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Network RFID—Automatic Data Capture and Identification Meets the Internet

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CASAGRAS 2
an EU Framework 7 Project

Overview

- Today's Internet and the way ahead
- Cyber-Physical computing
- RFID and other IoT devices
- Network services for the IoT
- Universal IoT architectures

The Internet (circa 1999)

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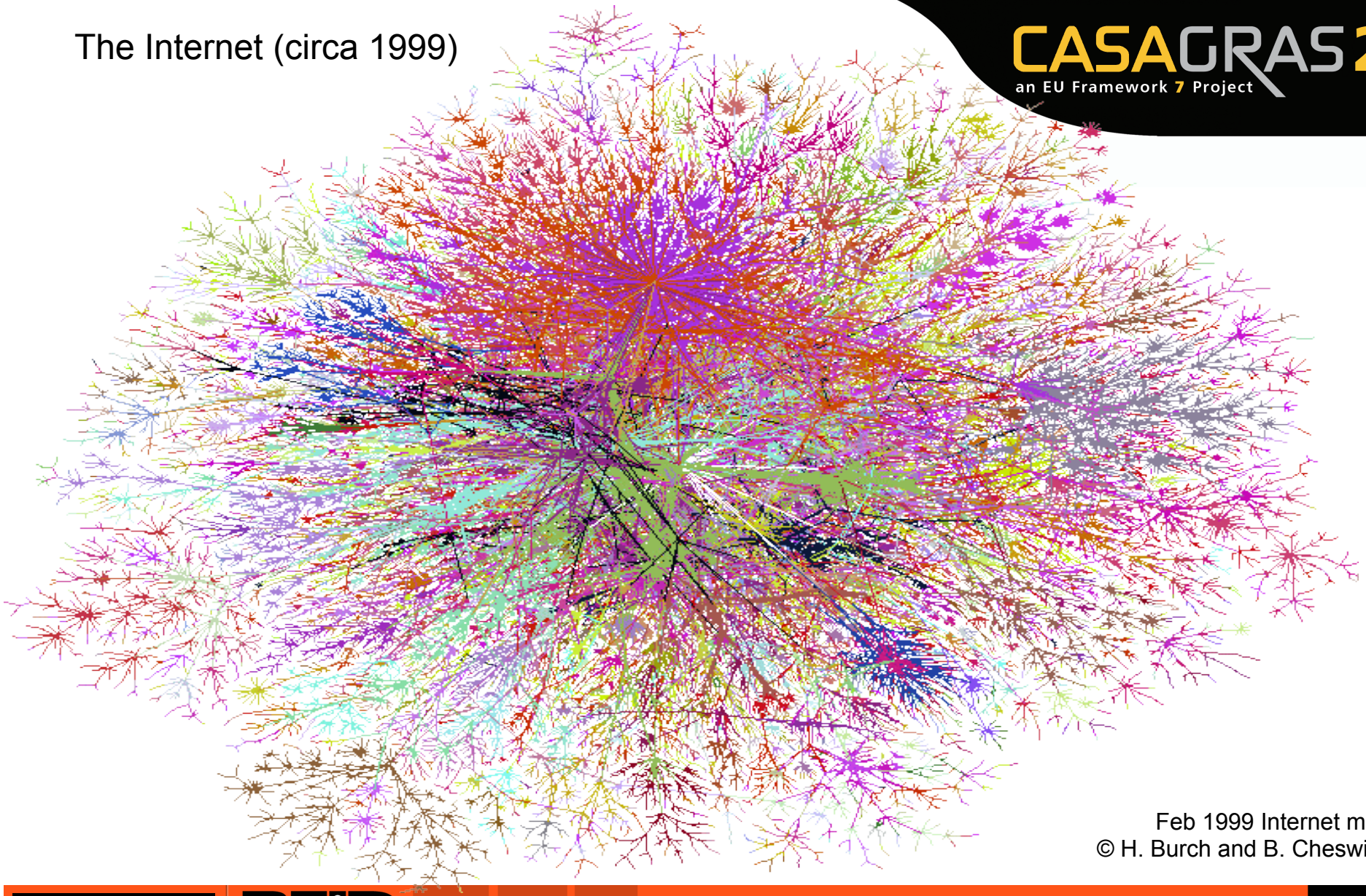

Feb 1999 Internet map
© H. Burch and B. Cheswick

Feb 1999 Internet map
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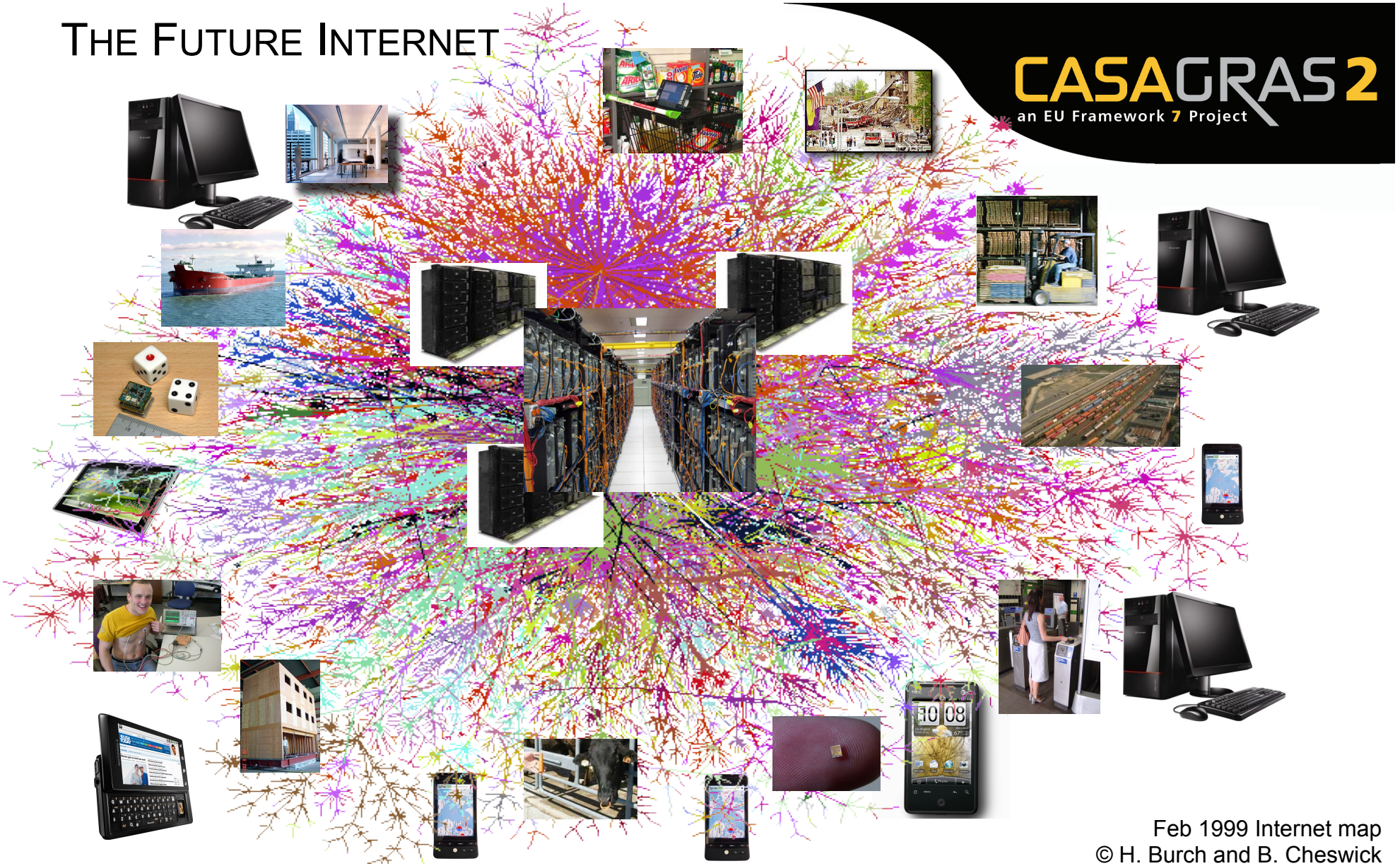
THE FUTURE INTERNET



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Feb 1999 Internet map
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Today's Internet: *Human-generated* data

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Email

Messaging

File sharing

Financial

Social Networking

Video

Blogging

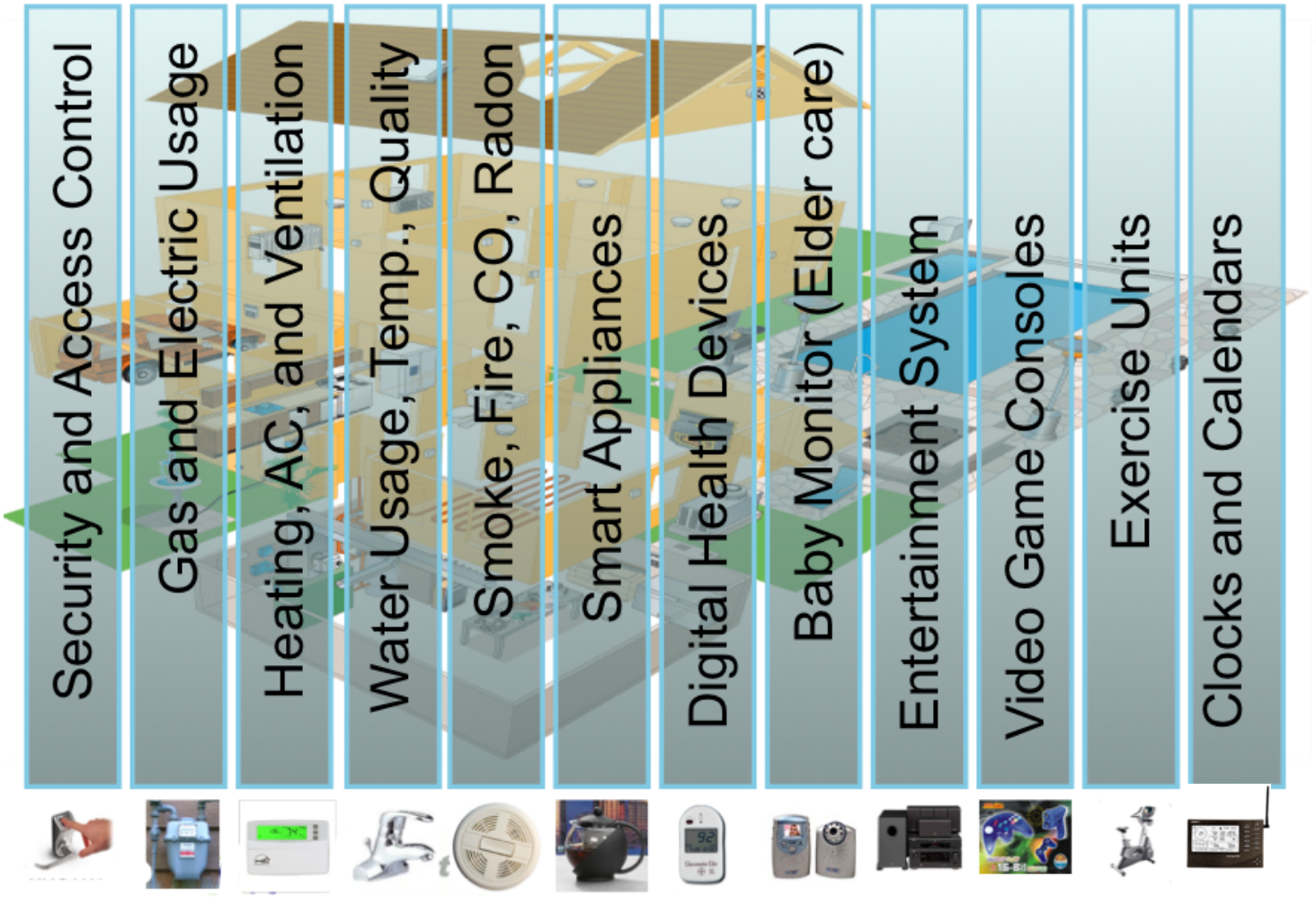
Weather

Maps

News

Sports

Most Real World Information is lost



Cyber-Physical Systems

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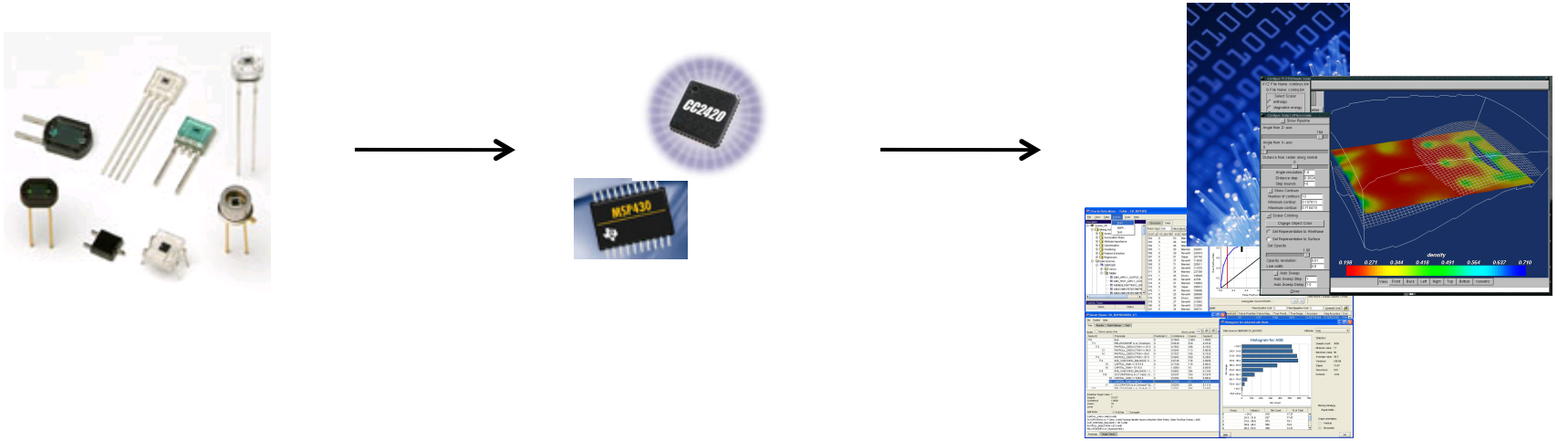
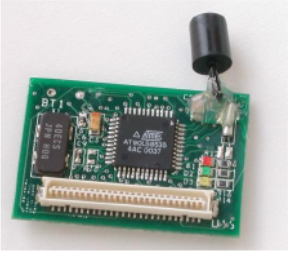


- Physical (Thing) -> Digital -> *Information*
- Sensors (including RFID) are everywhere
- Captured data live on the Internet
  - For applications, for longevity, for complex processing
- Each sensor becomes a network citizen

Device evolution

WeC (1999)

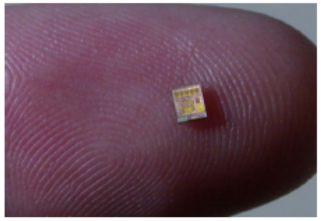


René (2000)

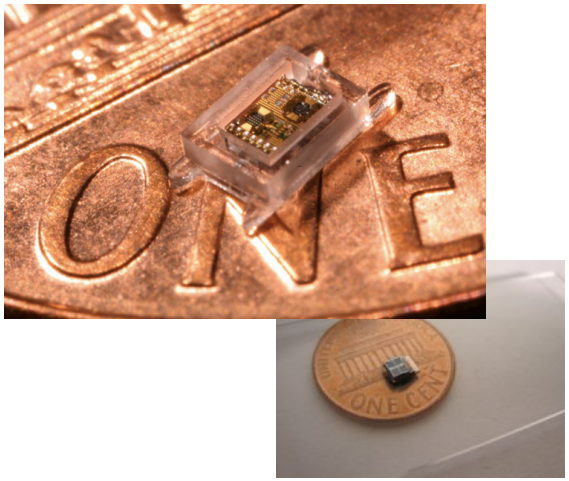
DOT (2001)

Berkeley
University of California

MICA (2002)



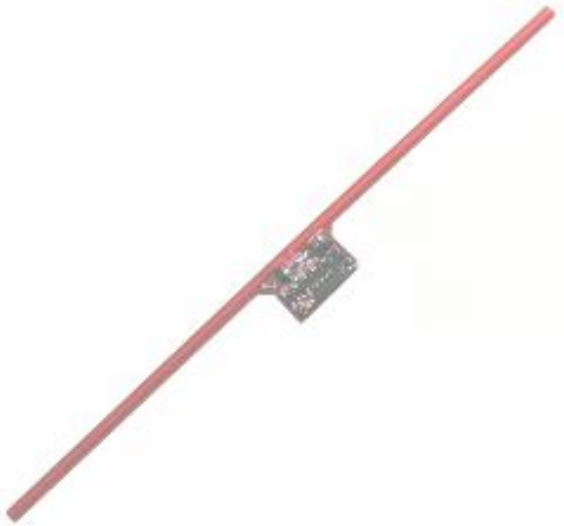
Speck (2003)



University of Michigan
(2011)

New devices in between

- Wireless Identification and Sensing Platform (WISP)
- Uses UHF passive RFID techniques to harvest power and communicate (compatible with EPC Gen2)
- Includes most of the components on the telos WSM node
- Programming must cater for frequent power failure (several times per second possible)
- Similar devices from Uni Rome (IT), Warwick (UK) and Oulu (FI)

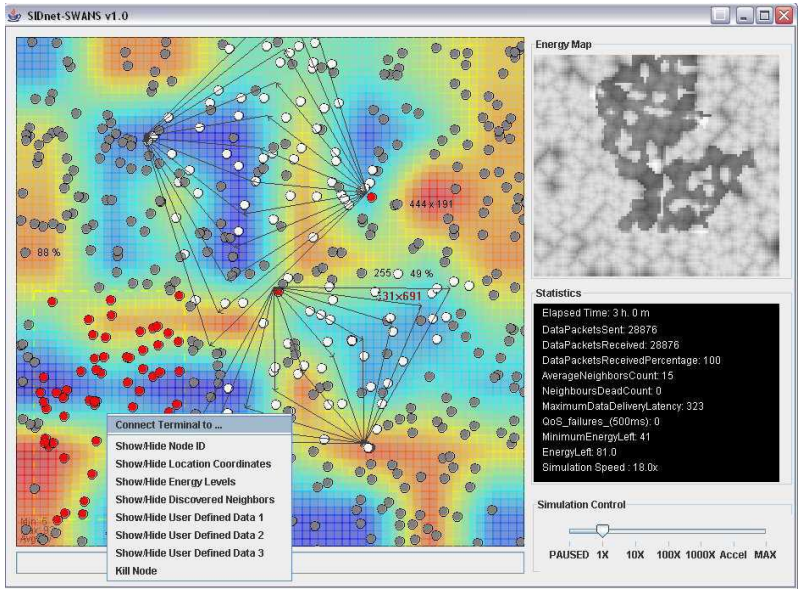


Intel Research (2009)

Wireless Sensor Networks

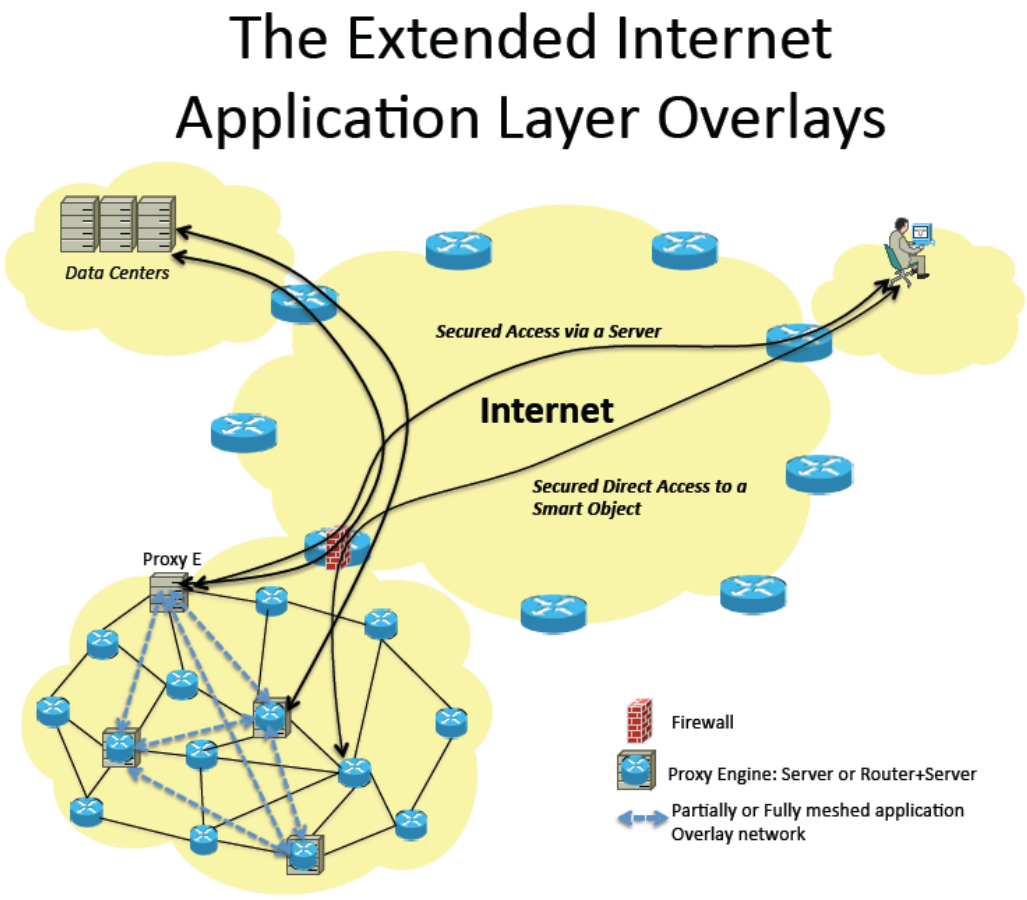
- Network of tiny footprint computers
- Optimized for long life on low power
- Big varieties of sensing modalities
- Networked using low-power radio
- Network citizens
  - Sense
  - Form mesh network
  - Harvest data to the Internet

- Real and fully functional systems are finding their place on the Internet
- Distinct islands of functionality converge to the IoT



SIDnet-SWANS
Northwestern University

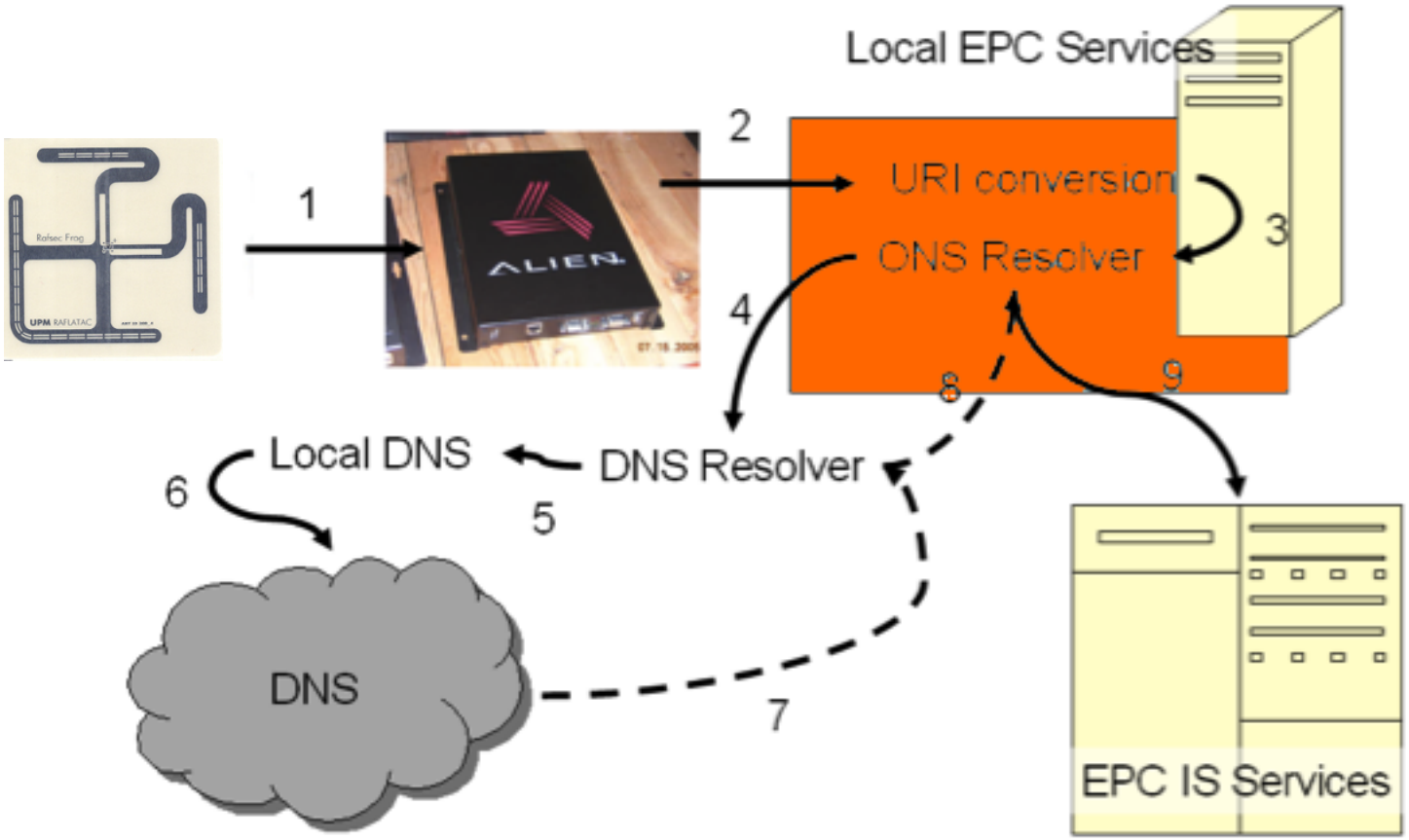
Internetworking WSNs



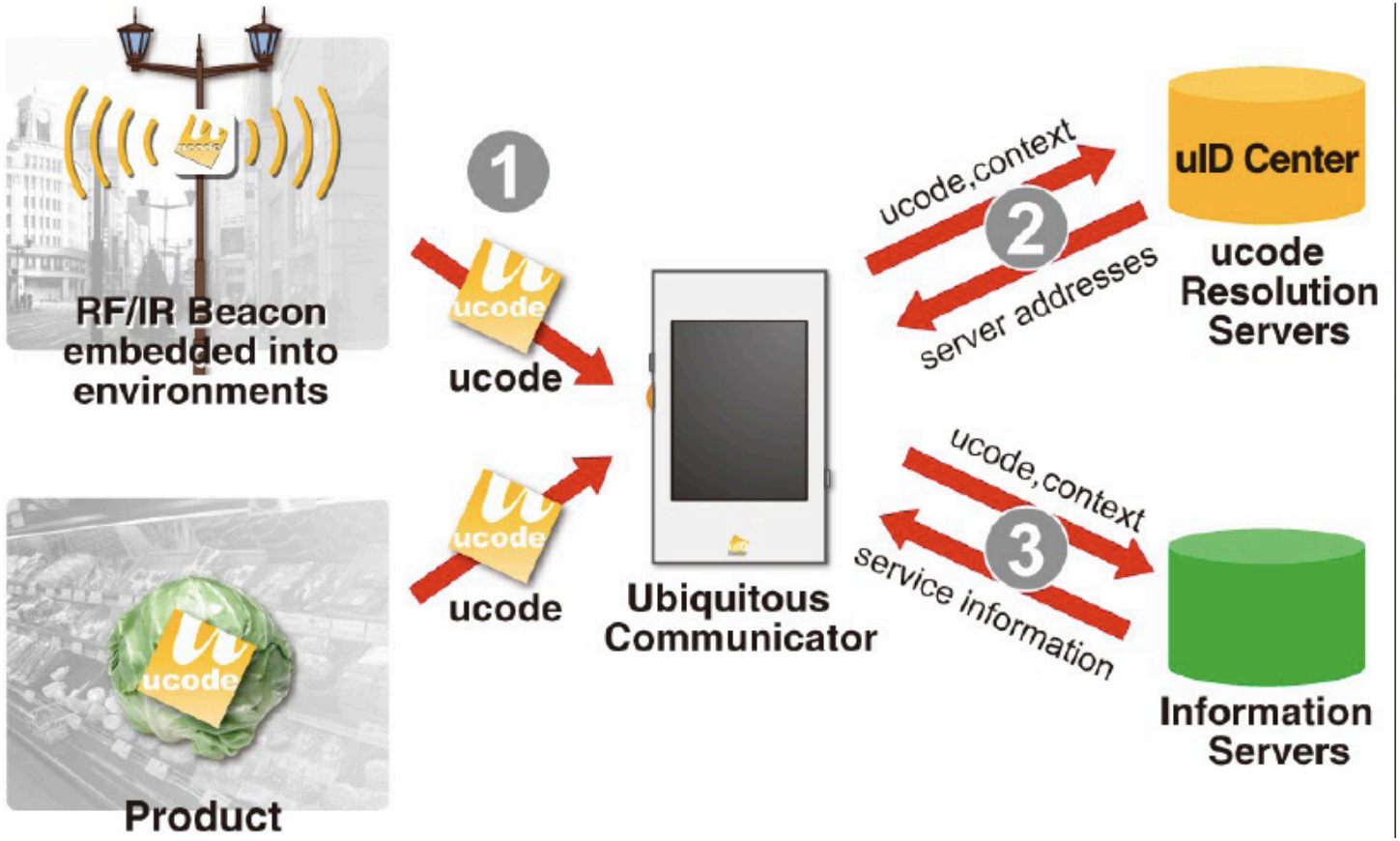
Low power IPv6 (6lowpan)
ROLL algorithm for routing
IETF specifications

CISCO

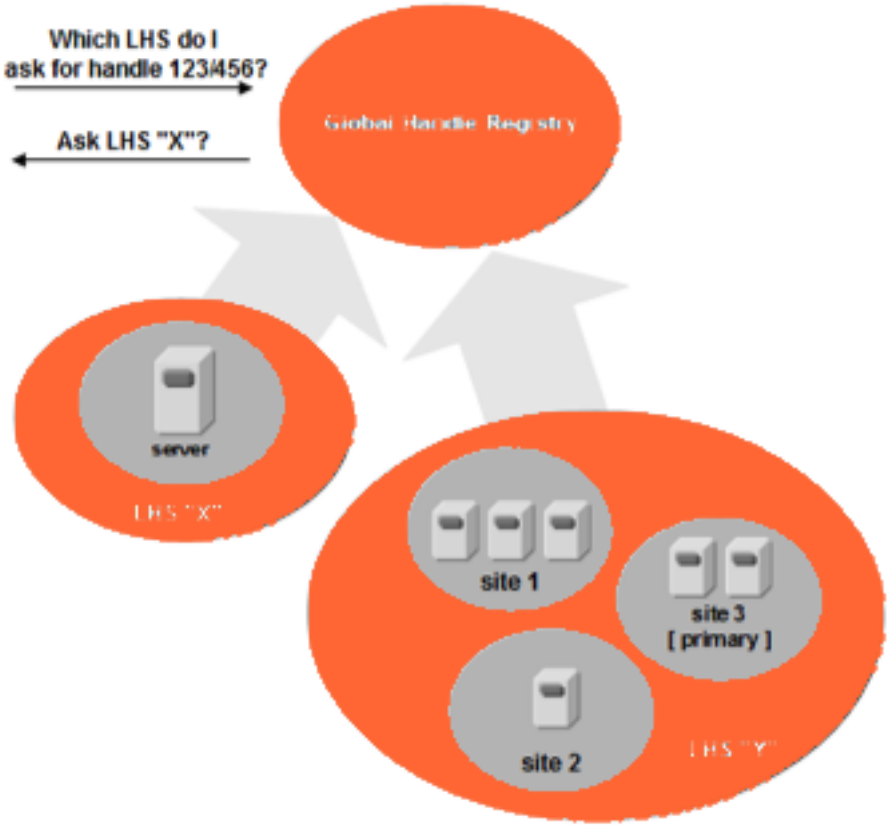
EPC resolution with ONS



ucode resolution on uID (YRP - Japan)



OID resolution with Handle (Praxis, Birkbeck, AIM - UK)



Meta-resolution service

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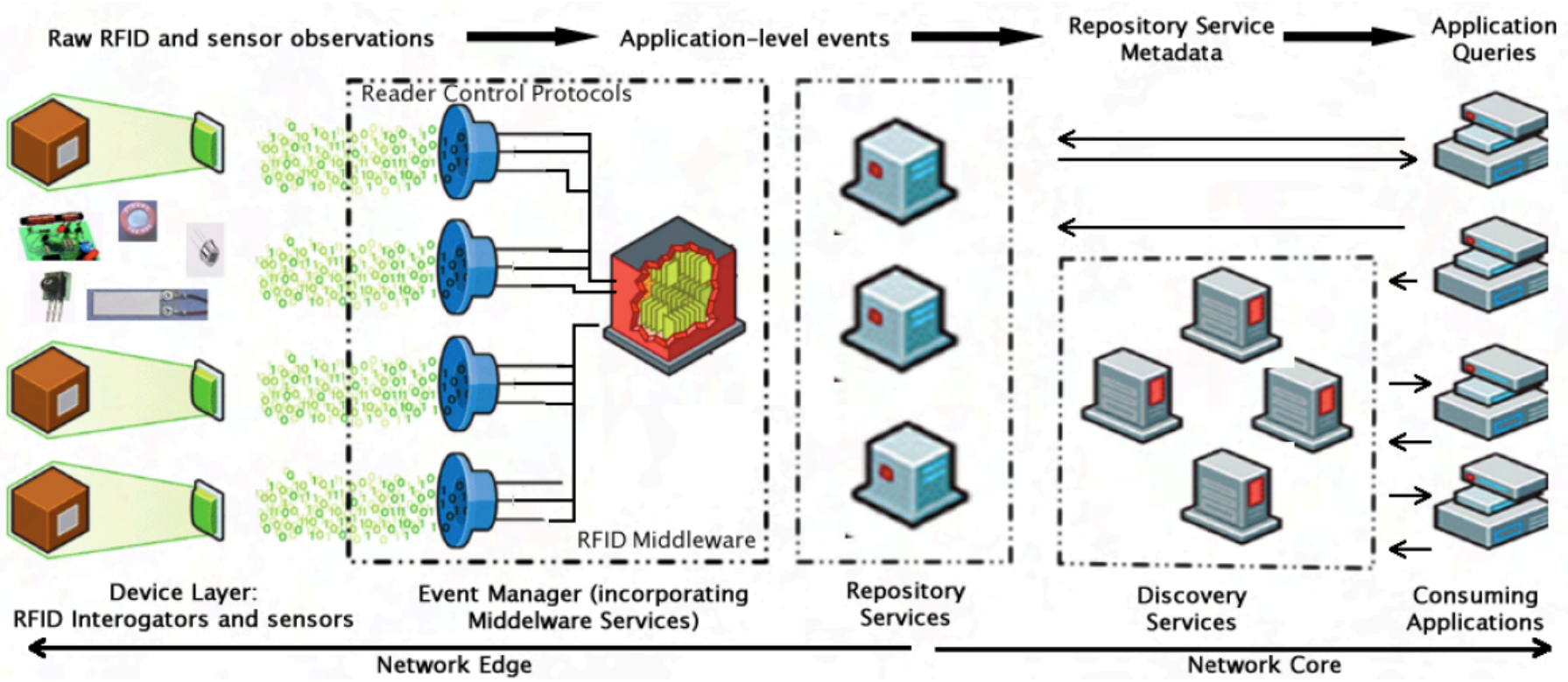
- Example: IANA Baggage Identification Codes
  - Root-OID 1.0.15961.12
  - Relative-OID 1
  - Compacted data 1234567890
  - Handle query 54321.1.0.15961.12.1/1234567890
  - Response

```
<location id="0"
        href=http://maps.google.co.uk/maps?q=51.522394,+-0.130881
        country="gb"
        weight="0" />
</location>
```

Network RFID system



IoT Network Architecture (ETRI, Korea)

ETRI

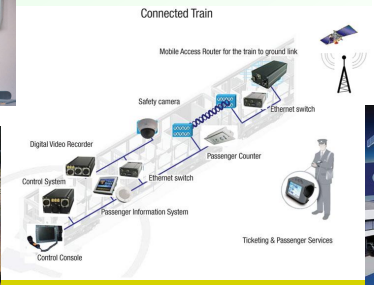
Logistics, SCM

Structural health monitoring

Agricultural control

Health care

Connected train



Bus management system

ITS/Telematics

IoT, M2M, USN applications

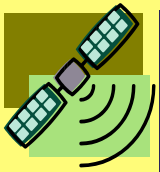
Sensor data manipulation | Item identification | ID management | Location management | Identity management | Object identification

Network management | Middleware | Directory service | Context awareness | Object management | Spatial information management

Service networks

BcN, Next Generation Networks, Internet, Future Internet, etc.

Core networks



Access networks

IrDA

RFID

Ethernet

RS-serials

Connected!

SENSEI vision

Real World Dimension of the Network of the Future

Mobility/Scalability Issues

Service interface design

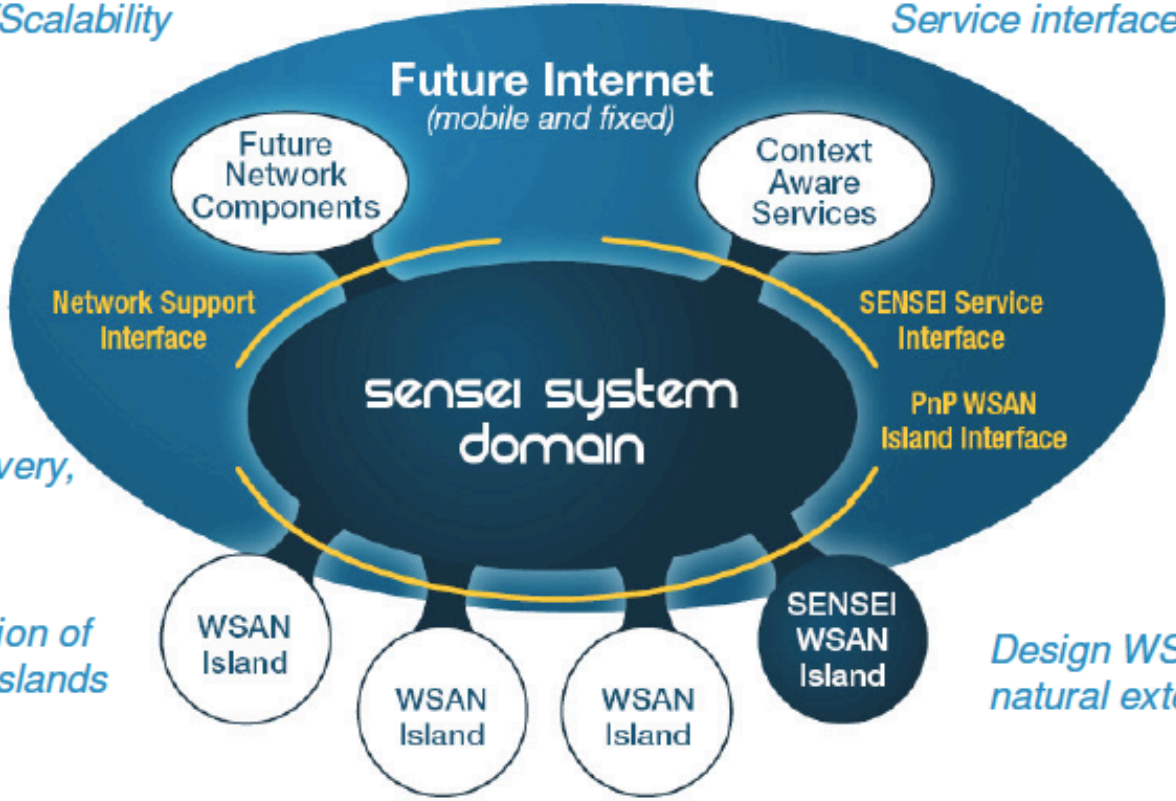
Network management, security and control

Multi-level context models, information processing and management

Networking (addressing, service discovery, routing, …)

Integration of legacy islands

Design WS&AN as natural extension of FI



Efficiency, Manageability, Re-configurability, Security

Summary

- RFID one of several enabling technologies for the IoT
- Material entities obtain network presence
- Sensing devices become full network citizens
- Numerous service proposals for network support (for persistence, complex processing)
- Major new challenge: data management