Expectances for AAL and Enhanced Living Environments for 2025/2030

Universitat d'Alacant
Universidad de Alicante

UNIVERSITÀ POLITECNICA DELLE MARCHE

UNIVERSIDADE BEIRA INTERIOR

AAPELE
COST Action IC1303

Associate Professor at the University of Alicante, Spain. Member of the research group on Domotics and Ambient Intelligence

Previously, Senior Researcher at Kingston University, United Kingdom. Leader of the Theme on AAL in the Interdisciplinary Centre for the Study of Health and Age-related conditions (IhSH

Recent EU projects:

- caring4U - A study on people activity in private spaces: towards a multisensor network that meets privacy requirements (Marie Curie IEF, 2011-2013)
- BREATHE - Platform for self-assessment and efficient management for informal caregivers (AAL JP, 2013-2015)

Chair of the IET International Conference on Technologies for Active and Assisted Living (TechAAL 2016)

Editor of book “Active and Assisted Living: Technologies and Applications”

Francisco Florez-Revuelta

**Assistant Professor in Telecommunications at the Universit`
Pollitecnica delle Marche, Italy. Member of the
Telecommunications System Team**

**Member of D4 Action Group of the EIP-AHA on
Age-friendly buildings, dities and environments (2016-2018)
Leader of general domain 6: dementia-friendly environments**

Recent and current AAL projects:

- **HOME-based ICT solutions FOR the independent living of people with DEMentia and their caregivers – The Home4Dem project (AAL JP, 2015-2017)**
- **SHELL: shared interoperable ecosystems for enhanced living environments (Italian funding, 2014-2017)**
- **TRASPARENTE: technologies for assistive networks aimed at independent living of elderly (Italian funding, 2013-2015)**

Chair of the International Workshop on Internet of Things for Ambient Assisted Living (IoTAAL)

Susanna Spinsante

Assistant Professor at the University of Beira Interior, Portugal.
Director of the Assisted Living Computing and Telecommunications Laboratory

Chair of COST Action IC1303 – AAPELE - Algorithms, Architectures and Platforms for Enhanced Living Environments

Recent AAL projects:

- **SIVIC: Wearable Integrated Cardiovascular Surveillance System (Portuguese funding, 2013-2015)**
- **TICE-Healthy (Portuguese funding, 2011-2014)**
- **iDTV-HEALTH: Inclusive services to promote health and wellness via digital interactive television (Portuguese funding, 2010-2013)**

Nuno Garcia

Architectures, Algorithms and Platforms for Enhanced Living Environments * AAPELE

Start date: 13/11/2013

End date: 12/11/2017

Nuno M. Garcia, Chair

Instituto de Telecomunicações *and*

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COST is supported by the EU Framework Programme

ESF provides the COST Office through a European Commission contract

On AAPELE

- AAPELE is IC1303 COST Action
- Funded by COST Office through European Science Foundation (2014)
- and by COST Association through H2020 (2015~)
- AAPELE gathers Researchers and Industry from 34 COST Countries
- AAPELE has 380+ members

Scientific context and objectives (1/2)

- **Background / Problem statement:** Loose community of researchers in disperse areas of AAL; need to build an anchor for scientific research and technological cooperation; need to foster research and technological cooperation that focus on promoting the interchange of ideas between researchers from different scientific backgrounds on the subject of AAL

- **Brief reminder of MoU objectives:** AAPELE COST Action addresses the issues of defining software, hardware and service architectures for AAL, on studying and creating more efficient algorithms for AAL, particularly those related to the processing of large amounts of data and of biosignals in lossy environments, and on the research of protocols for AAL or, with more detail, on studying communication and data transmission protocols for AAL.

Scientific context and objectives (2/2)

- **Research directions:**
  - Analysis of Medical Data
  - Sensor and actuator platform definition
  - Quality of Service | Experience analysis
  - Activities of daily living detection
  - Context aware architecture for AAL
  - Mobile AAL

Working groups

1. Sensor Networks and Communication Infrastructure for AAL Services WG
2. Requirement Analysis and Profiling WG
3. Protocol and Platform Analysis, QoS, QoE, Capacity Planning WG
4. Medical Data Acquisition and Algorithms WG
5. User Interaction WG
6. Mobile AAL Applications and Communications WG

Future Plan and Challenges

For year 3, the challenges are

1. To host an Industry day, to strengthen the interaction between research and industry (September 2016, Cluj Napoca Romania)
2. To host the 3nd workshop ELEMENT – Enhanced Living EnvironMENTs (Cluj Napoca, Romania)
3. To host a Training School on AAPELE (proposals accepted)
4. To invite additional members to join AAPELE

Cooperation in

- Books
- SI in journals
- Workshop and conference papers
- Joint papers with joint acknowledgements
- Other COST actions like IC1406 CHIPSET
- Joint project proposals
- Data exchange

MORE INFO ON AAPELE

Visit our website:

www.aapele.eu

Email us to have access to AAPELE documents and Working Groups

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- Review of research roadmaps on AmI and AAL published in the early 2000
- Review of recent roadmaps on AAL
- Open discussion on the expectances of past roadmaps
- Open discussion on the expectances on AAL for the next decades

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The computer for the 21st century, by Mark Weiser:

"Machines that fit the human environment instead of forcing humans to enter theirs will make using a computer as refreshing as taking a walk in the woods"

Ambient Intelligence (AmI):

"In the near future our homes will have a distributed network of intelligent devices that provides us with information, communication, and entertainment. Furthermore, these systems will adapt themselves to the user and even anticipate on user needs. These consumer systems will differ substantially from contemporary equipment through their appearance in peoples environments, and through the way users interact with them. Ambient Intelligence is the term that Philips uses to denote this new paradigm for in-home computing and entertainment" (2000)

A bit of history

Ambient Intelligence (AmI):

"AmI provides a vision of the Information Society where the emphasis is on greater userfriendliness, more efficient services support, user-empowerment, and support for human interactions. People are surrounded by intelligent intuitive interfaces that are embedded in all kinds of objects and an environment that is capable of recognising and responding to the presence of different individuals in a seamless, unobtrusive and often invisible way" (2001)

"Ambient intelligence will become a network of hidden intelligent interfaces that recognise our presence and mould our environment to our immediate needs" (2002)

". . a new paradigm in information technology is emerging, in which people are served by a digital environment that is aware of their presence and context, and is responsive to their needs, habits, gestures and emotions: ambient intelligence" (2003)

A bit of history

Ambient Intelligence (AmI):

"An AmI system requires the use of distributed sensors and actuators to create a pervasive technological layer, able to interact transparently with a user, either passively by observing and trying to interpret what the user actions and intentions are, but also actively, by learning the preferences of the user and adapting the system parameters (applied to sensors and actuators, for instance) to improve the quality of life and work of the occupant (2005)

A bit of history

Ubiquitous computing Embedded processing into everyday objects like furniture, clothes or toys; i.e. there is an interconnection of embedded systems that are hidden in the environment. This includes computers, communication systems, cameras, microphones, and pressure light, motion, and temperature sensors. There is also a possibility of communication among objects and between objects and the user

Awareness The system must know at all times the state of the environment and
its dwellers, being able to locate and identify objects and people;

Intelligence The system must be able to adapt to new data and establish connections with the existing knowledge; and

Natural interaction The basic requirements must be able to be transmitted and
interpreted without the user performing strange or unnatural movements or orders. This suggests the development based on the most common means of interaction for human interfaces, such as speech and gestures. Besides, interfaces must be mixed with the environment so that the user does not feel them present

Four key aspects

Four scenarios of application of AmI

- ‘Maria’ – Road Warrior
- ‘Dimitrios’ and the Digital Me’ (D-Me)
- Carmen: traffic, sustainability & commerce
- Annette and Solomon in the Ambient for Social Learning

Key enabling technologies

- Very unobtrusive hardware
- A seamless mobile/fixed web-based communications infrastructure:
- Dynamic and massively distributed device networks
- A natural feeling human interface
- Dependability and security

Four scenarios of application of AmI

- **‘Maria’ – Road Warrior**
- **‘Dimitrios’ and the Digital Me’ (D-Me)**
- **Carmen: traffic, sustainability & commerce**
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Personalised computer – wearable

- **Automatic identification**
- **Border control**
- **Room booking**
- **Car renting**

Autonomous cars
Ubiquitous displays
Automatic translation
Context awareness

Mention to services similar to Dropbox, Google Drive, Skype

Four scenarios of application of AmI

- **‘Maria’ – Road Warrior**
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Chatbots that learn from their users – Automatic reply
Social networks
Video-conferencing
Speech recognition
Automatic translation
Self-organising databases

Four scenarios of application of AmI

- **‘Maria’ – Road Warrior**
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Intelligent appliances
E-commerce
Online payment systems
Intelligent traffic management
GPS

Four scenarios of application of AmI

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Online collaborative learning platforms
Web-TV
Co-design at different places
Human-environment interaction
Virtual reality, holographic representations
Haptic surfaces

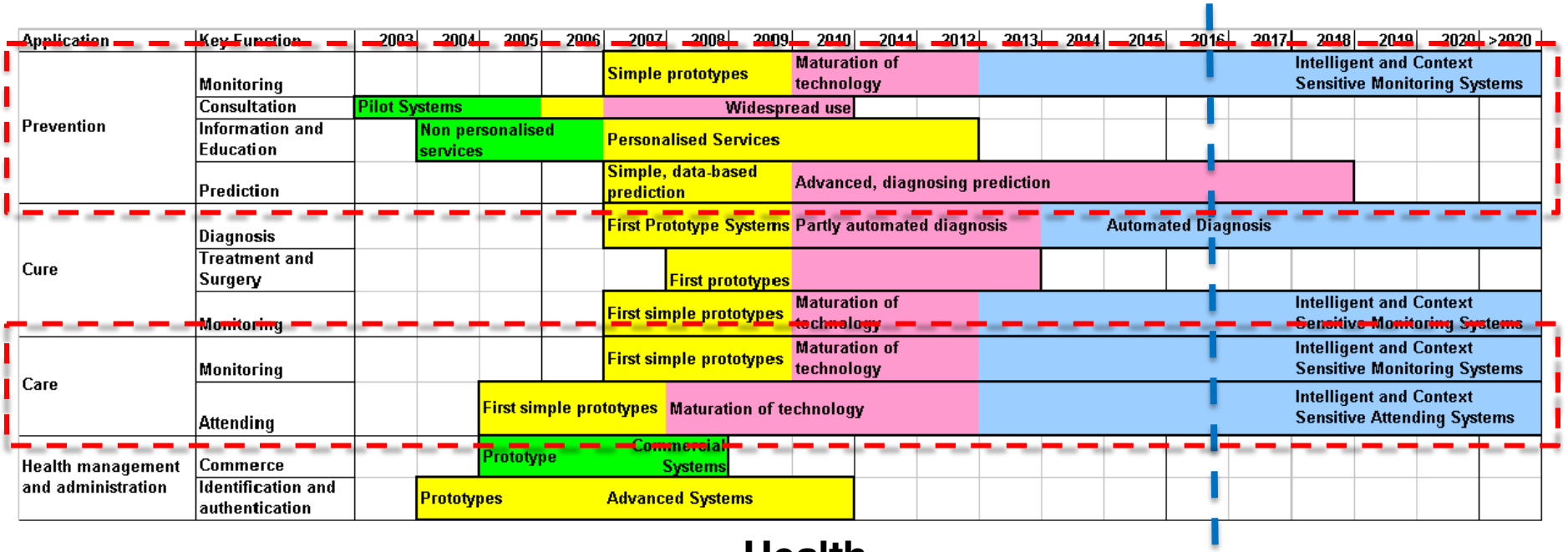
Thorought report by the Institute for Prospective Technological Studies (IPTS)
and the European Science and Technology Observatory (ESTO) network

Roadmap for the design and development of ambient intelligence technologies and services

It identifies different areas for application of AmI:

- **Housing**
- **Mobility and transport**
- **Shopping and commerce**
- **Education and learning**
- **Culture, leisure and entertainment**
- **Health**

Ambient Intelligence for 2003 everyday life



Health

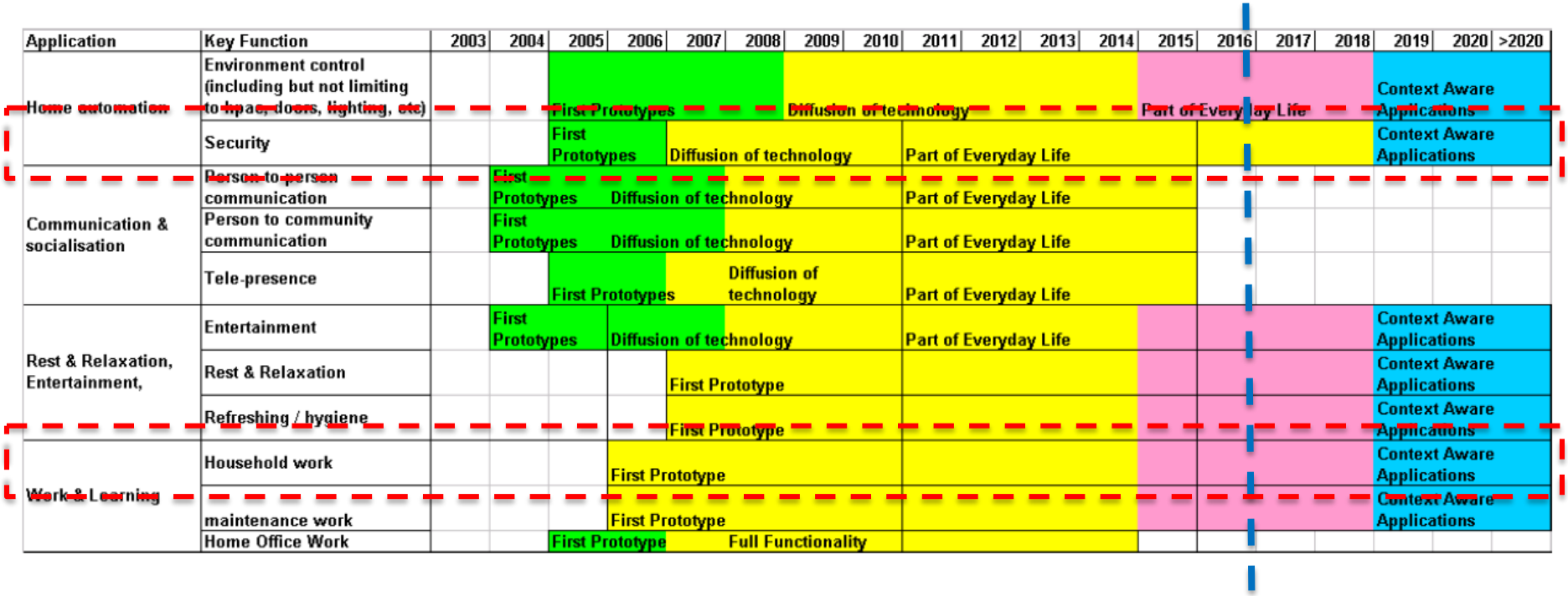
Monitoring

- Activity patterns, sleeping behaviour, pre-indications of incontinence…
- Monitoring of performance and controlling of assistive technology
- Working of assistive technology responding to context, e.g. time of day, mood or surroundings
- Tagging of mentally ill or demented persons

Attending

- Ambient buddies
- Ambient emergency systems
- Domotics aimed at people with special needs

Ambient Intelligence for 2003 everyday life



Housing

Support for the elderly

- Monitor health status
- Compensate possible functional impairments
- Add security
- Provide improved communication
- Long-term monitoring

Household work

Ambient Intelligence for 2003 everyday life

The authors of those two documents stressed that either these were the views of a relatively small group, or they were pure wishes, mind-opening vision or science fiction

Usually, the authors are biased by their own expertise. Are end-users asked for their expectances?

It is very difficult to establish expectances for future technologies and services

There a number of socio-political factors, and business and industrial models that produce these differences in developments and early adoption by the users

Are we still at the same point? No.
Have we reached those predictions? Neither.

Conclusions

References and credits

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Gunnarsdóttir, Kristrún, and Michael Arribas-Ayllon. "Ambient intelligence: a narrative in search of users (discussion paper)." (2011)

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Picture of robot "Head area without mimic", by Xavier Caré

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Review of research roadmaps on AmI and AAL published in the early 2000s

Review of recent roadmaps on AAL

Open discussion on the expectances of past roadmaps

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AAL: What's next?

A long-term view

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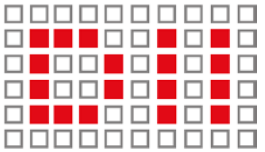


***W24**: Expectations for AAL and enhanced living environments in 2025/2030*

AAL Forum 2016 – St. Gallen – 28/09/2016

Outline

- EIP-AHA short term aim
- AAL Roadmap and Strategic Research Agenda by AALIANCE2 (2014)
  - Focus on long-term view for scenarios and KETs
- Insight in future innovation landscape

EIP on AHA 2016-2018

- The European Commission launched the pilot European Innovation Partnership on Active and Healthy Ageing (EIP on AHA) in 2010 under the Europe 2020 Flagship Initiative Innovation Union
- **Goal: increasing by two years the average healthy life years of EU citizens by 2020**
- Identify and remove persisting barriers to innovation across the health and care delivery chain, through interdisciplinary and cross-sectoral approaches

EIP on AHA 2016-2018

Aims:

- Improving the health status and quality of life of European citizens, with a particular focus on older people;
- Supporting the long-term sustainability and efficiency of health and social care systems; and
- Enhancing the competitiveness of EU industry through an improved business environment providing the foundations for growth and expansion of new markets.

Six priority actions identified

AALIANCE2 Roadmap (RM) and Strategic Research Agenda (SRA)

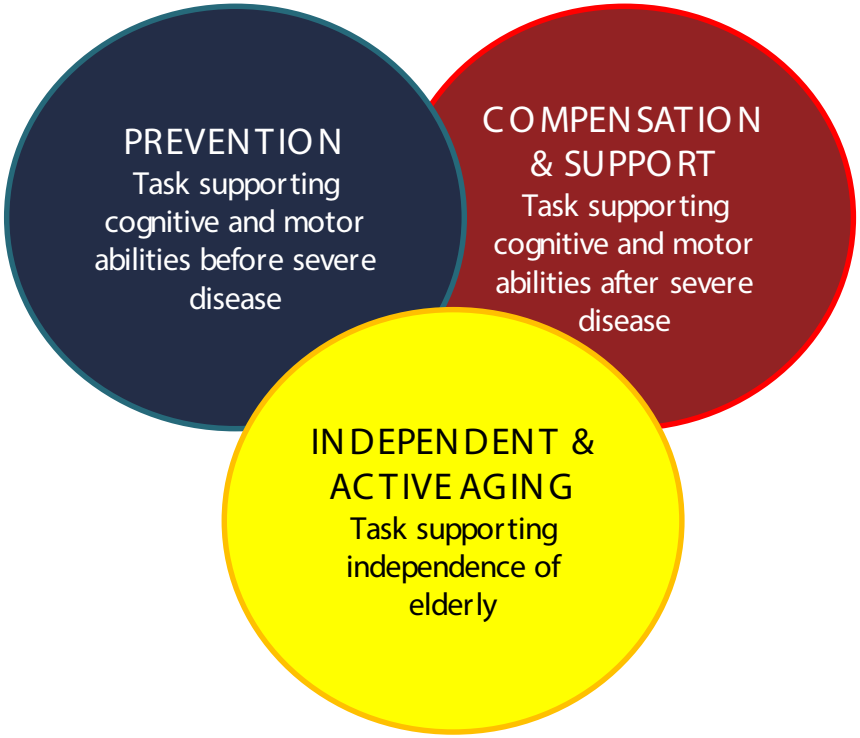
- Delivered in 2014 by AALIANCE2 project
- Describe the main social, service and technological issues, challenges and recommendations which could favor the success of Ambient Assisted Living (AAL) solutions in the society
- Tools to promote for all relevant stakeholders a common and strategic vision to ensure appropriate investments and successful deployments in the AAL market

From 2010 to 2014 RM

- Several changes with respect to AALIANCE AAL RM 2010
- From AAL *application domains* (AAL for Persons, AAL in the Community and AAL at work) to:
  - **three main service areas:** Prevention, Compensation & Support, and Independent & Active Ageing
  - **ten AAL service scenarios** more appropriate to the current social, economic and political challenges and objectives of our countries
  - detailed **stakeholders' needs** and relative technological gaps identified and shared with the AAL community
- Ethics, acceptability of technology, optimal service design, analysis of AAL market, standardisation, certification and interoperability of AAL tools, dependability and green sustainability are also discussed
- Key enabling technologies (KET) overview
- Research priorities for KETs in short, mid and **long term (2025-2030)**

AAL Service Areas

- Group main solutions conceived to support older people in need of care
- Delay and slow-down decrease in QoL
- Services enhanced by the use of appropriate AAL technologies
- Aim to satisfy users' needs, favor a better perceived QoL, active and fruitful participation in society
- Complementary and overlapping

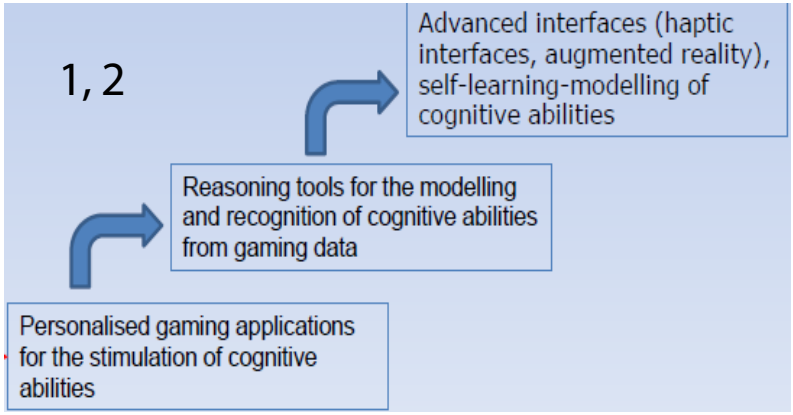


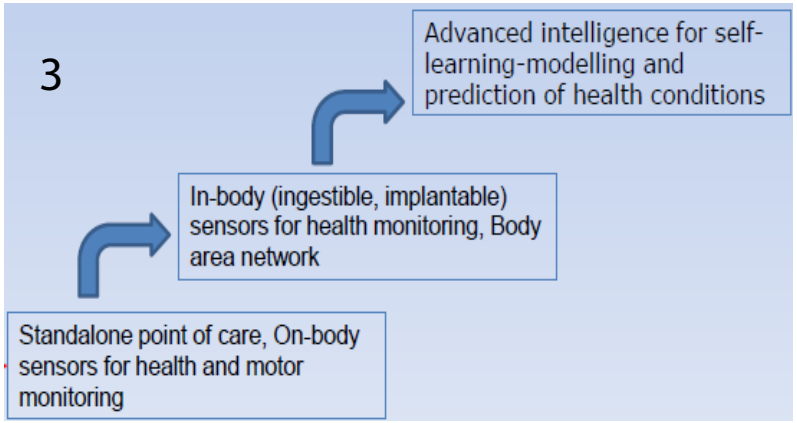
From: AALIANCE2 project – deliverable 2.7 Ambient Assisted Living Roadmap, 2014 – p. 33

AAL Scenarios

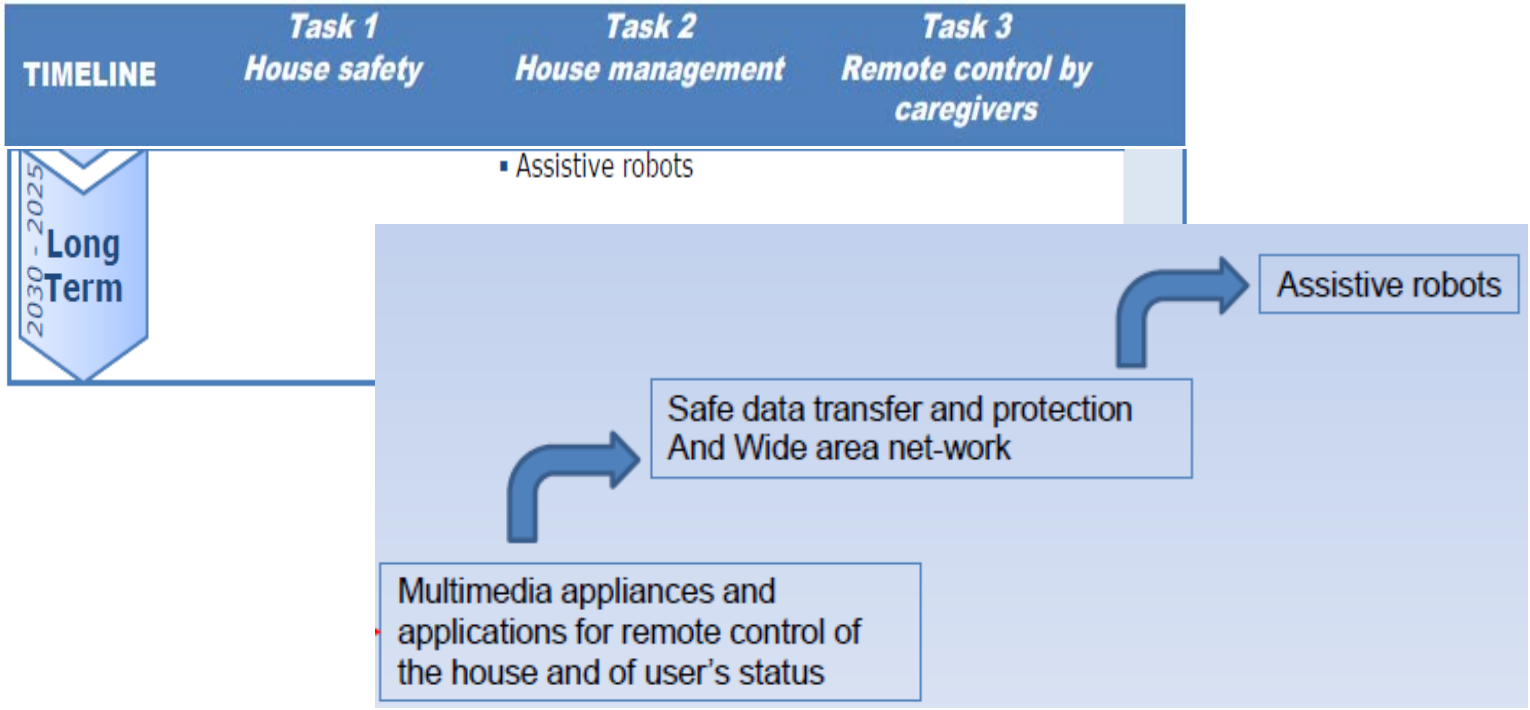
Long-term view of activities and KETs for some scenarios follows

Scenario 1: Prevention of early degeneration of cognitive abilities
Scenario 2: Healthy living
Scenario 3: Management of chronic diseases





Scenario 4: Age-friendly and safe environments



Scenario 5: Fall prevention
Scenario 6: Management of daily activities and keeping control over own life
Scenario 7: Maintaining social contacts and having fun

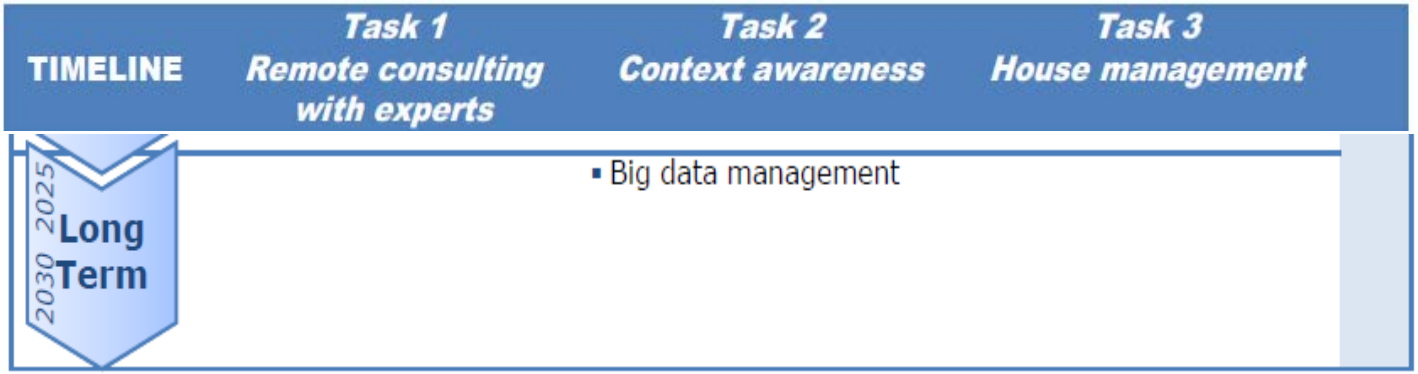
TIMELINE	Task 1 Facilitating sport and hobbies	Task 2 Support for manual hobbies	Task 3 Playing cards	Task 4 Participation to social activities
2025 2030 Long Term	▪ Light exoskeletons for lower and upper limbs	▪ Light exoskeletons for arms and hands to facilitate fine movements Assistive robots		

Scenario 8: Outdoor mobility (i.e. pedestrians, public transport and private cars)
Scenario 10: Senior citizens at work

TIMELINE	Task 1 Public transportation	Task 2 Pedestrians	Task 3 Private transport
2025		▪ Wearable robotic solutions, i.e. prosthetics	▪ Autonomous cars (self-parking, no-pilot drive) ▪ Advanced infrastructure for transportation in smart cities and rural areas

TIMELINE	Task 1 Heavy work activities	Task 2 Precision work activities	Task 3 Preventive training
2025 Long Term 2030	▪ Advanced co-worker robots with high cognitive and physical interaction capabilities	▪ Exoskeletons	▪ Reasoning systems to manage work activities and prevent related risks

Scenario 9: Avoiding caregiver isolation

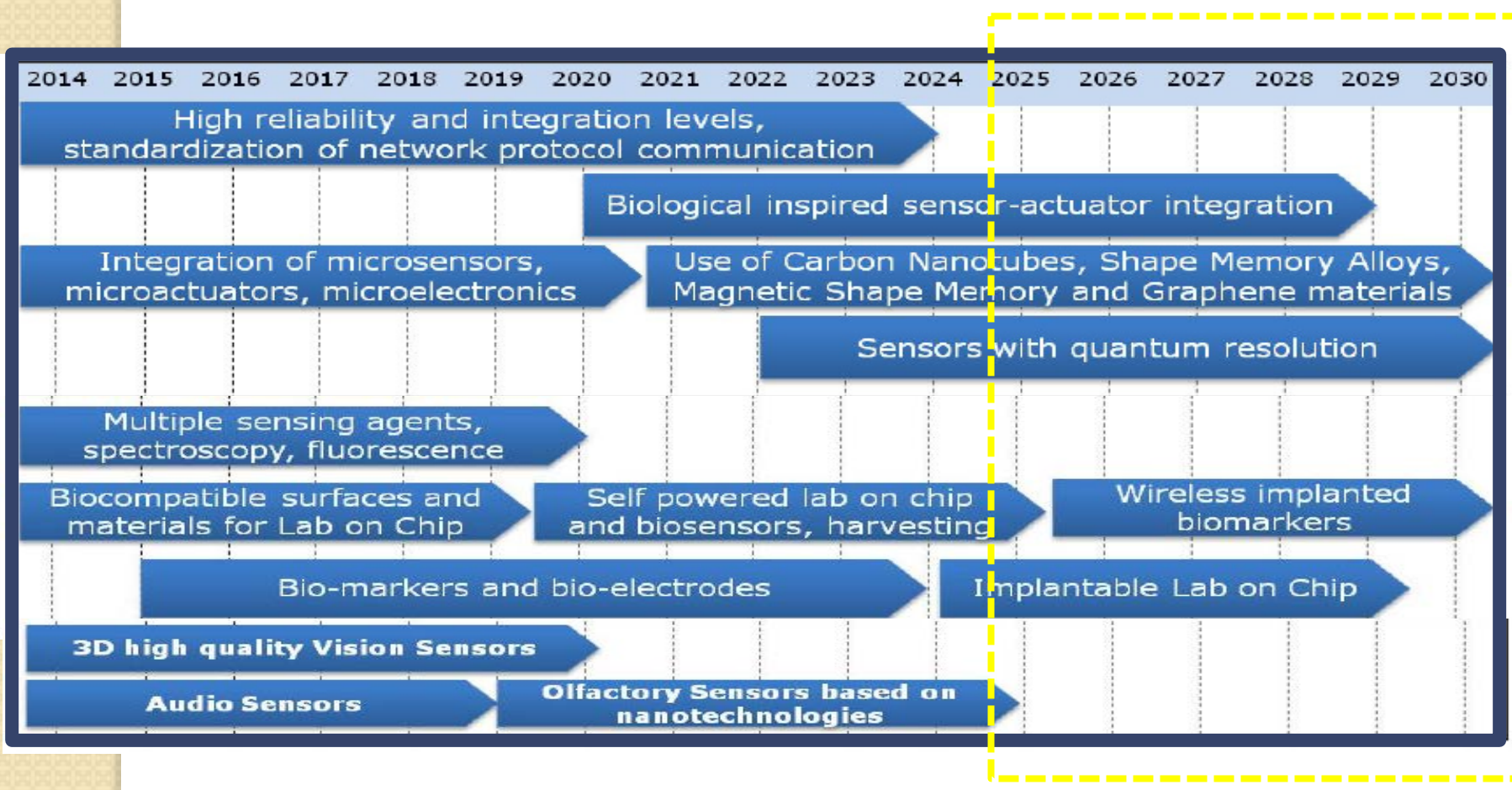


Key Enabling Technologies overview

Sensing	New sensing principles and technologies to measure physical, chemical, electrical, optical, etc. quantities of a phenomenon and to produce outputs usable to improve the AAL services
Reasoning	Intelligent systems with computational capabilities able to generate knowledge using logical techniques of deduction, induction or other forms of reasoning
Acting	Automated systems and robotics, which proactively act for providing useful services, including physical and cognitive support
Interacting	All kinds of means, both software and hardware, that allow interaction processes and bridge capabilities between users and service/machines
Communicating	Technologies related to machine to machine interfacing that allow devices to communicate and cooperate

KET RM: sensing

- Smart Sensors, MEMs, Quantum
- Lab-on-chip, biosensors
- Vision, audio, olfactory sensors
- Environmental sensors
- Personal sensors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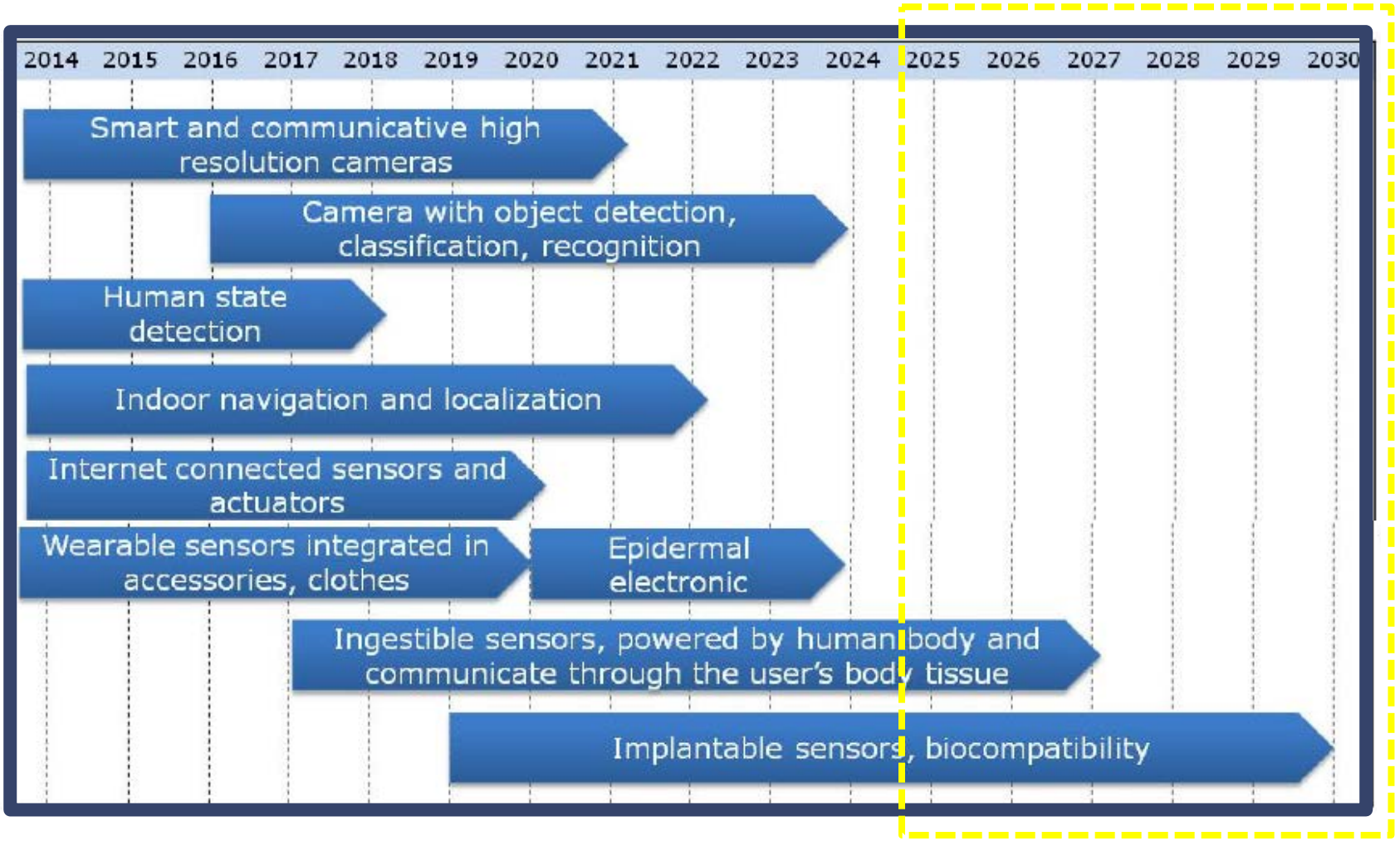
High reliability and integration levels, standardization of network protocol communication
Biological inspired sensor-actuator integration
Integration of microsensors, microactuators, microelectronics
Use of Carbon Nanotubes, Shape Memory Alloys, Magnetic Shape Memory and Graphene materials
Sensors with quantum resolution
Multiple sensing agents, spectroscopy, fluorescence
Biocompatible surfaces and materials for Lab on Chip
Self powered lab on chip and biosensors, harvesting
Wireless implanted biomarkers
Bio-markers and bio-electrodes
Implantable Lab on Chip
3D high quality Vision Sensors
Audio Sensors
Olfactory Sensors based on nanotechnologies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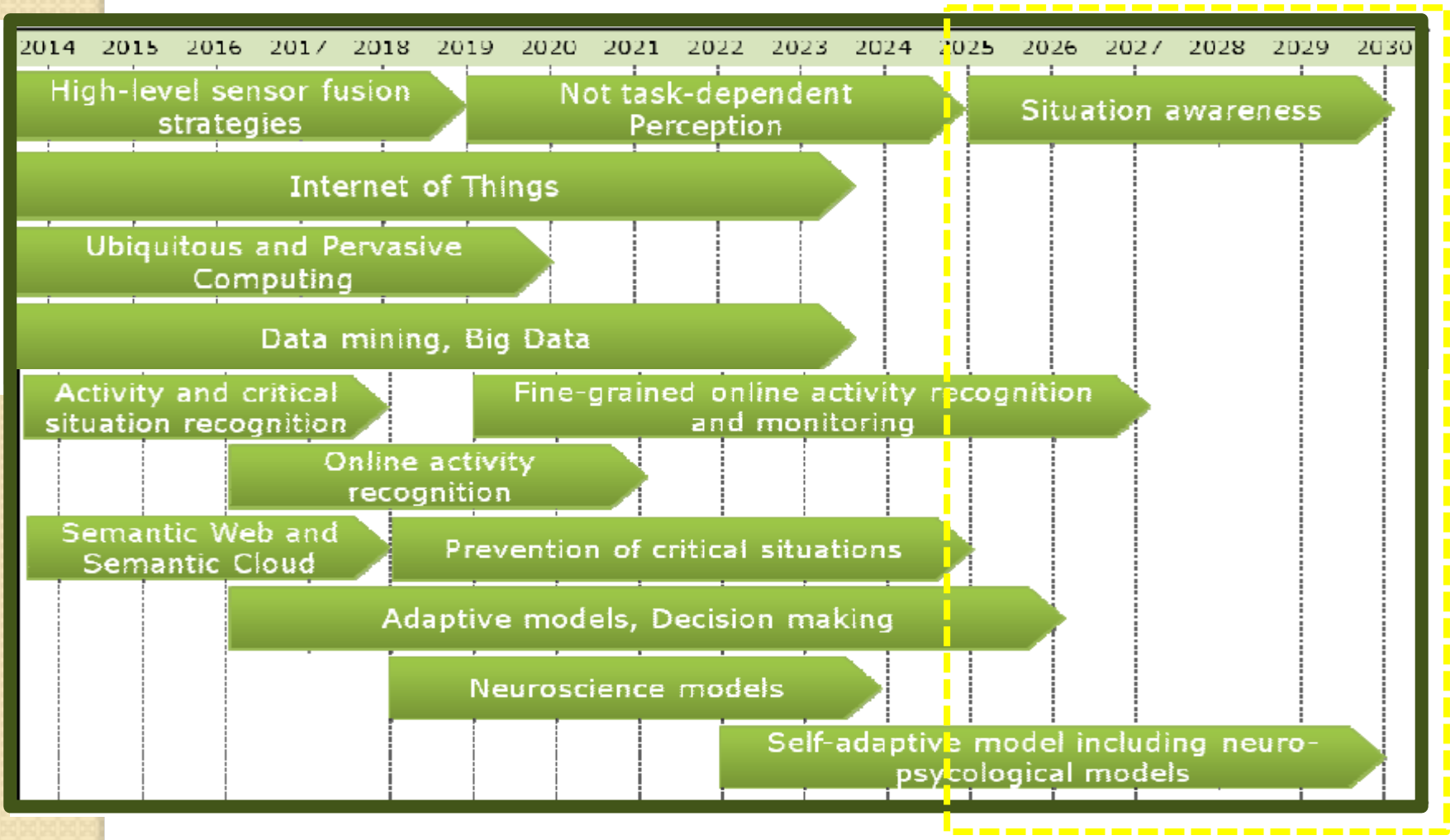
Smart and communicative high resolution cameras
Camera with object detection, classification, recognition
Human state detection
Indoor navigation and localization
Internet connected sensors and actuators
Wearable sensors integrated in accessories, clothes
Epidermal electronic
Ingestible sensors, powered by human body and communicate through the user's body tissue
Implantable sensors, biocompatibility

KET RM: reasoning

- Context-awareness and sensor data fusion
- Advanced intelligence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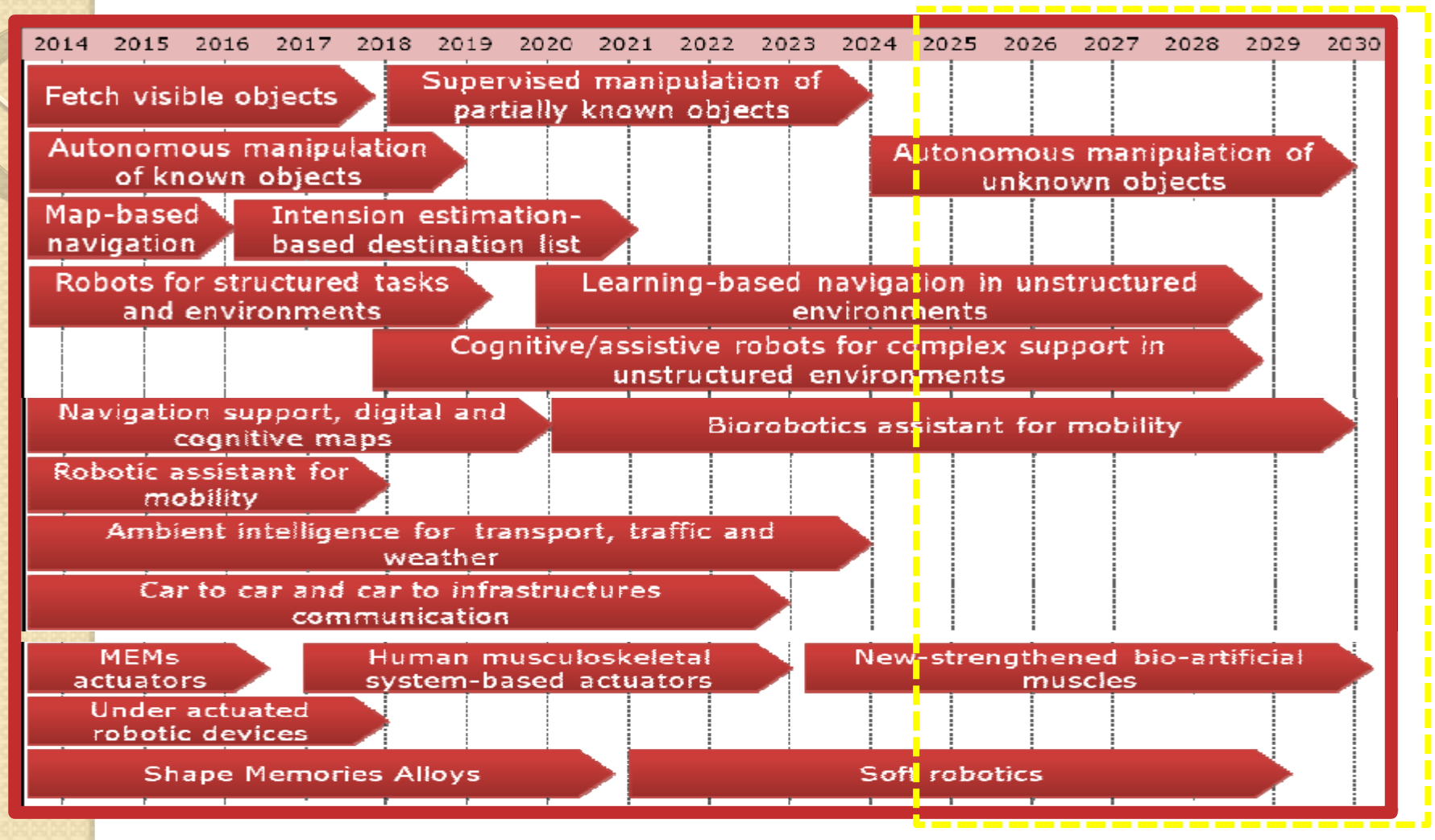
High-level sensor fusion strategies
Not task-dependent Perception
Situation awareness
Internet of Things
Ubiquitous and Pervasive Computing
Data mining, Big Data
Activity and critical situation recognition
Fine-grained online activity recognition and monitoring
Online activity recognition
Semantic Web and Semantic Cloud
Prevention of critical situations
Adaptive models, Decision making
Neuroscience models
Self-adaptive model including neuro-psycological models

KET RM: acting

- Service robotics
- Smart mobility
- Smart actuators
- Wearable robotics, neurorobotics
- Smart environments, AmI, social and cloud robotics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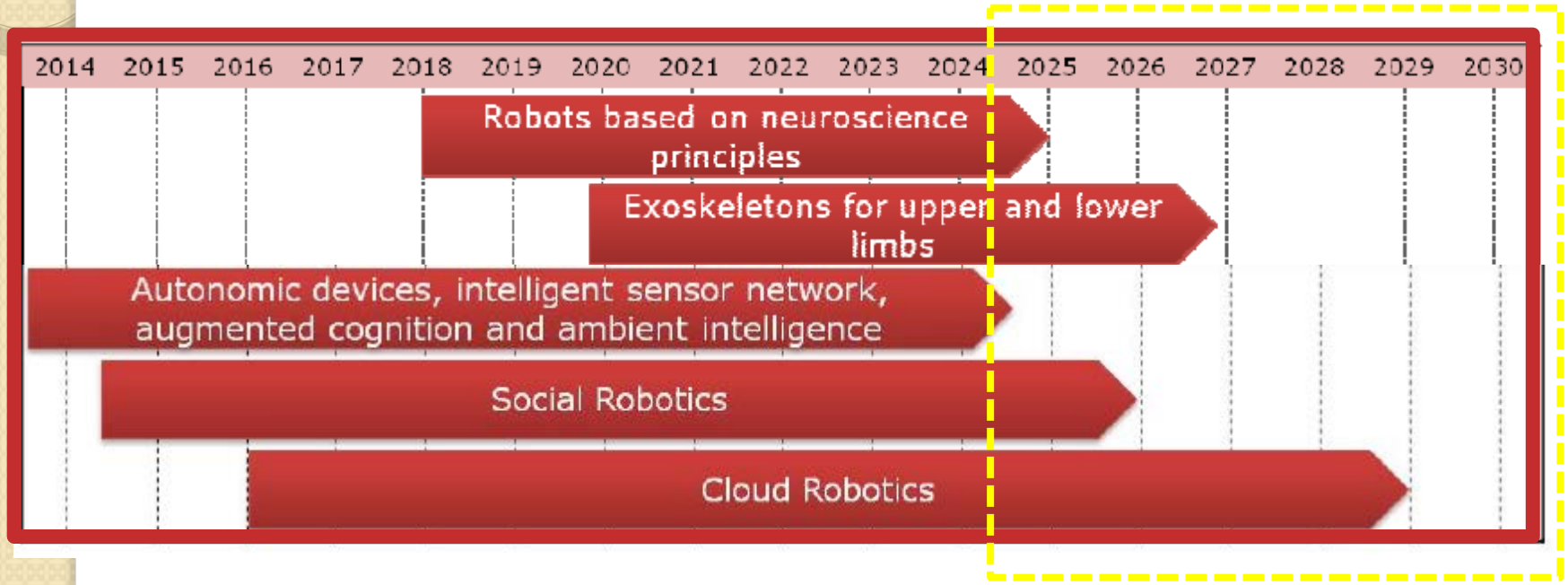
Fetch visible objects
Supervised manipulation of partially known objects
Autonomous manipulation of known objects
Autonomous manipulation of unknown objects
Map-based navigation
Intension estimation-based destination list
Robots for structured tasks and environments
Learning-based navigation in unstructured environments
Cognitive/assistive robots for complex support in unstructured environments
Navigation support, digital and cognitive maps
Biorobotics assistant for mobility
Robotic assistant for mobility
Ambient intelligence for transport, traffic and weather
Car to car and car to infrastructures communication
MEMs actuators
Human musculoskeletal system-based actuators
New-strengthened bio-artificial muscles
Under actuated robotic devices
Shape Memories Alloys
Soft robotics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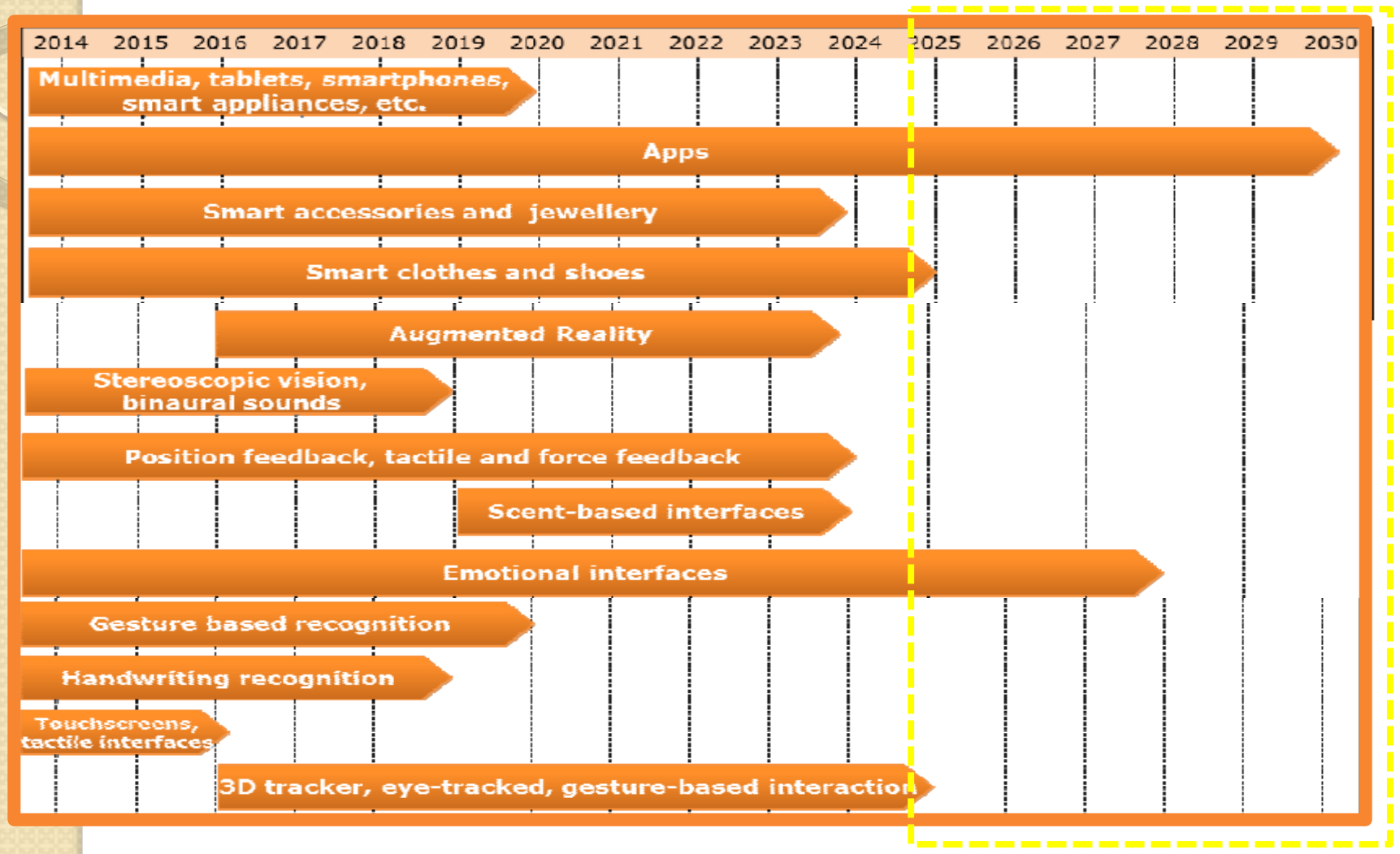
Robots based on neuroscience principles
Exoskeletons for upper and lower limbs
Autonomic devices, intelligent sensor network, augmented cognition and ambient intelligence
Social Robotics
Cloud Robotics

KET RM: interacting

- Smart appliances, multimedia, apps, smart accessories and smart clothes
- Sensorial interfaces
- Spatial interfaces
- Natural language interfaces
- Multi-modal interfaces
- Neural interfaces and Brain Computer Interfaces (BCIs)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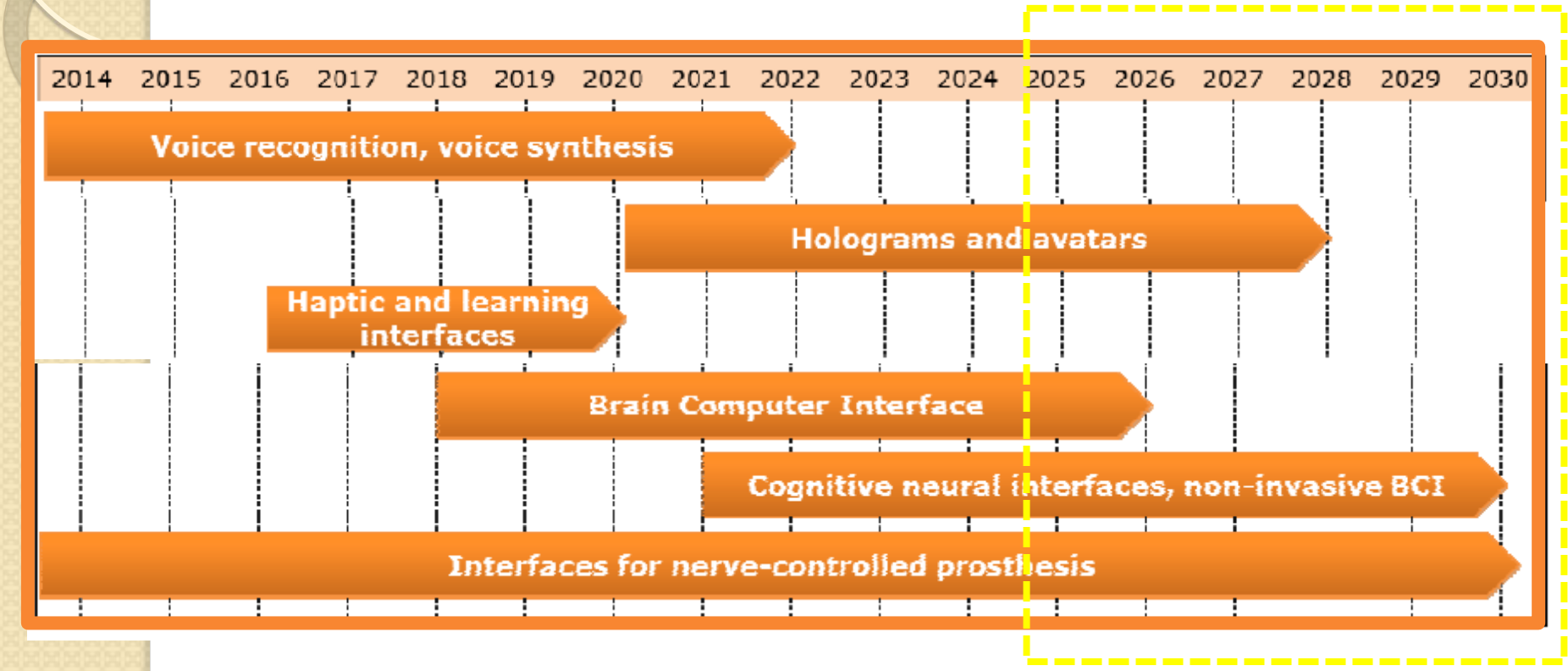
Multimedia, tablets, smartphones, smart appliances, etc.
Apps
Smart accessories and jewellery
Smart clothes and shoes
Augmented Reality
Stereoscopic vision, binaural sounds
Position feedback, tactile and force feedback
Scent-based interfaces
Emotional interfaces
Gesture based recognition
Handwriting recognition
Touchscreens, tactile interfaces
3D tracker, eye-tracked, gesture-based interaction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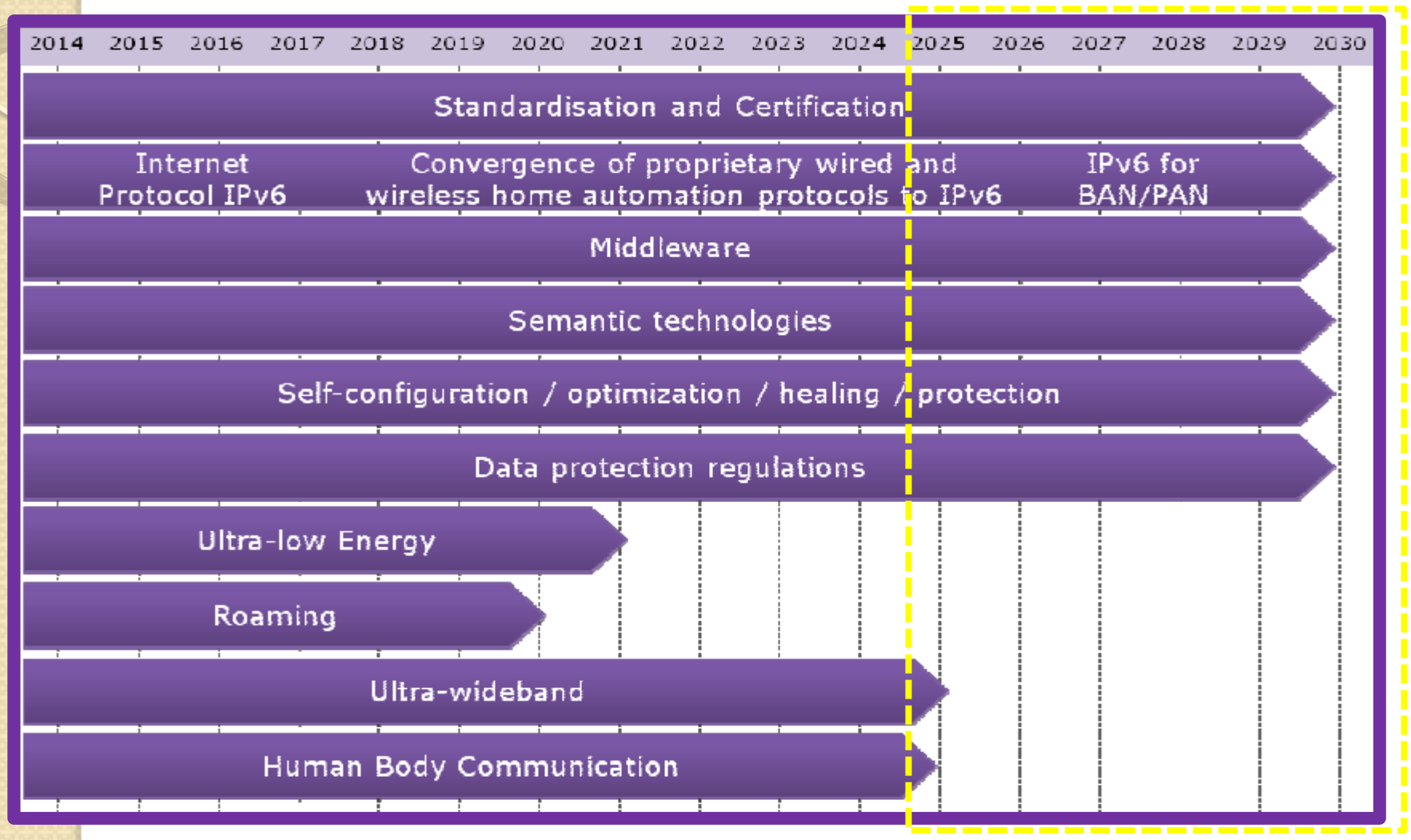
Voice recognition, voice synthesis
Holograms and avatars
Haptic and learning interfaces
Brain Computer Interface
Cognitive neural interfaces, non-invasive BCI
Interfaces for nerve-controlled prosthesis

KET RM: communicating

- General aspects of communicating
- Body/Personal Area Network (BAN/PAN)
- Local Area Network (LAN) / Home Network
- Wide Area Network (WAN)


2014
2015
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2030
Standardisation and Certification
Internet Protocol IPv6
Convergence of proprietary wired and wireless home automation protocols to IPv6
IPv6 for BAN/PAN
Middleware
Semantic technologies
Self-configuration / optimization / healing / protection
Data protection regulations
Ultra-low Energy
Roaming
Ultra-wideband
Human Body Communication

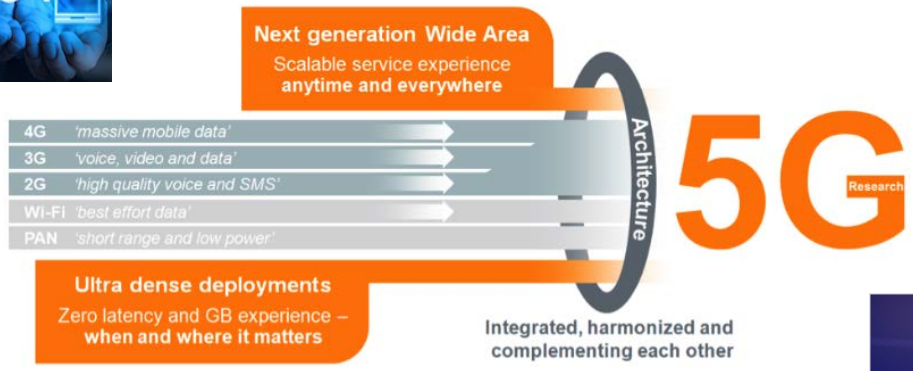
Trends

- The **wearable wireless device** market is growing with the advances in wireless communication technology, either using short range or cellular radio
- **mHealth**: more than 97.000 health & fitness – related mobile apps available. Doctors are encouraging the use of mHealth
- Service and domestic **robotics** market is increasing

Future innovations…

M2M communications and IoT for AAL

Social & Cloud Robotics, Tactile internet



Next Generation Wireless Communications

Personalised and Connected Health

Big Data, Analytics, Deep Learning, Predictive systems

…and still open issues

- New technologies needed (energy-efficient design, deep learning, virtualization, low power devices…)
- Fragmented approaches, scalability
- Device interoperability within verticals, cross-vertical interoperability
- Standards proliferation (which means no standard)
- Privacy & security concerns, shared requirements and tools for security
- Socio-ethical implications (e.g. in tracking and geo-location through wearable sensors…)
- New policies and integrated service models

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Telecommunication Systems Team

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cost
EUROPEAN COOPERATION
IN SCIENCE AND TECHNOLOGY

Review of research roadmaps on AmI and AAL published in the early 2000s

Review of recent roadmaps on AAL

Open discussion on the expectances of past roadmaps

Open discussion on the expectances on AAL for the next decades

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EUROPEAN COOPERATION
IN SCIENCE AND TECHNOLOGY

What will AAL and ELE be like in the next 10 to 20 years

Nuno Garcia, Chair AAPELE

St. Gallen, 28 September 2016

COST is supported by the EU Framework Programme Horizon 2020

AAPELE @ St. Gallen

- Summary
- * this is an interactive presentation
- * we will try to foresee the future
- * so… let's start!

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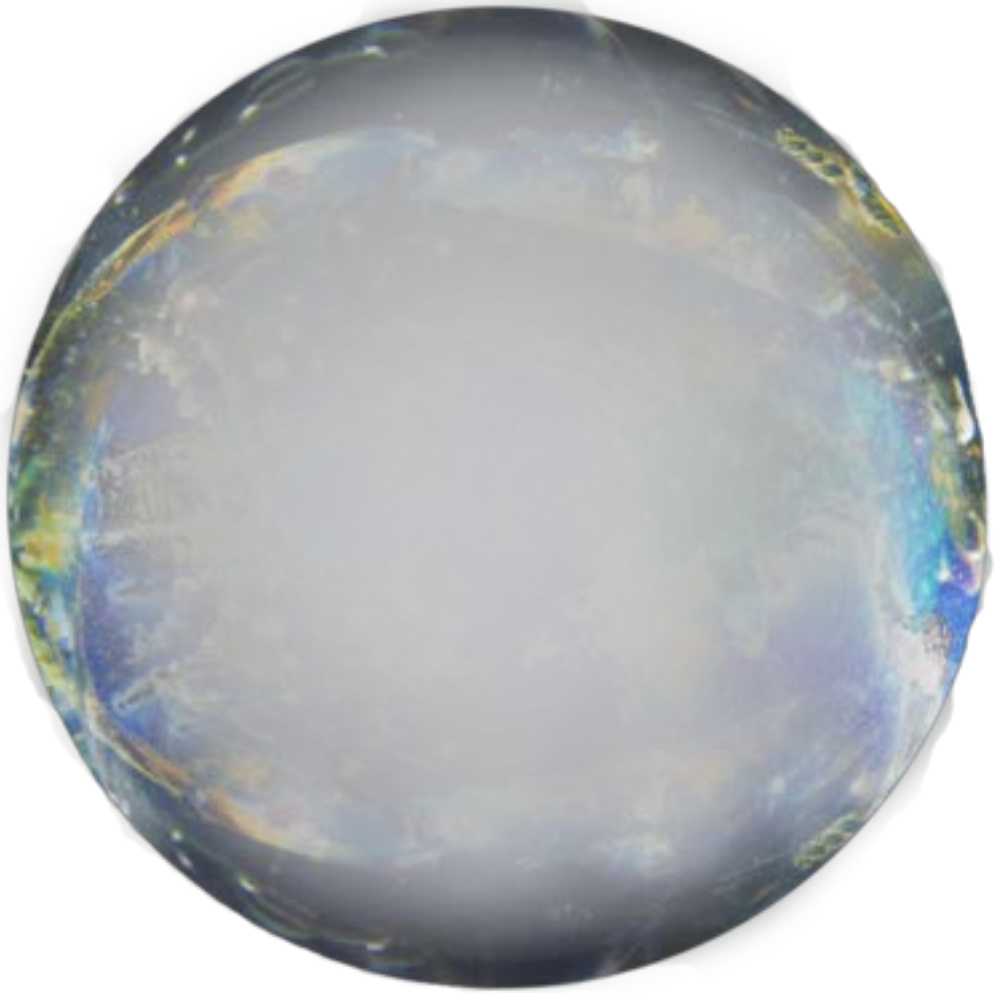
AAPELE @ St. Gallen



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- Pointers / tips / inspirational thoughts
- - Moore's Law
- - self powered devices and sensors
- - long lasting batteries
- - personal big data
- - fora in social networks (disease / lifestyle related)
- - digital lifestyle coaches
- - mobile computing (on-body computing)
- - will there be humans in the loop? (is AAL/ELE humanless?)
- - …
- - (please help to complete)

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AAPELE @ St. Gallen

- Taking into account what we have seen, let's now all work.

- Goal: to create a story of an AAL user living in the year of 2030.
- Task 1: create a "persona". Who is your user? How old is he/she? Does he/she still work?
- Task 2: describe a day in that person's life. What is it to be her/him in 2030?
- Task 3: What is the role of AAL/ELE technology in that user's life?

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- Conclusions:

- (to be completed by all)

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