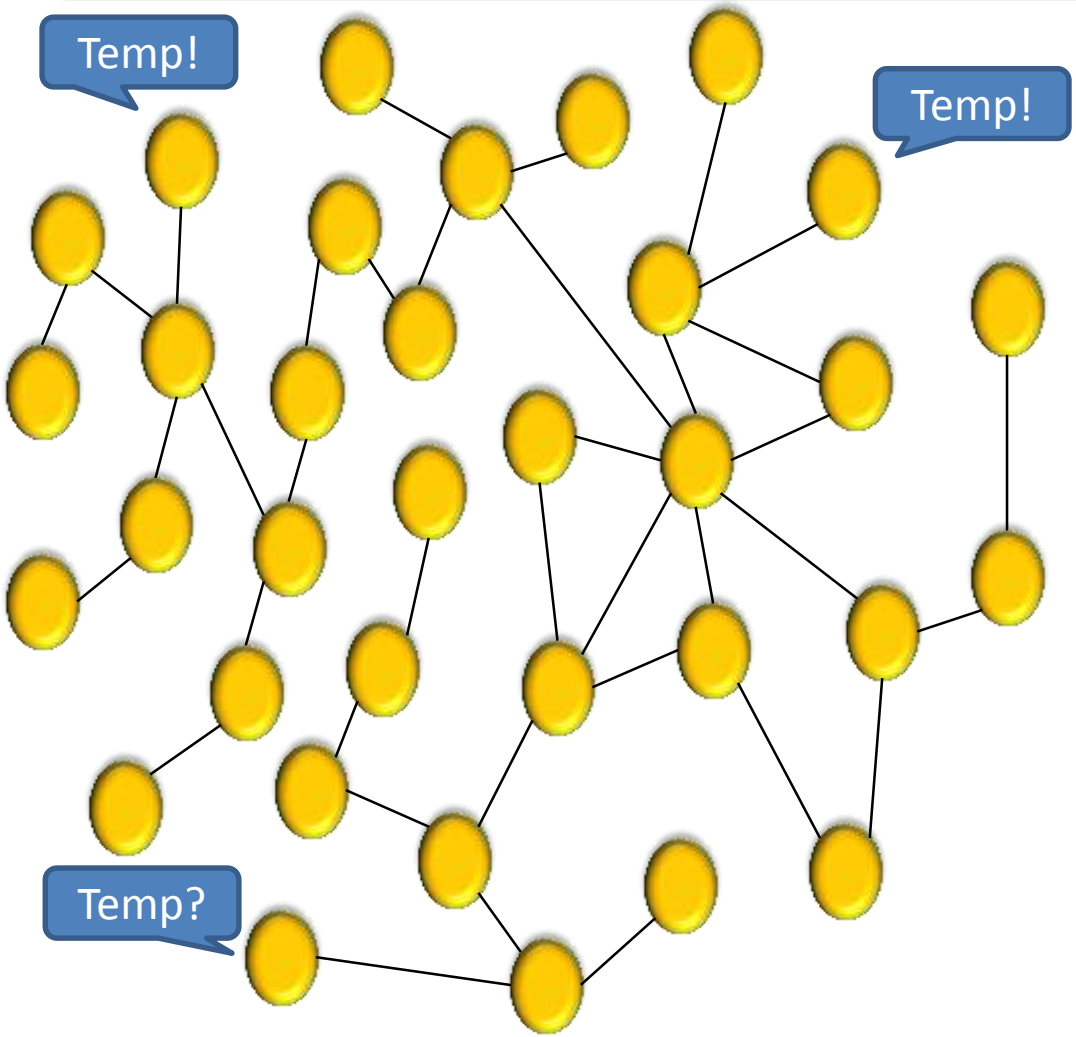
- **RECALL:** we are looking for a distributed solution

•*Kleinberg, Jon. "Small-world phenomena and the dynamics of information." NIPS. 2001.*

Social IoT - Navigability

Milgram's experiment demonstrated that people can find a short path efficiently with only local knowledge of the network

Network Navigability - Properties



Node degree

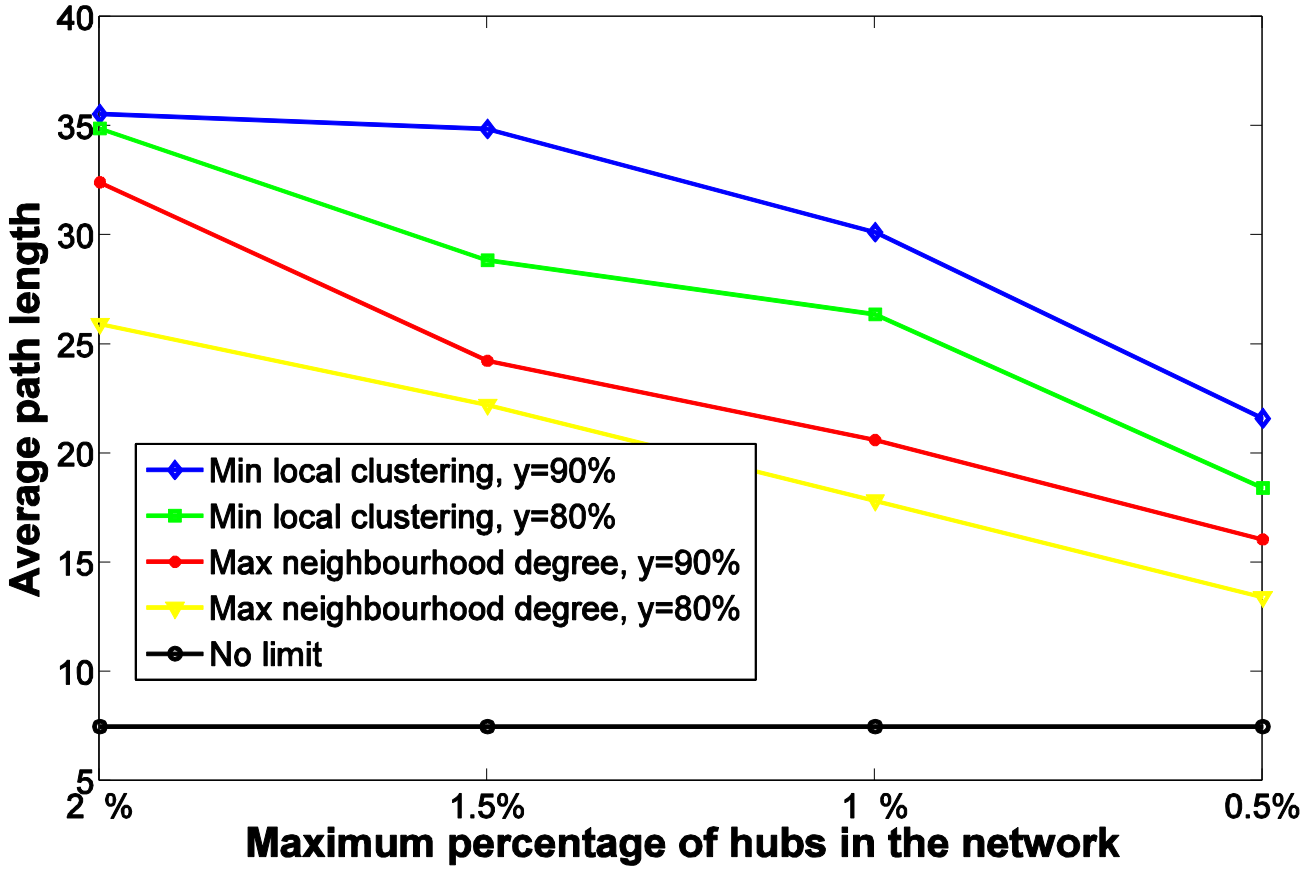
- Neighborhood average degree

Local clustering

$$C_{local}(n) = \frac{2 * e_n}{k_n * (k_n - 1)}$$

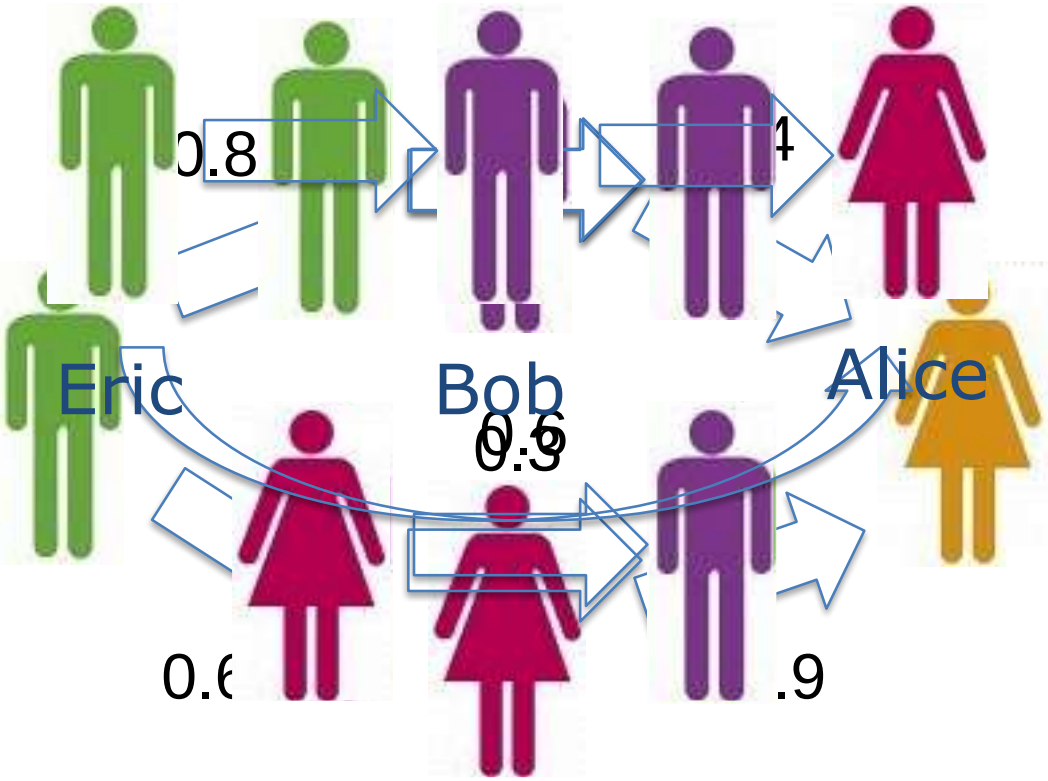
Average path length using local rules

x% of the nodes in the network with at least y% of Nmax friends



Social IoT - Trustworthiness Basic Properties for SIoT

- Transitivity
- Composability
- Personalization
- Asymmetry



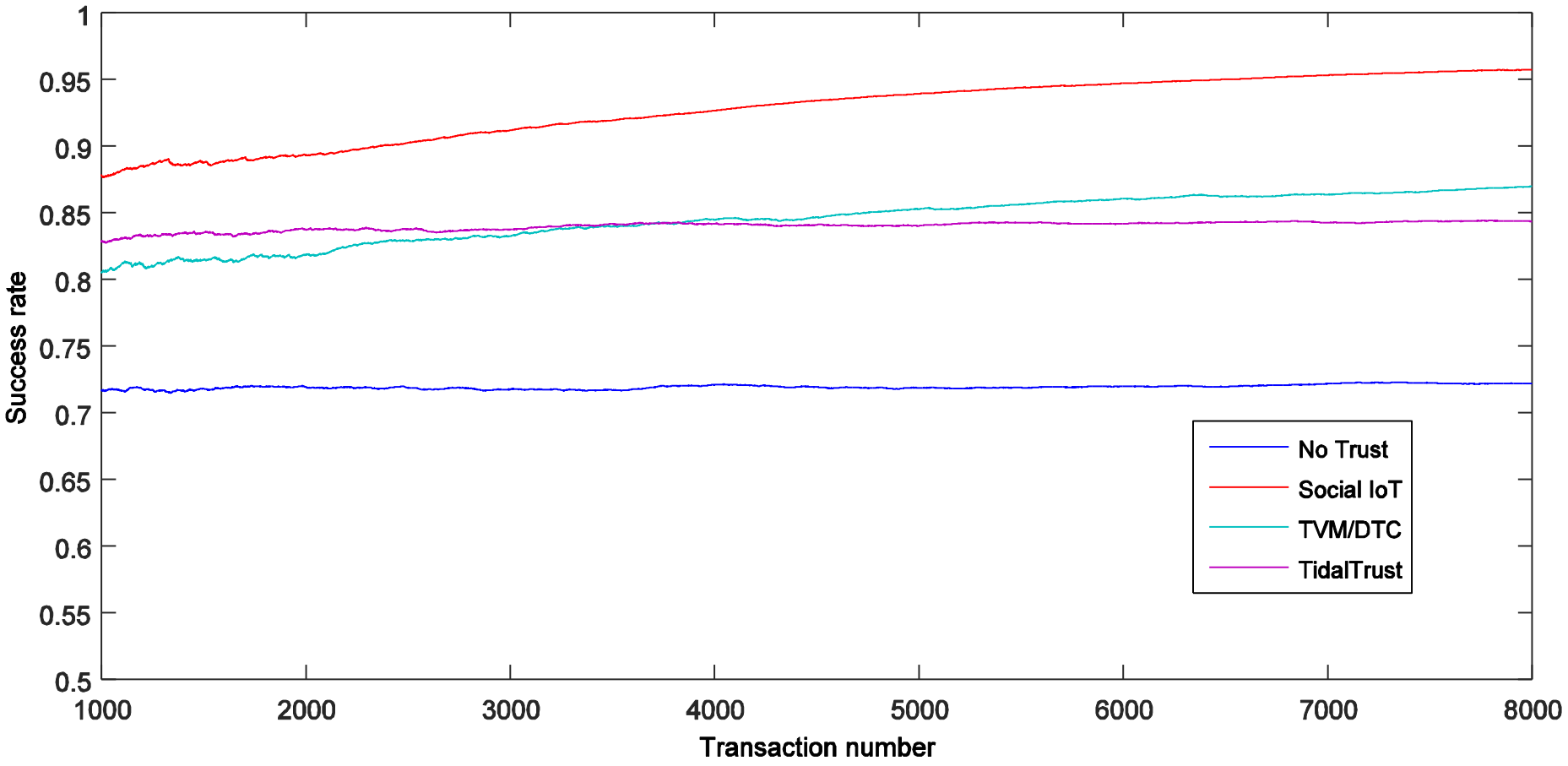
Social IoT - Trustworthiness
Major trust Elements for SIoT

- Feedback system
- Number of transactions
- Credibility
- Transaction Factor

Social IoT - Trustworthiness
Major trust Elements for SIoT

- Relationship Factor
- Centrality
- Computation Capabilities

Simulations – Success rate



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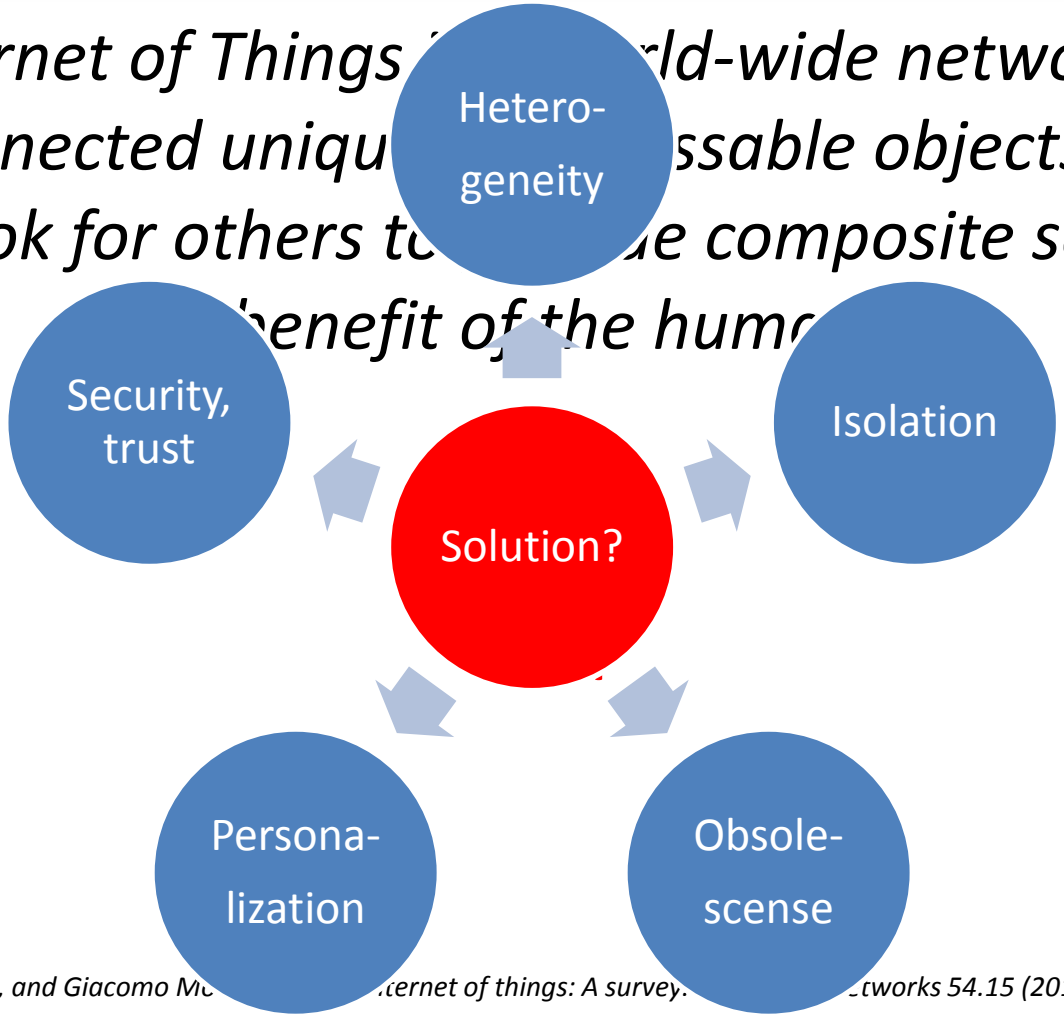
IoT today

"Internet of Things is a world-wide network of interconnected uniquely addressable objects, where objects look for others to create composite services for the benefit of the human"



•*Atzori, Luigi, Antonio Iera, and Giacomo Mo... ternet of things: A survey... tworks 54.15 (2010): 2787-2805.*

Social wearables kick in!

Social wearables:

- Strengthen the degree of connectivity between users and things
- Turn “communicating objects” into “autonomous decision-making entities”
- Give an accurate view of the user context

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Conclusions (1/2)

The Social Internet of Things

- is a good model to manage objects' trustworthiness
- is a solution to control network navigability when looking for object services

Conclusions (2/2)

Social wearable

- close the gap between users and IoT
- provide a mean to improve the QoE of IoT applications

What we still need

Real data on objects' «behavior»!

- Only through applications' deployments

Object interactions should also include

- Light social objects' authentication
- Rewards mechanisms

What we are doing

- Implementing a PaaS platform for SIoT
  - http://lysis-iot.com
- Defining a SIoT architecture that exploits the network edge resources
- Deploying applications with industrial partners to collect useful data

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Thank you for your attention

If you need more info send an email to:

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