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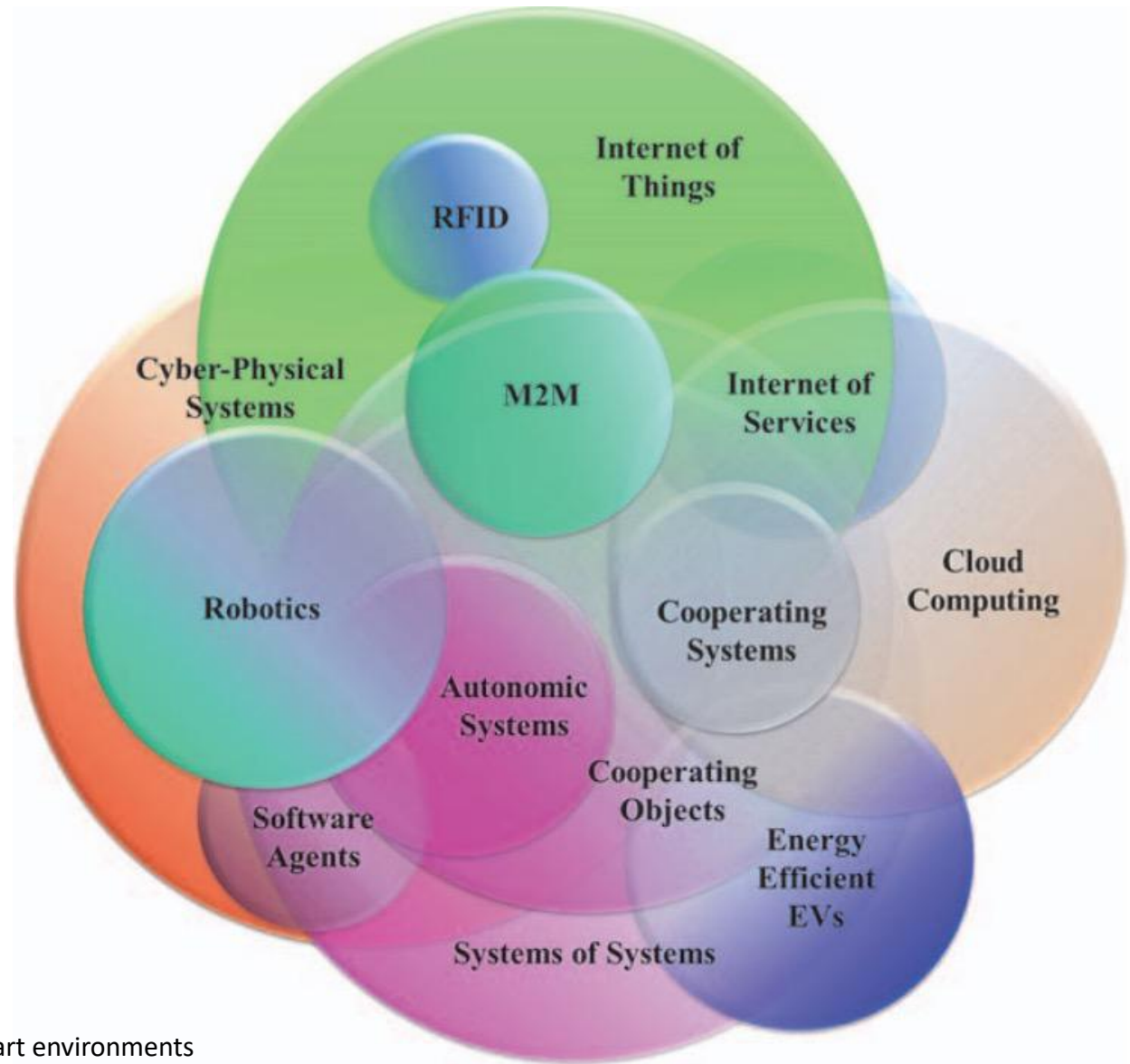
Module 10:
Cloud Integration with
physical systems

Dr. Maria Valero

Agenda

- Introduction to technology trends
 - IoT, Cloud Computing and Big Data
- Integration of Clouds, Big Data considering the IoT
 - Various examples, related activities
- Cloud-based Internet of Things
 - Basic Concepts
 - Architectural views
- Challenges for future standardization
- Conclusion

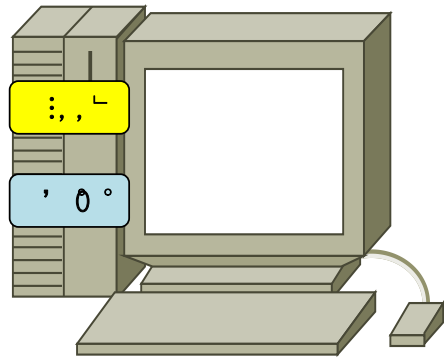
Technology Convergence



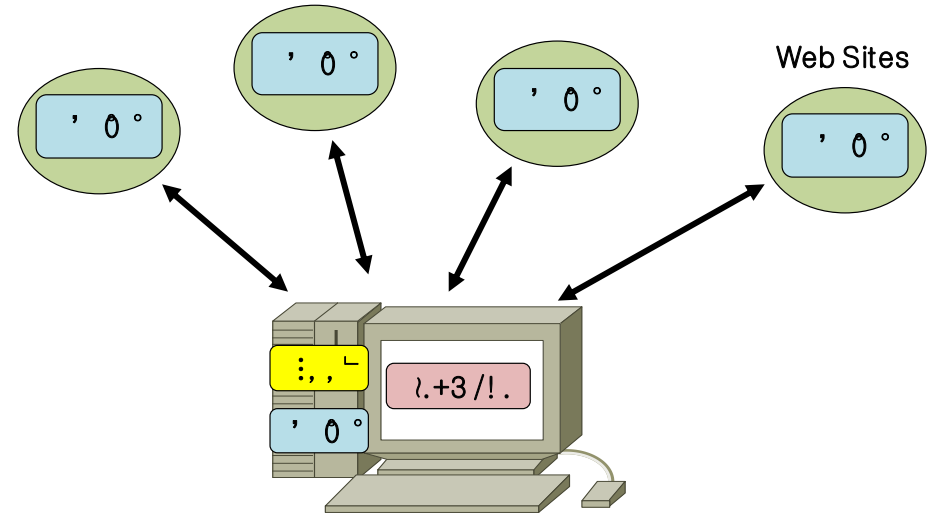
Source: Ovidiu Vermesan "Internet of Things – Converging technologies for smart environments and integrated ecosystems" Riverpublishers, 2013.

From stand alone PC to the Cloud-based IoT

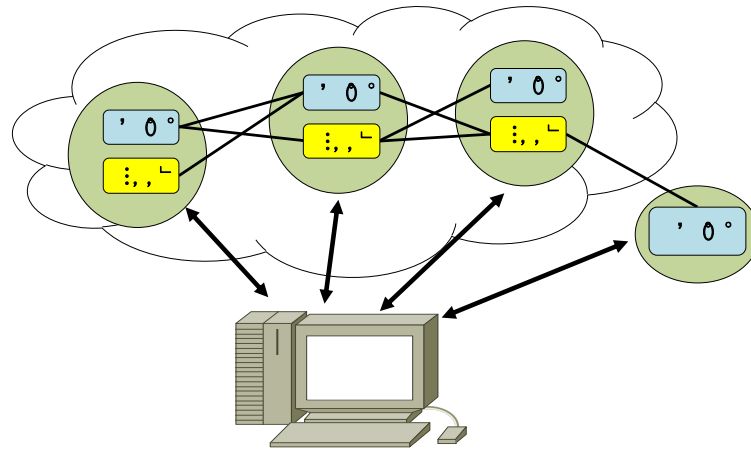
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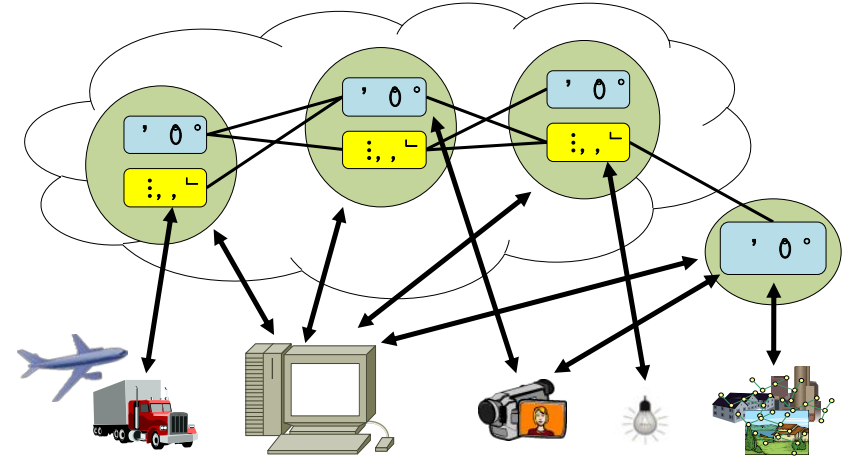
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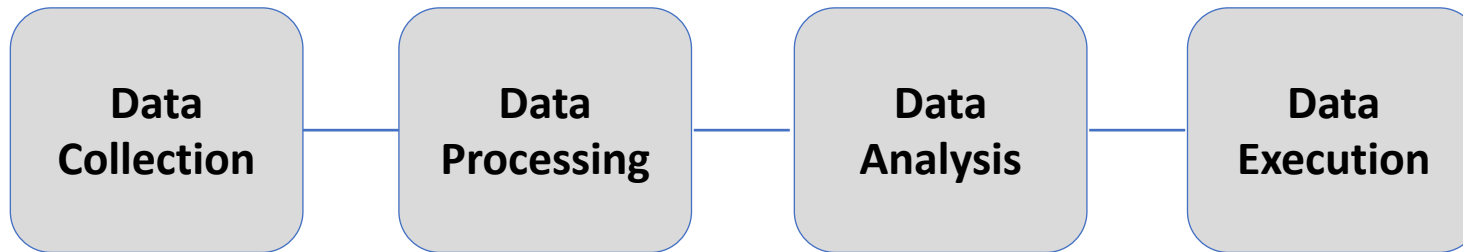


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Big Data

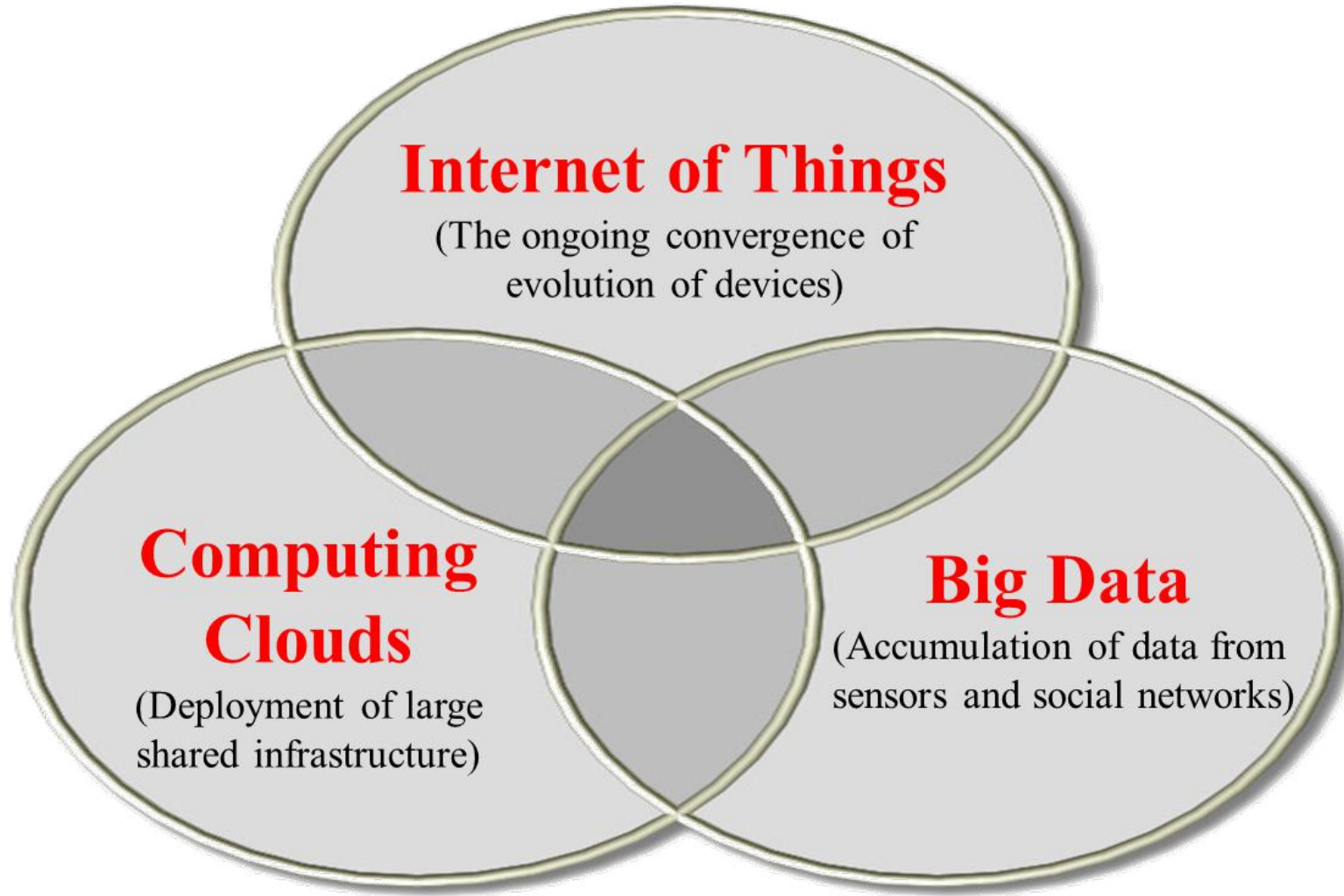
- A category of technologies and services where the capabilities provided to collect, store, search, share, analyze and visualize data which have the characteristics of high-volume, high-velocity and high-variety.



IoT and Big Data

- **Big Data is not just about volume**
 - Volume, Velocity, and Variety
 - Geo-distribution from IoT
- **Technical aspects**
 - Data collected and stored continues to grow exponentially
 - Data is increasingly everywhere and, in many formats.
 - Traditional solutions are failing under new requirements
 - ➔ Aggregate and process data from Things in the Cloud

Exciting new challenges

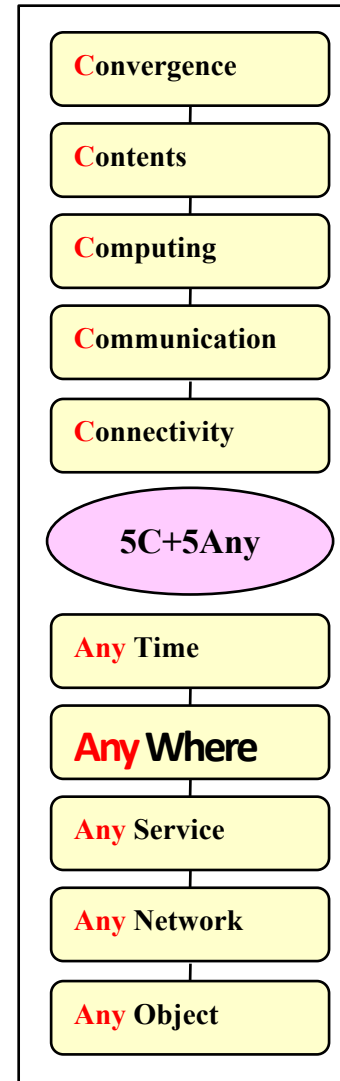


Vision – Interdisciplinary fusion revolution

- **Ubiquitous connectivity**
 - Allowing for whenever, whoever, wherever, whatever types of communications
- **Pervasive reality**
 - For effective interface to provide connectable real-world environments
- **Ambient intelligence**
 - Allowing for innovative communications and providing increased value creation.

Clouds, Big data considering IoT

- Data **stored** in the “Cloud”
- Data **follows** you & your devices
- Data **accessible** anywhere
- Data can be **shared** with others



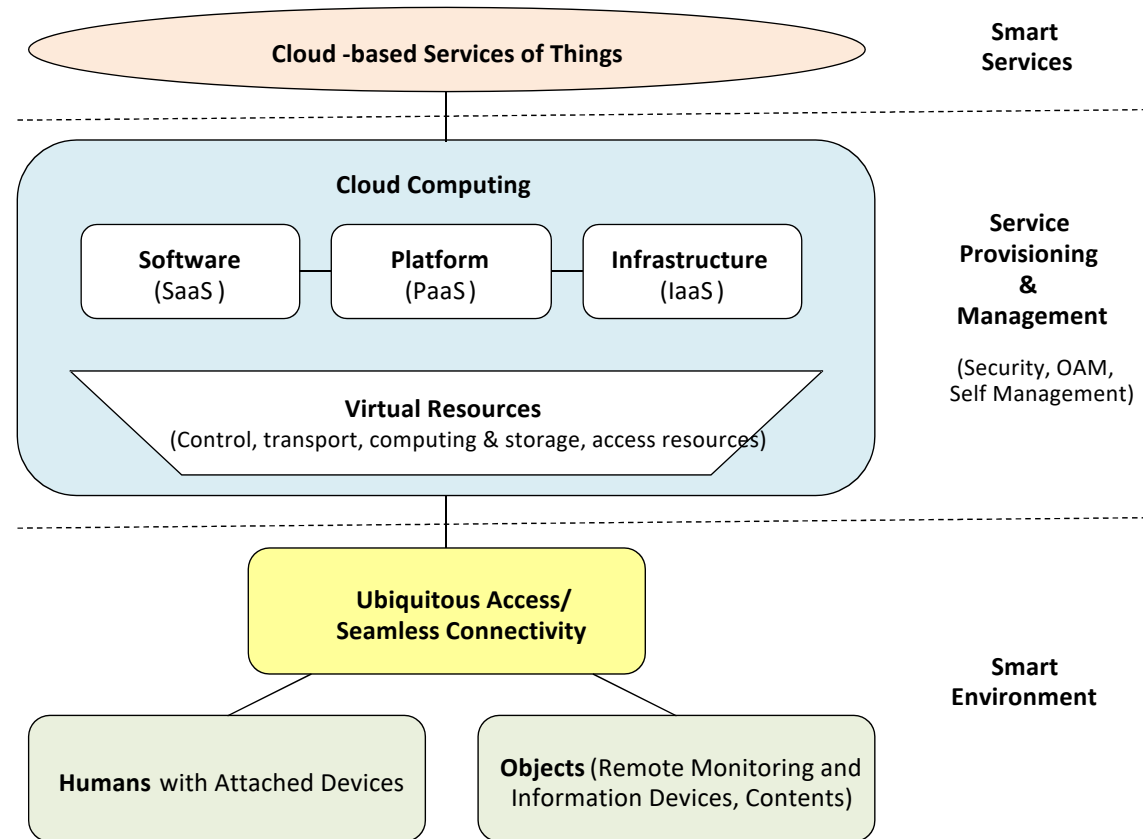
Integration of Clouds and the IoT

- **Combining clouds and the IoT**
 - To support required resources to increasing heterogeneous objects
 - To meet the dynamic computational needs of environmental applications with existing sensor network technologies
- **Benefits**
 - The cloud can work on behalf of the object for increasing availability, maintaining performance and scalability.
 - The cloud can support resource continuity so that objects move freely changing access technologies while using resources from the same cloud.

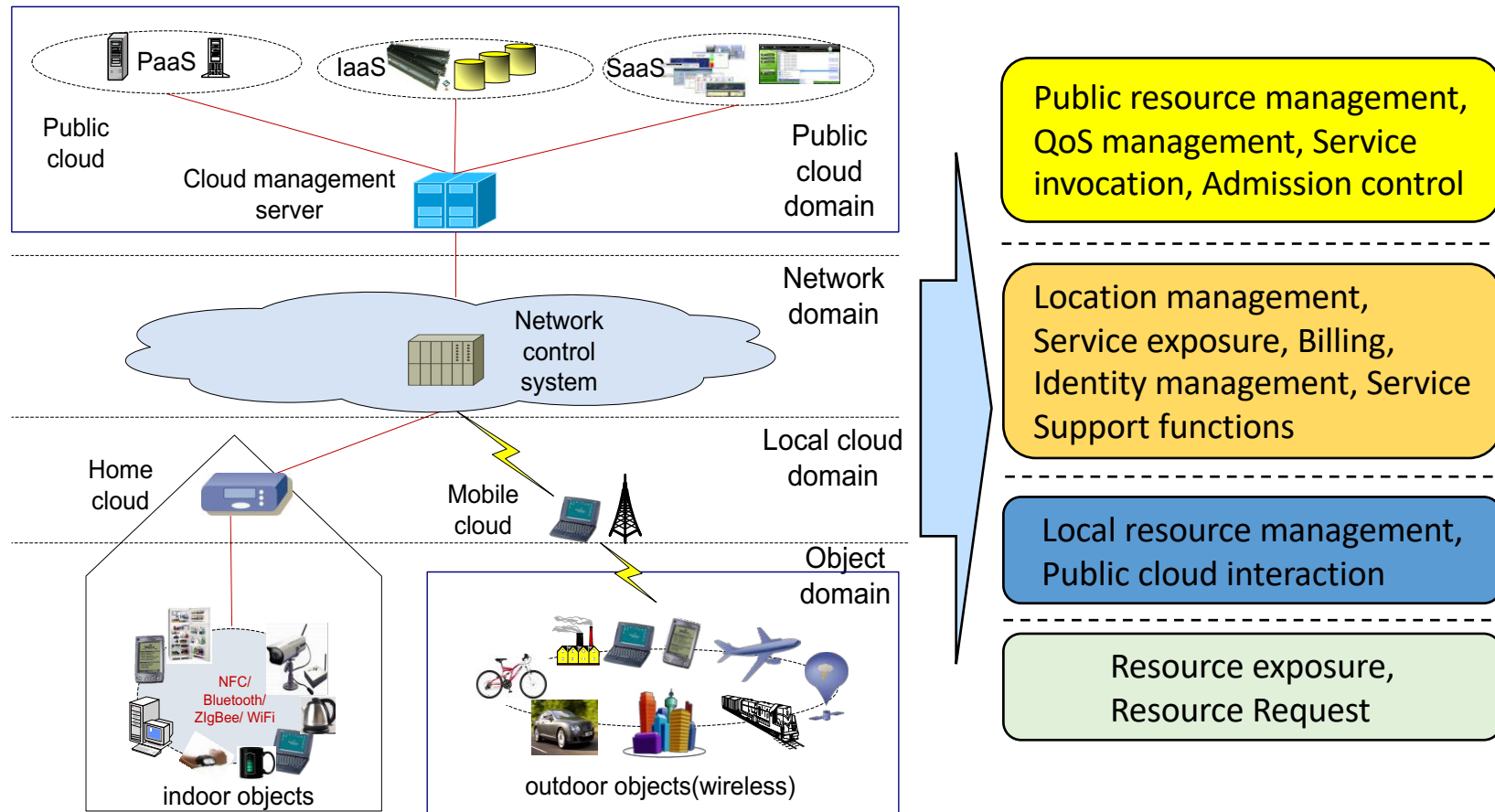
Key features of clouds to support IoT

- Several features available in clouds are requirements of **resource-constrained objects**
 - Flexibility of resource allocation
 - More intelligent applications
 - Energy saving
 - No on-site infrastructure
 - Heterogeneity of the smart environment
 - Scalability and agility
 - Virtualization

A conceptual diagram for Cloud-based IoT



The IoT using local distributed clouds



Challenges for future standardization

- Technical consideration for standardization
 - Object naming
 - Virtualization
 - Inter-clouds
 - Distributed clouds (edge clouds)
 - Security
 - Geo-distribution
 - Mobility considering mobile objects
 - Resource provisioning for constraint objects
 - Application-awareness
 - Big Data considering dynamics of traffic pattern
 - Connected objects and interdisciplinary fusion services

Conclusion

- **The cloud-based IoT service environment**
 - Combines the cloud computing, big data and the IoT
 - Aims to efficiently support various services using cloud and analytics technologies from different kinds of objects (e.g., devices, machines, etc.).
- **Standardization**
 - The relevant standardization efforts for realization of the cloud-based IoT need to be accelerated with special consideration of their commercial viability.
 - Q11/13: a new work item on “cloud-based IoT” (living list)