

# All Sensors: The Networks of the Future?

## **Moderator**

Reinhardt Karnapke, BTU Cottbus, Germany

## **Panelists**

Arndt Steinke, CiS Forschungsinstitut für Mikrosensorik und  
Photovoltaik GmbH, Germany

Manuela Vieira, CTS-ISEL, Portugal

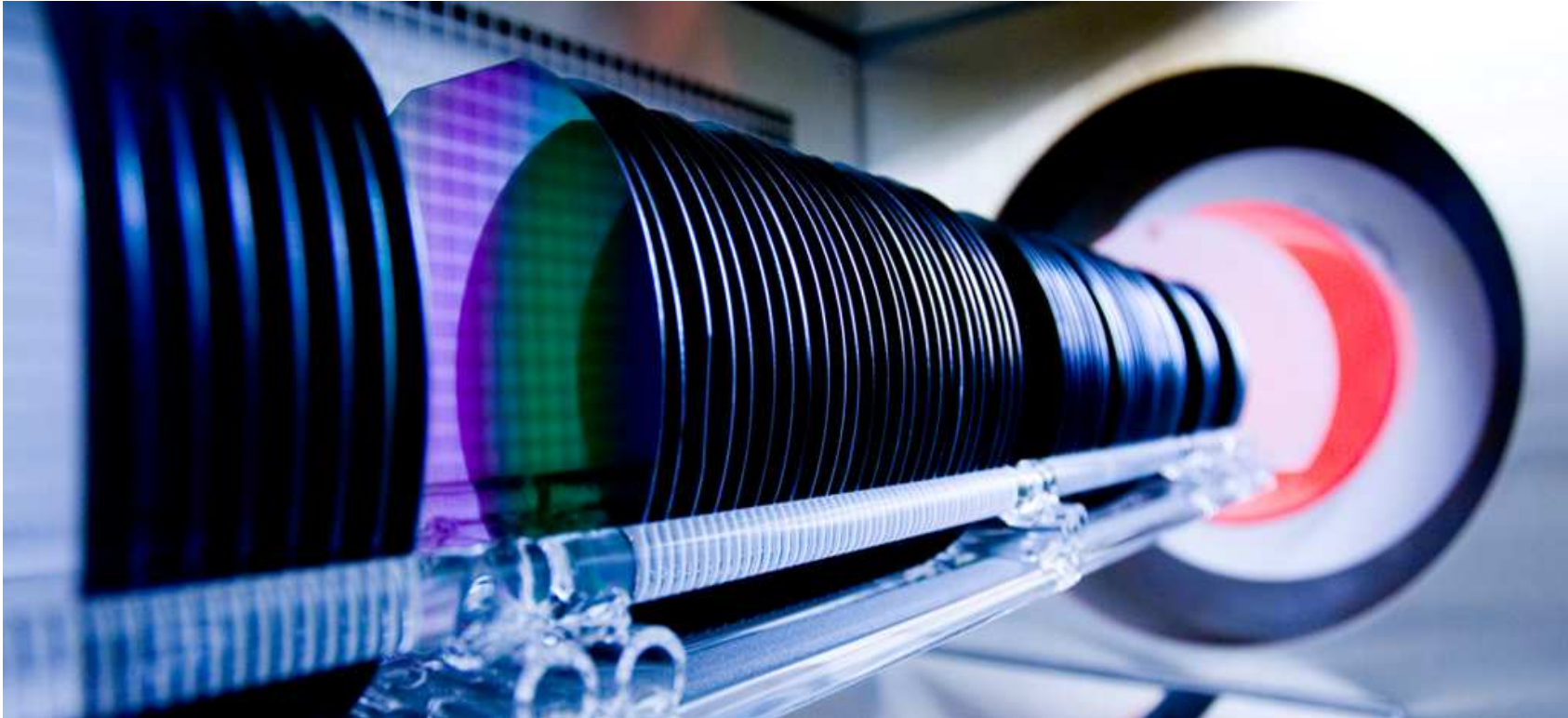
Tapio Saarelainen, National Defence University, Finland

Sergey Yurish, Excelera, S. L., Spain

Vítor Carvalho, Minho University, Portugal

# All Sensors: The Networks of the Future?

- The Future
  - Impossible to know, hard to predict
  - Moore's Law holds
- All Sensors
  - Getting smaller
  - Integrated in cars, houses, phones ...
- Networks
  - Developing communication protocols challenging
  - Hierarchical networks, IoT



**Panel on SENSORCOMM/SENSORDEVICES TOPIC: All Sensors**

**Sensor Platforms – The solution for fast market entrance of Research Results**

Arndt Steinke



# The expectations of SME`s for smart sensor systems



- CiS practical experiences -



## Sensor components for

- \*integrated optical encoder sensor
- \*integrated dew point sensor
- \*radiation detector
- \*reflective pulse oximeter
- \*pressure sensor
- \*roughness sensor
- \*optical hybrid encoder sensor
- \*optoelectronical pO<sub>2</sub>-sensor
- \*optoelectronical NH<sub>3</sub>- sensor
- \*particle sensor

Most important demands of our customer SMEs and larger enterprises

- High performance parameters
- Low volume/low cost
- Innovation in system components
- Fast market entrance

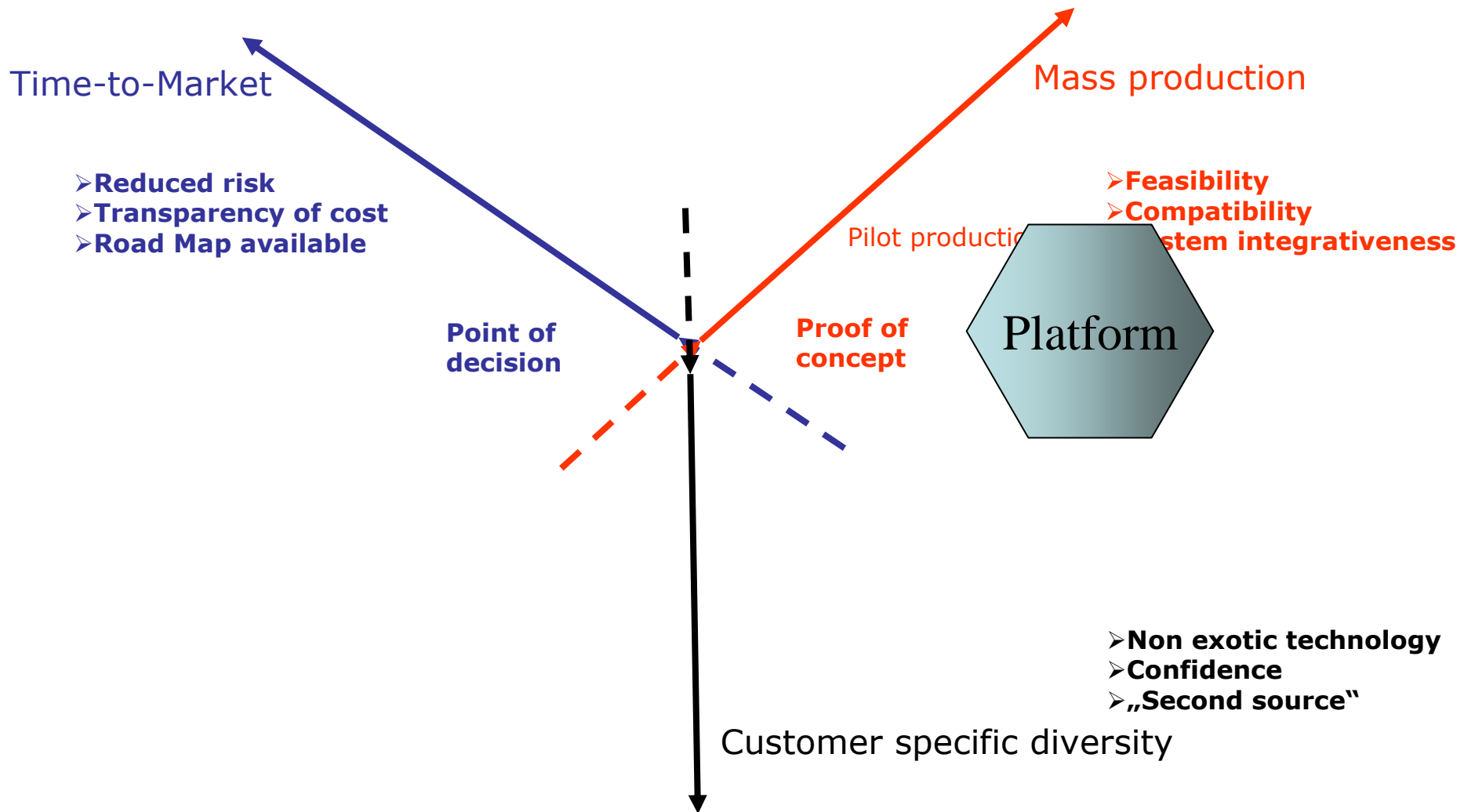
**Solution ?** lessons learnt from microelectronics - basic technologies (*platform*)  
 - step-by-step (*innovation*)  
 - shorter cycles („1,5" years)



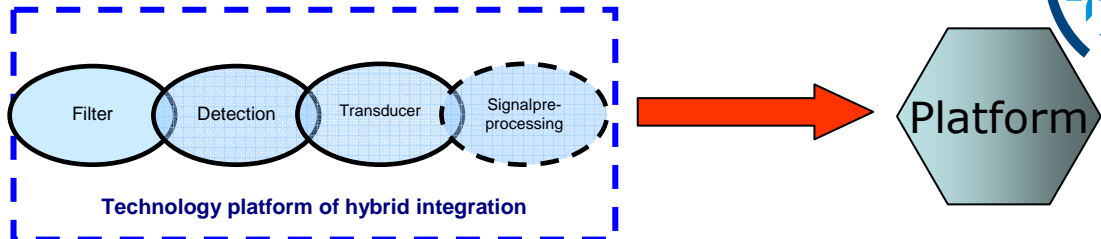
# The necessity and specifics of sensor platforms



What are our SMEs looking for?



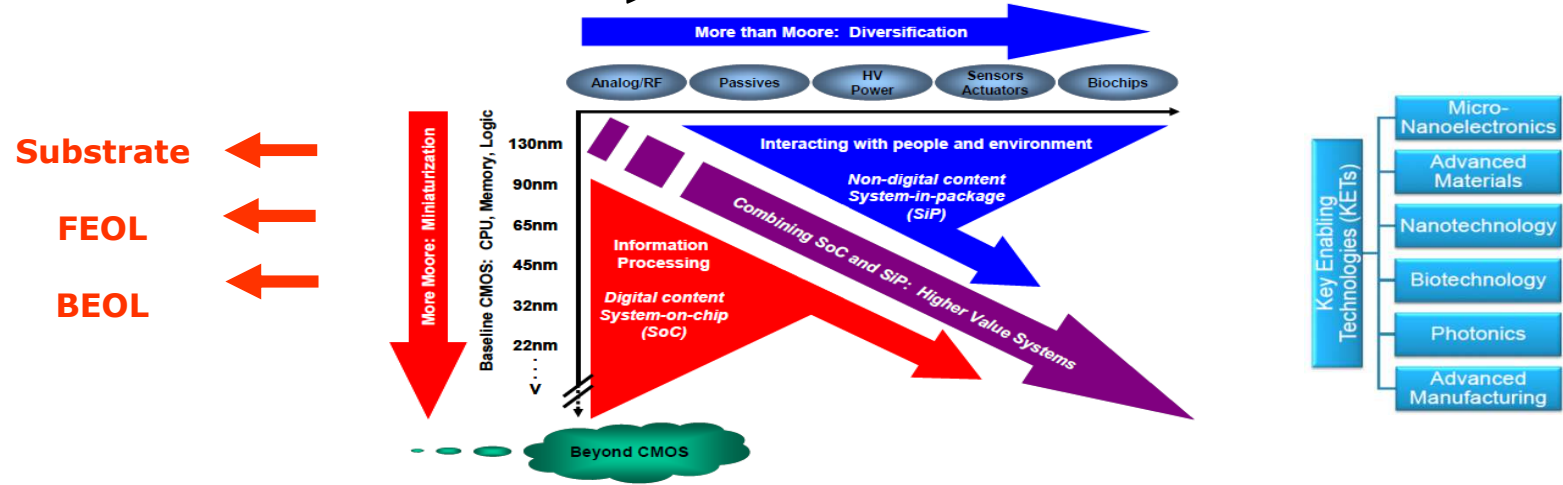
# The necessity and specifics of sensor platforms



**Technology**

**Integration potential**

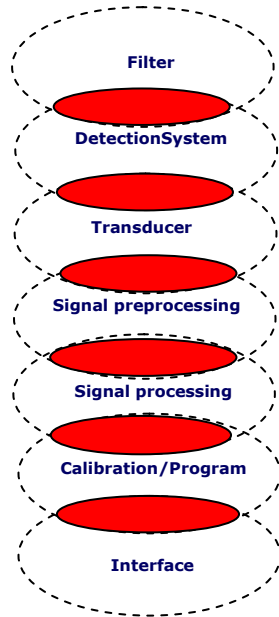
**Technological modules**



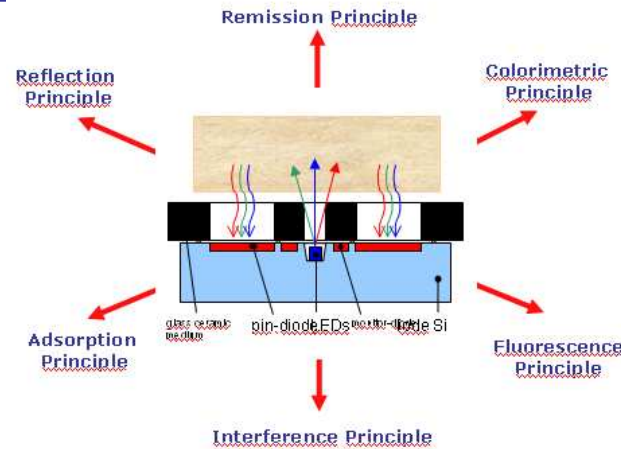
# The experiences with sensor platforms



## Sensor system

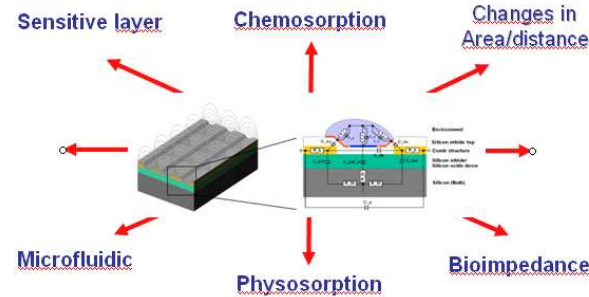


MORES™  
microoptical  
remission sensor



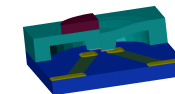
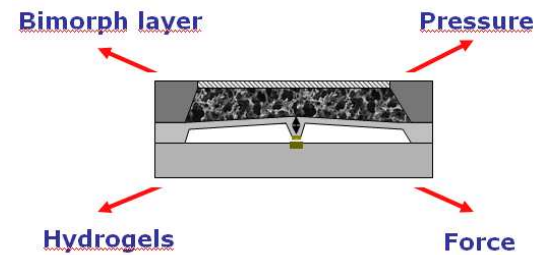
Example:  
Bubble level sensor

CCC™  
condensate controlled  
capacitance



Example:  
Dew point sensor

BiZEPS™  
bistable zero power  
sensor



Example:  
Hygostat



- The results presented underline the strategy that an open (technological, commercial and international) platform has a high leverage for SMEs` strength
- With an open technology platform consisting of basic technology and building blocks the consideration of M-M and M-t-M technologies is possible and necessary

**Let`s talk about it!**



***Thank you very much for your attention***

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**[www.cismst.de](http://www.cismst.de)**



**All Sensors: The Networks of the Future**

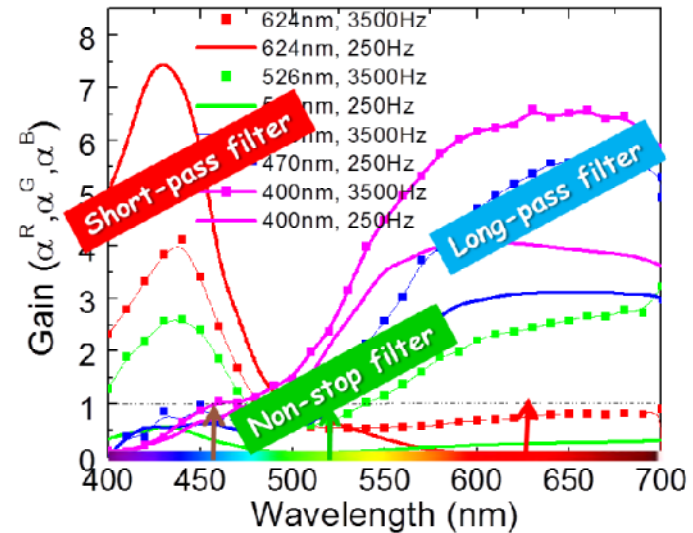
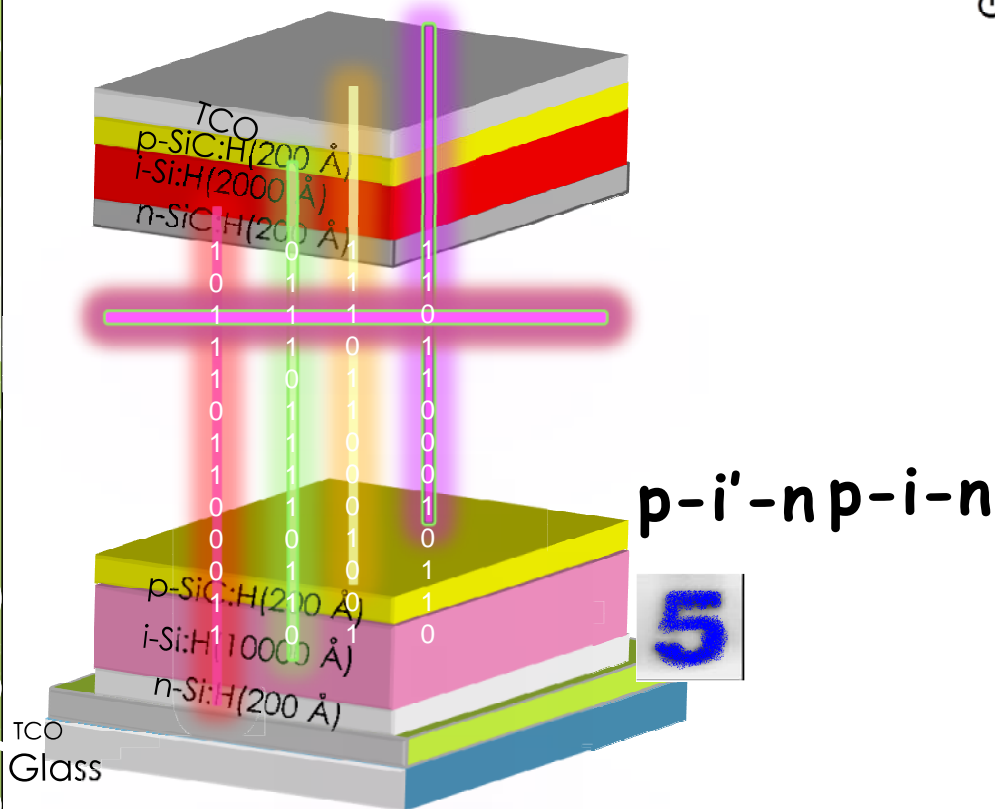
**By:  
Manuela Vieira  
CTS-UNINOVA**



# **Visible Light Communication**

**Wireless Communication  
Using Light**

- Coder/decoder device
- Visible Light Communication;

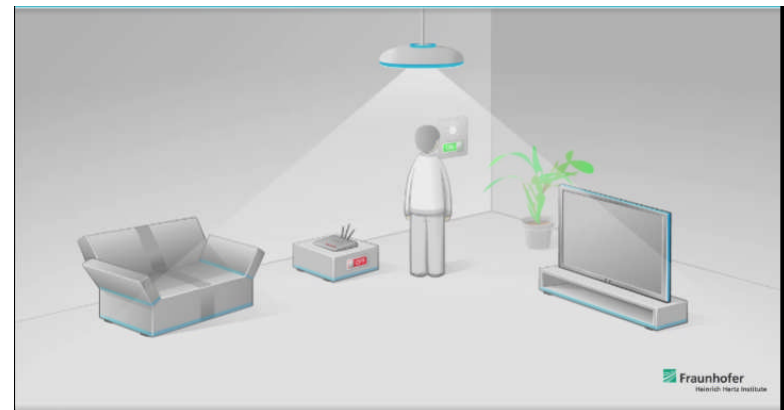


- Light-to-dark sensitivity depends on the **carbon concentration**
- Color recognition depends on the **applied bias**
- Light filtering depends on the **bias wavelength and side**
- WDM device **RGB** channels;

# Introduction

- Visible Light Communication is a **data communication medium** using visible light;
- Lighting is a **major source** of electric energy;
- General Characteristics:

Visibility  
Security  
Harmless for human body  
Unregulated  
Used in restricted areas



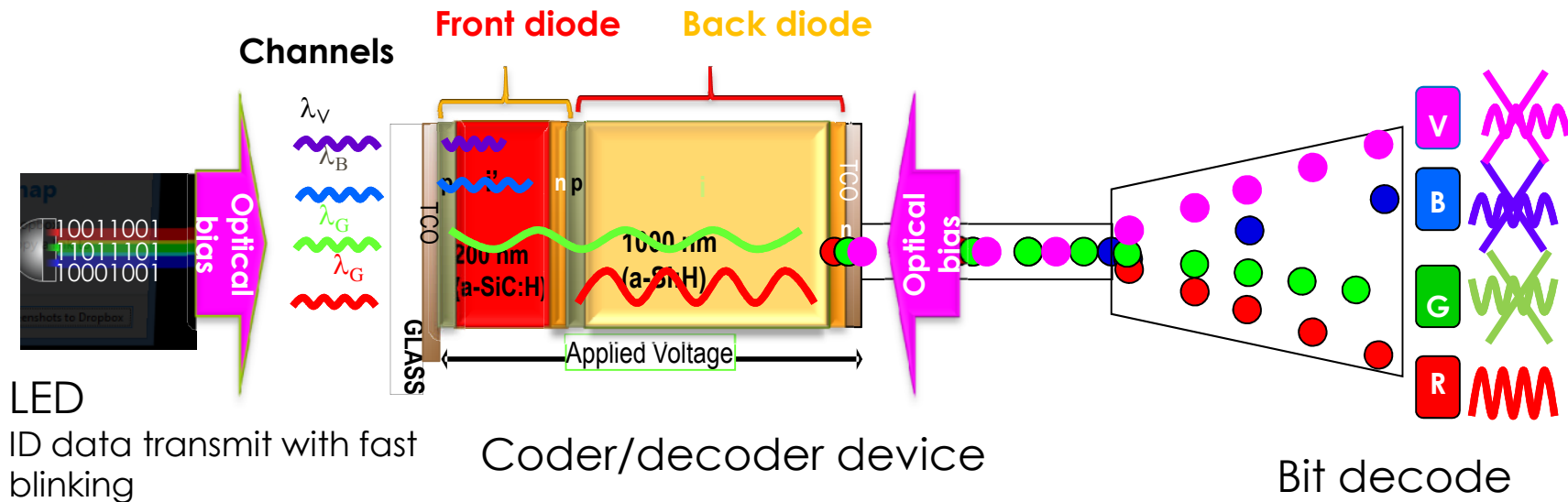
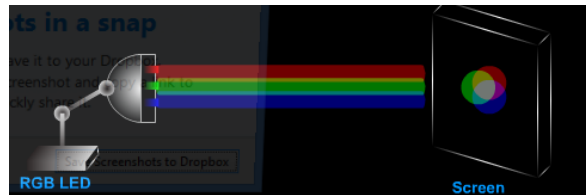
# Motivation

- WLED devices could be used for wireless purposes.
- LEDs are cheaper than Radio Frequency.
- Optical wireless allows easy bandwidth reuse and improve security.
- It does not generate RF contamination.
- RF radiation in hospital and airplanes will be vanished
- Large amount of **energy can be saved.**



# Transmitter / Receiver of VLC

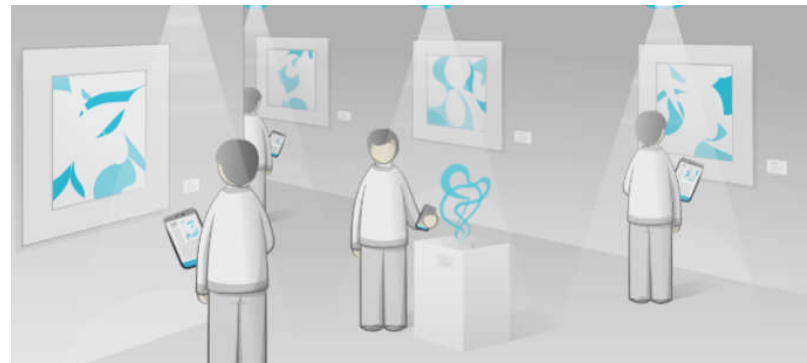
- Visible light LED
- Fluorescent lamps
- Single or double p-i-n photodetectors
- Image sensors





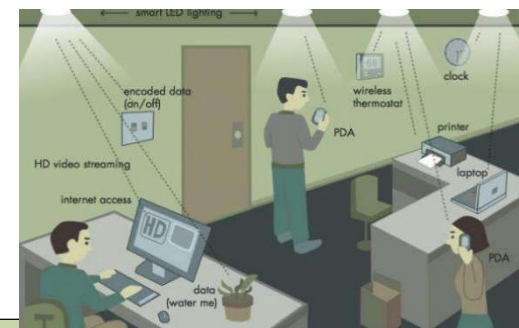
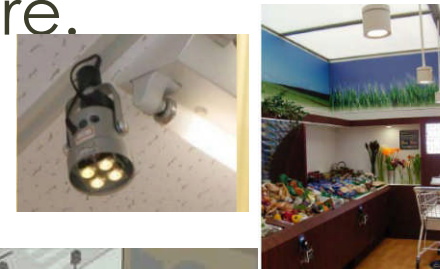
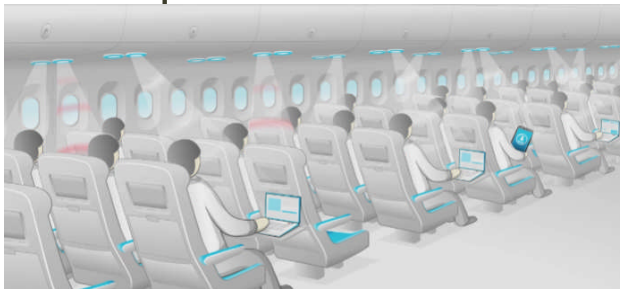
# Advantages/Disadvantages

- Transmit data by sockets of existing high equipment.
- Less problems associated with RF communication systems.
- Consume less energy
- Security.
- Harmless for human body.
- Atmospheric absorption.
- Shadowing.
- Beam dispersion.
- Interferences from background light sources.



# Applications

- Under water communication systems.
- Flow planning survey systems for a store.
- Inside airplane communications.
- Vehicle to vehicle messaging.
- Indoor broadcasting system.



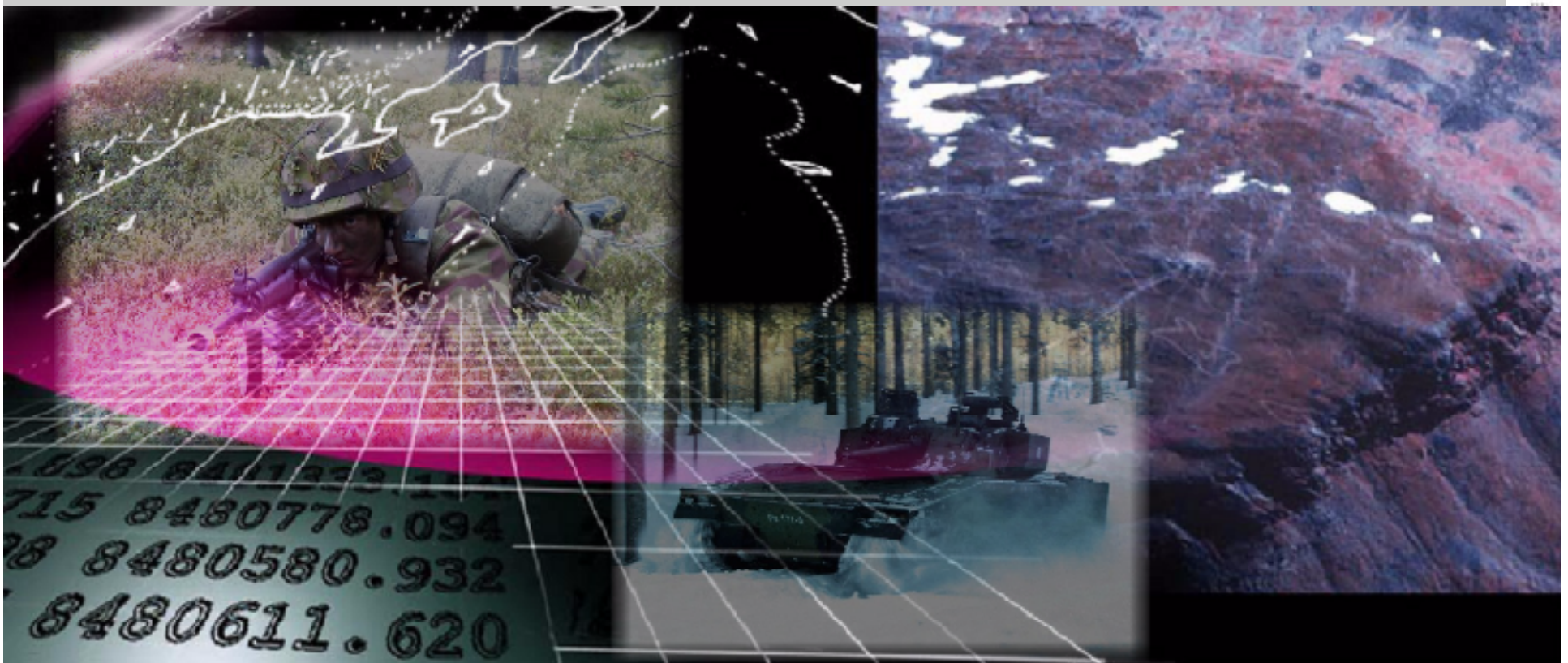


# Army Academy

## *Networks in the Battlespace*

Panel presentation, SENSORCOMM/ IARIA, 20.11.2014

Major Tapio Saarelainen, PhD, IARIA FELLOW





# 1. Every Soldier is a Sensor

## Gathering big data from:

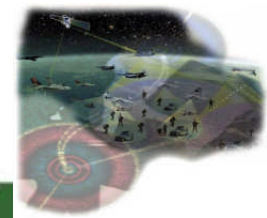
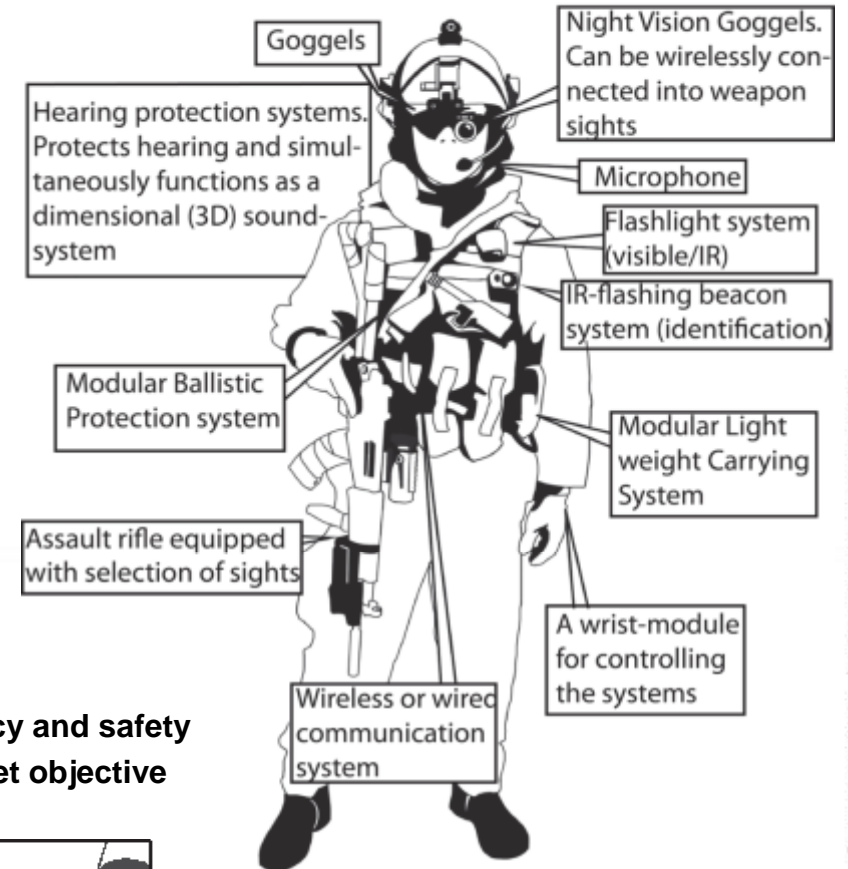
1. Soldier him/herself via biometric sensors, internal (heart-rate, activity, performance, level of sleep, level of nutrition)
2. Soldier him/herself via embedded sensors in Battle Dress Uniform (levels and types of radiation, sensing temperature, pace of a soldier, direction, location)
3. Connecting soldiers to ubiquitous network systems (automatic/remote/manually) → data for higher echelons

## GOAL:

1. Capability to command and to be commanded
2. Instant relevant data in two ways -> operational efficiency and safety
3. Sustainability in operations and possibility to achieve set objective



An example of current Future Force Warrior System



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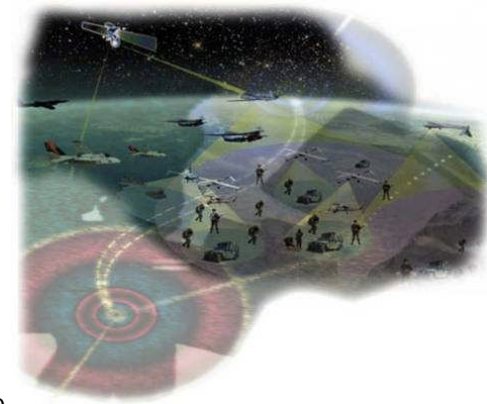
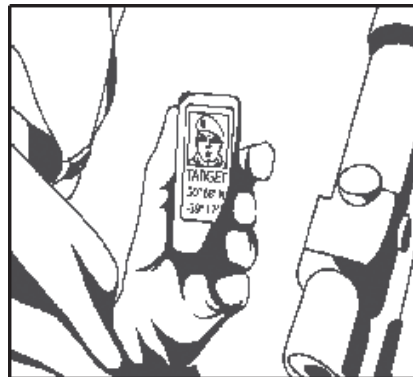




## 2. Why Networks in the Battlespace?

### GOALS for the networks:

1. Ubiquitous networks for constant communication and decision making process → computers, communication, command, control, information, intelligence, surveillance and reconnaissance (C4I2SR)
2. Forwarding data of Situational Awareness (SA) and Common Operational Picture (COP) → data for decision making!
3. Connecting soldiers to ubiquitous network systems → execution of operations
4. Providing more data and services for the soldiers → survivability
5. Connecting tactical level of operations to the higher echelon → optimizing the performance, minimizing fratricide



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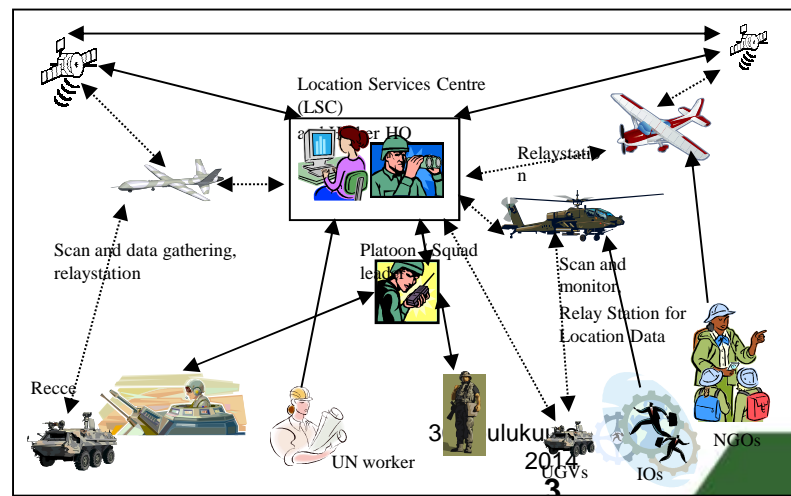
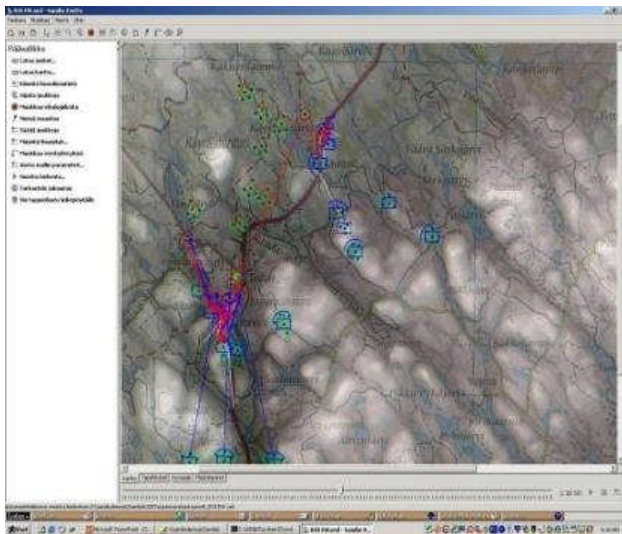
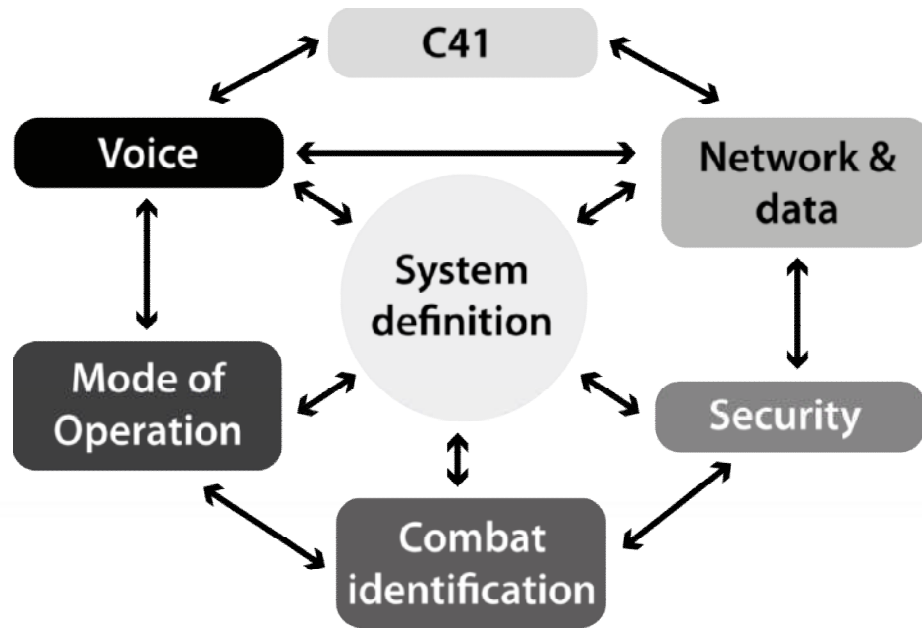






# 3. Situational Awareness for decision making process

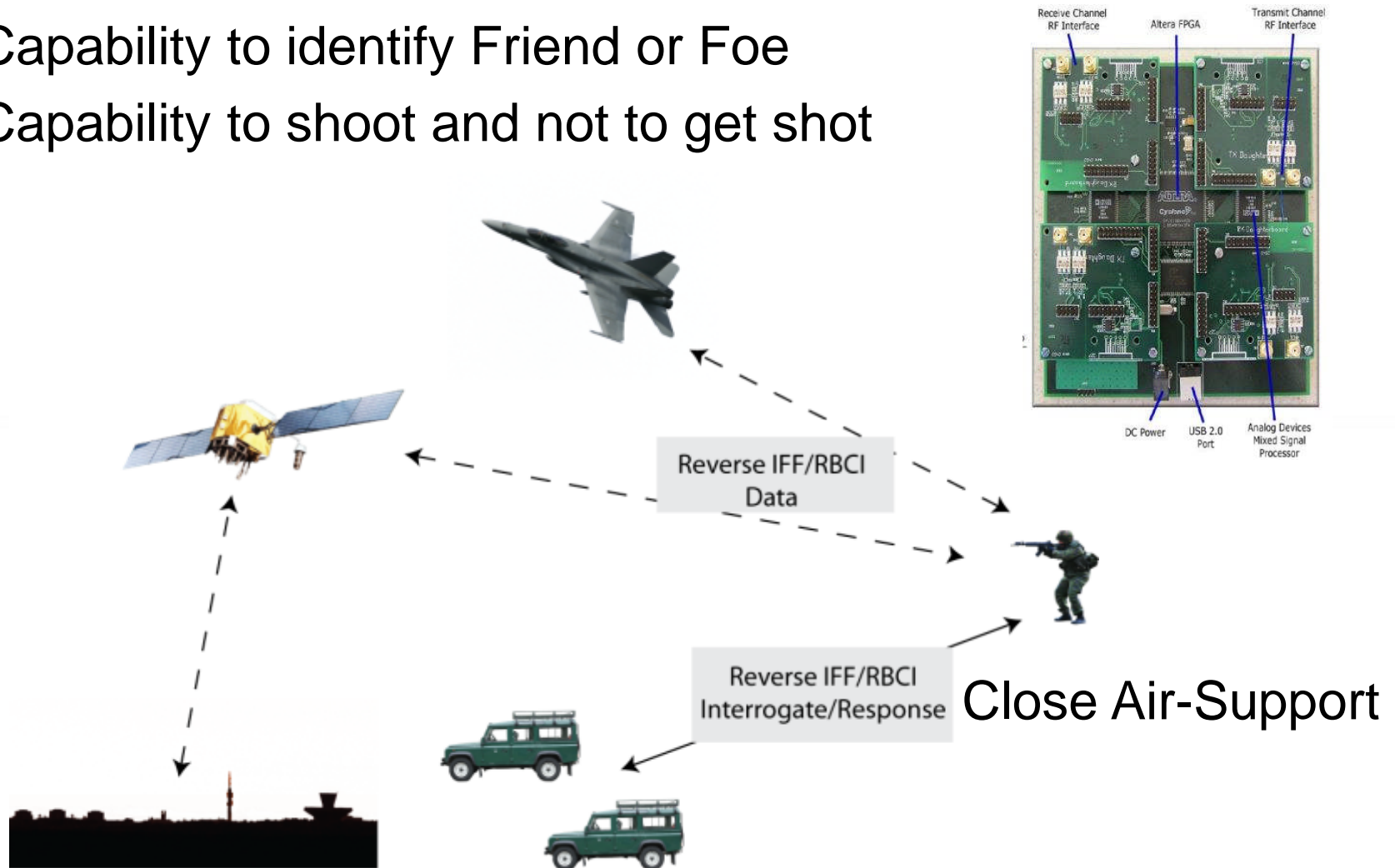
**FOCUS:**  
Capability to make reliable and timely accurate decisions





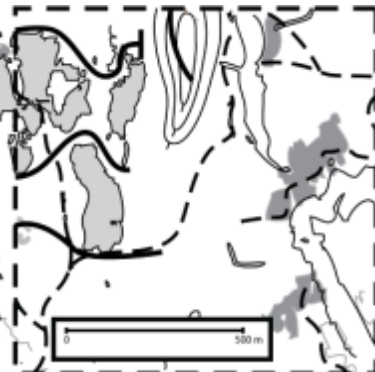
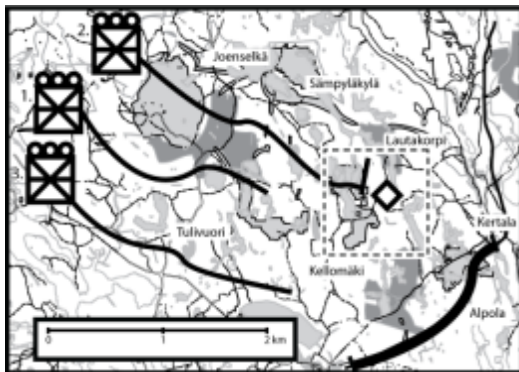
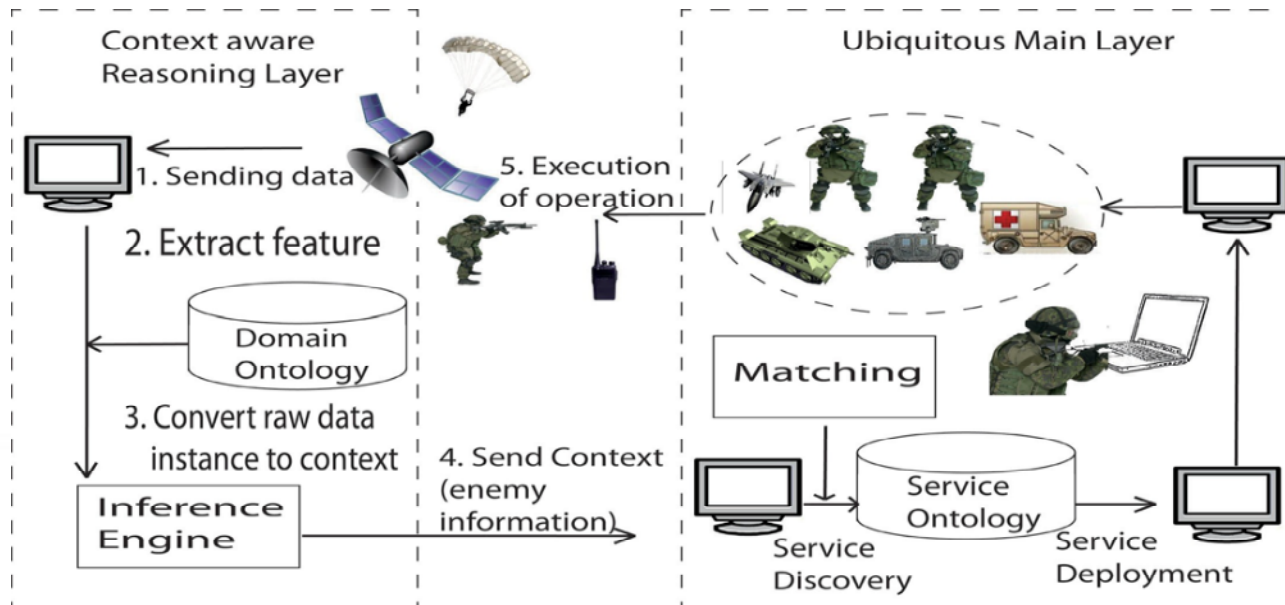
## 4. Common Operation Picture – Radio Based Combat Identification (RBCI)

- Capability to identify Friend or Foe
- Capability to shoot and not to get shot





# 5. Connecting soldiers to ubiquitous network systems - War as a Data Exchange Process





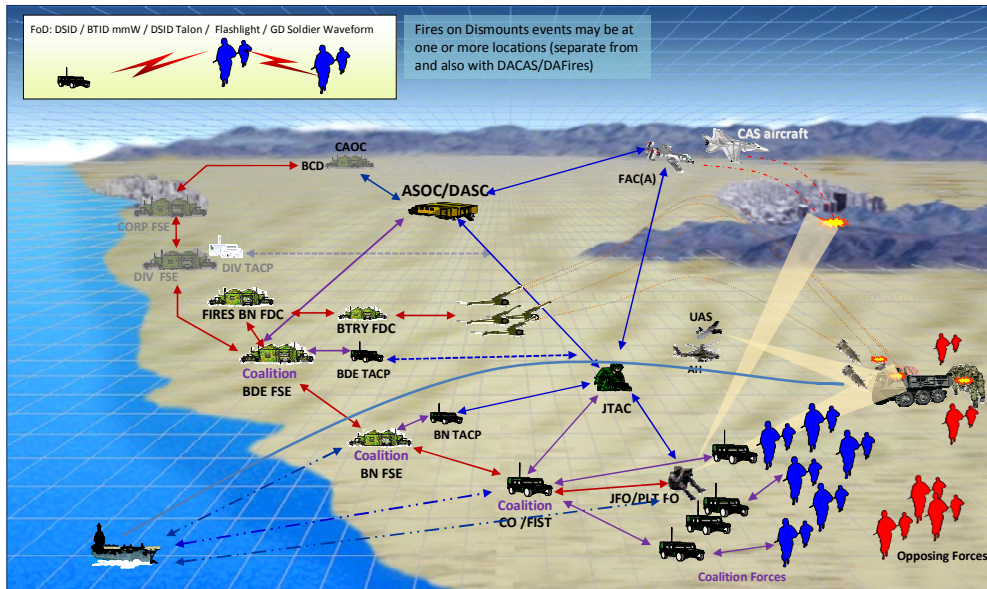


# 6. Providing more data... - Levels of Tactical Communication

DRAFT

Draft Version 4

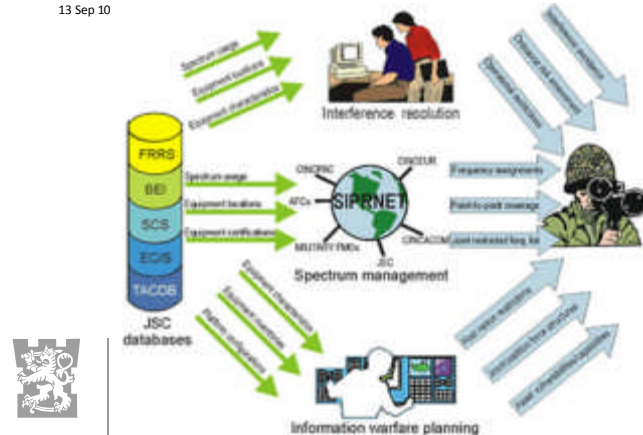
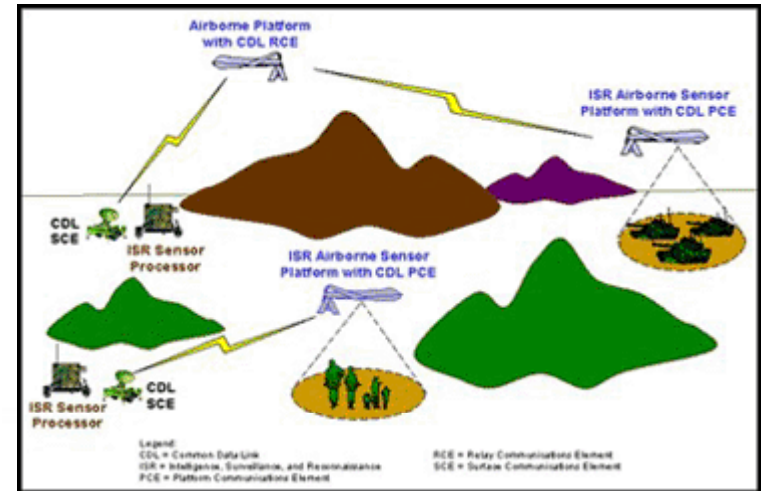
## BQ 11 DAFires/DACAS/FoD Operational View (OV-1)



Red lines = FS threads    Purple lines = Joint/Coalition threads    Blue lines = CAS threads    Blue -.- lines = Maritime threads

13 Sep 10

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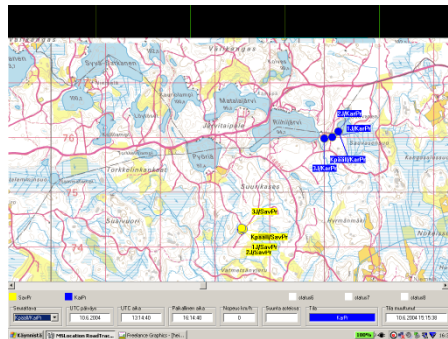
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## 7. Connecting tactical level of operations to the higher echelon - Products of Netted Battlespace

### Tactical Communication requirements for operating in Battlespace

- Situational Awareness (SA)
- Common Operational Picture (COP)
- Command and Control systems (C2)
- Identification Friend or Foe (IFF) or Blue Force Tracking (BFT)
- Capability to co-operate with UAVs and UGVs and robots
- Data from sensor to shooter
- Voice
- Navigation
- Situational Awareness
- Messaging
- Imaging
- Video
- Security



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**KIITOS**



# BEDRIDDEN PEOPLE CLOTHES FOR HEALTHCARE

SENSORDEVICES 2014

Vítor Carvalho (IPCA & Algoritmi-UM) - Portugal

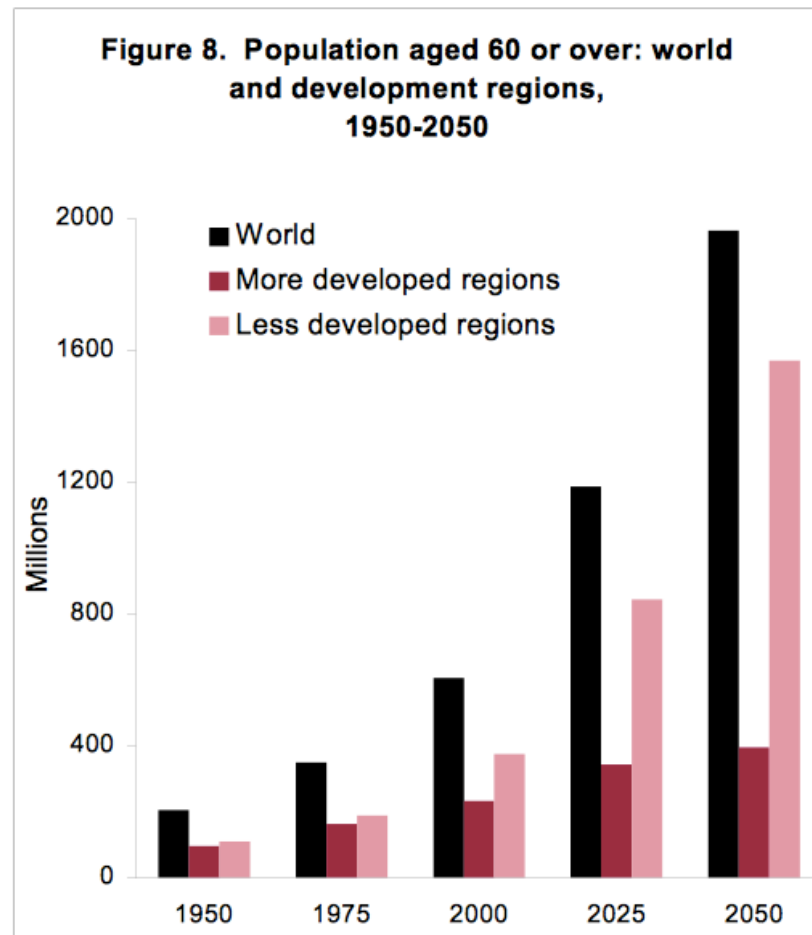
# The Problem?

2

- Demographic changes!
  - ▣ World population is getting older
  - ▣ People try to stay maximum of their life at their houses
    - Improve their comfort
    - Better quality of life
  - ▣ Requires available conditions for an efficient medical monitoring and treatment
  - ▣ Commercial systems are expensive and not affordable to most of population



# Population Aged or Over 60 Evolution



# Sensors & Daily Life Integration

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# Sensors in Smartphones

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## How Many Sensors are in a Smartphone?



- Light
- Proximity
- 2 cameras
- 3 microphones (ultrasound)
- Touch
- Position
  - GPS
  - WiFi (fingerprint)
  - Cellular (tri-lateration)
  - NFC, Bluetooth (beacons)
- Accelerometer
- Magnetometer
- Gyroscope
- Pressure
- Temperature
- Humidity

**19**

source: <http://2014.okfestival.org>



# Sensors in Smart Watches

6

## LG Watch R



### Sensors:

- Gyro
- Accelerometer
- Compass
- Heart rate monitor
- Barometer



android wear

# Sensors in Wrist-Bands

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## Microsoft Band

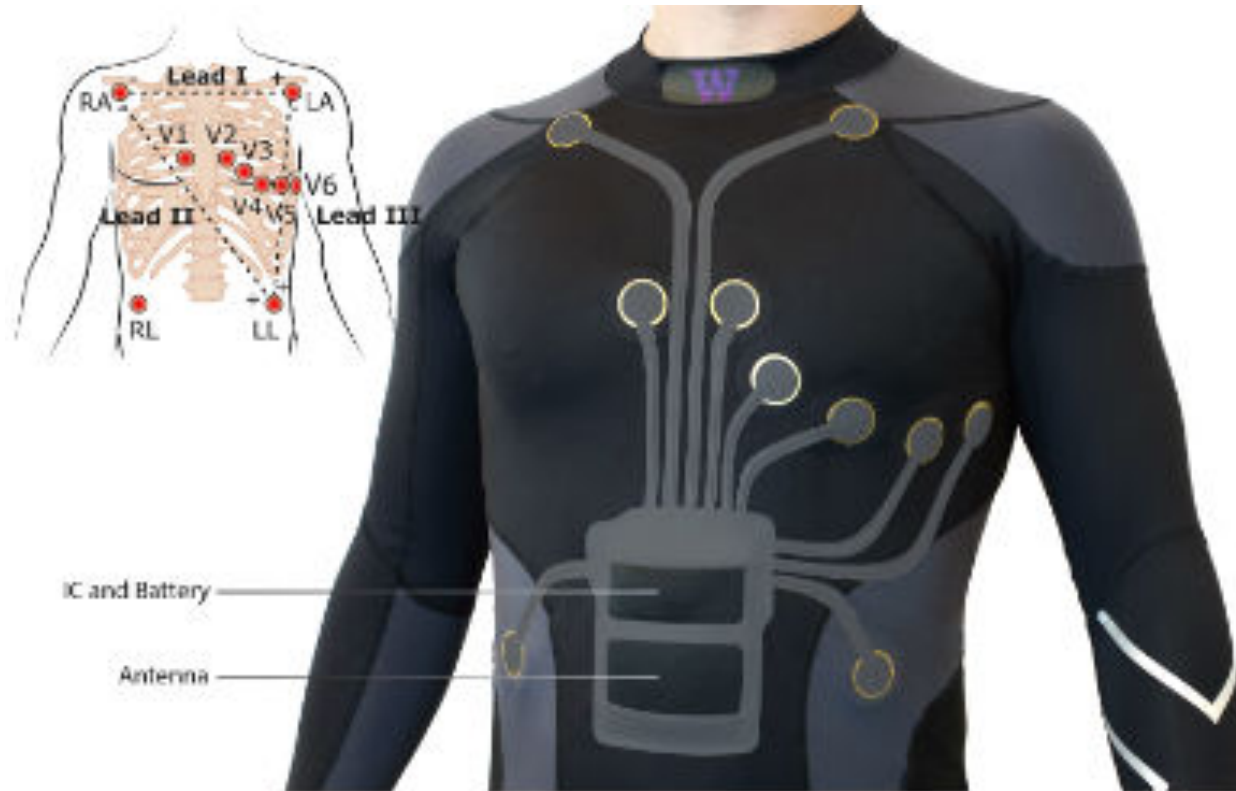


### Sensors:

- Optical heart rate sensor
- 3-axis accelerometer/gyro
- Gyrometer
- GPS
- Ambient light sensor
- Skin temperature sensor
- UV sensor
- Capacitive sensor
- Galvanic skin response
- Microphone

# Sensors in Clothes

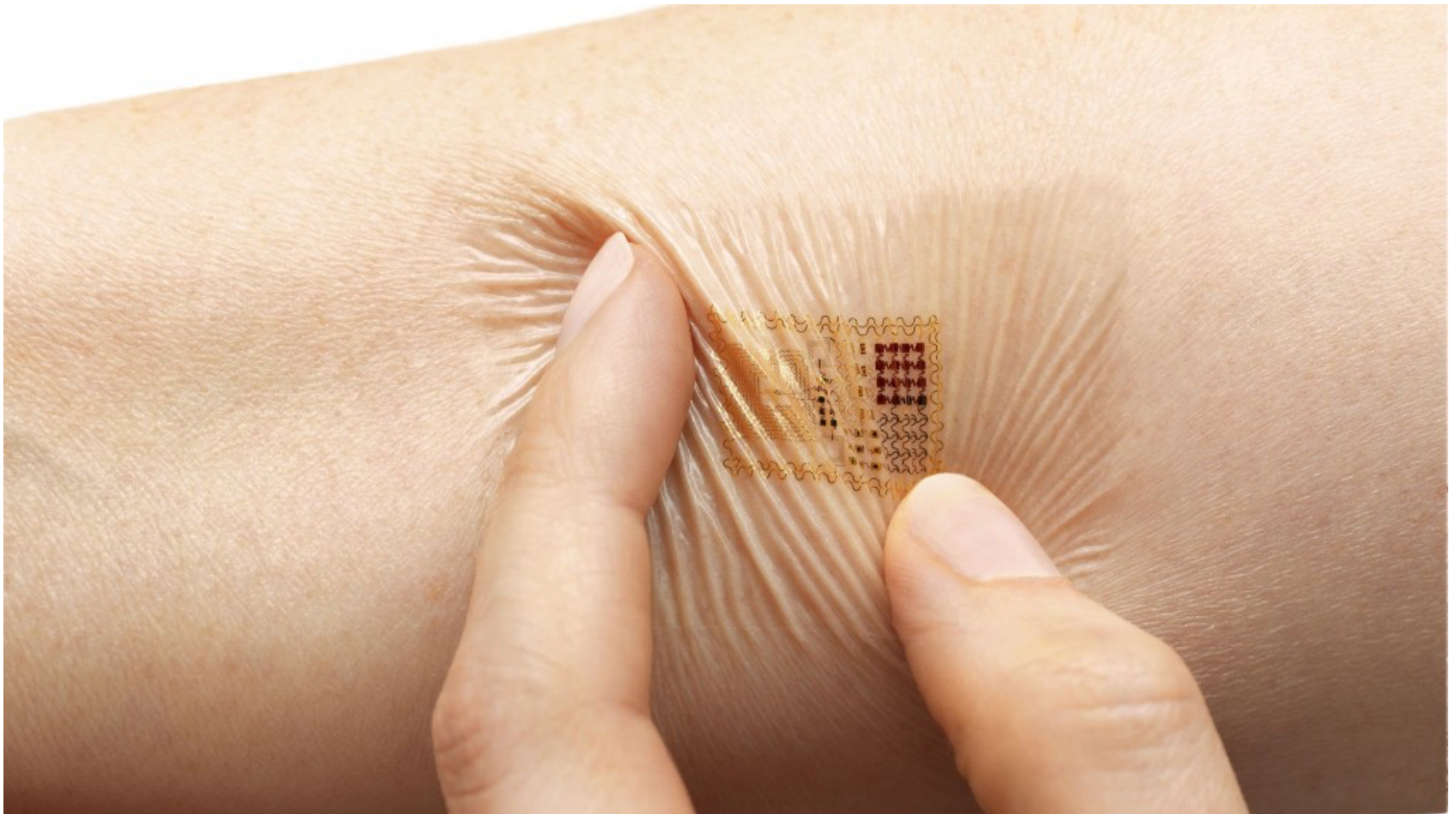
8



source: "A Single-chip Encrypted Wireless 12-Lead ECG Smart Shirt for Continuous Health Monitoring," T. Morrison et al., University of Washington

# Prototype of MC10's BioStamp Senses Temperature, Heart Rate, and Other Vital Signs

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source: <http://www.pbs.org/wgbh/nova/next/tech/week-review-draft/>

# Bedridden People – Challenge?

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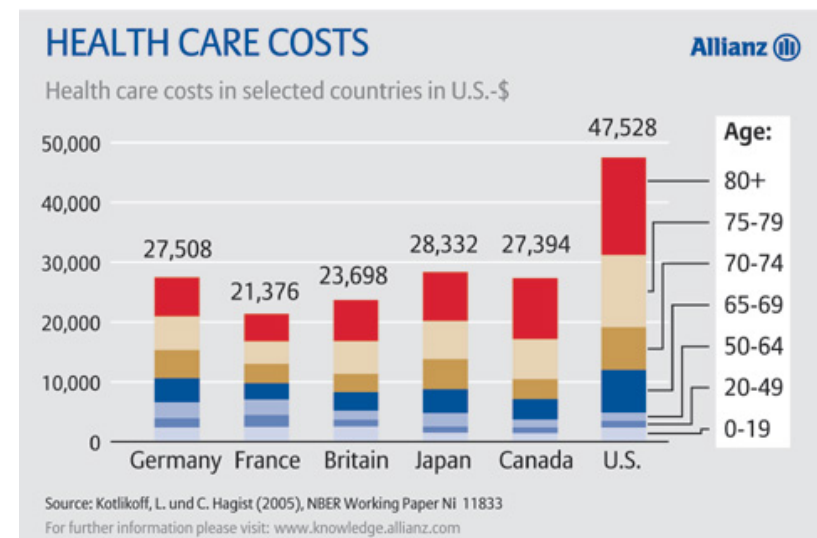
- Why not **integrate** all these already available technologies and build low cost and comfortable biomedical monitoring systems in clothes or other non invasive tools?



# Potential Advantages?

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- early diagnosis
- efficient and fast treatment
- improve comfort (patients can stay more time at their houses)
- reduce public health costs,...





# Bedridden People Clothes for Healthcare

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Thank you!

[vcarvalho@ipca.pt](mailto:vcarvalho@ipca.pt)

# **IoT: do we need a novel smart sensors and networks ?**

**Dr. Sergey Y. Yurish, R&D Director  
Excelera, S.L., Barcelona, Spain**



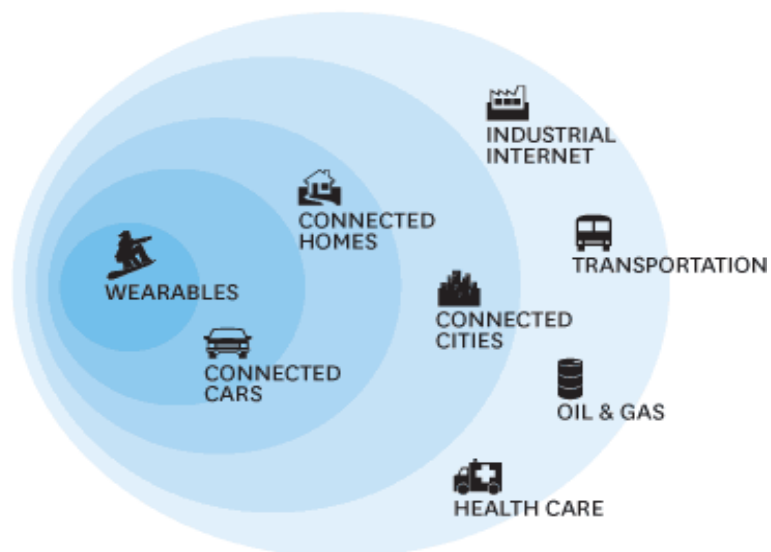
# Status and Challenges



- By 2020, sensors will link millions of objects through the Internet of Things (IoT): **212 billion** (*IDC*)
- Internet of Things market is on track to hit **\$7.1 trillion** in 2020 (*IT research agency, IDC*)
- The rapid rise of connected devices in the IoT landscape has raised security problems, big data storage, etc.

# IoT Development

THE INTERNET OF THINGS LANDSCAPE



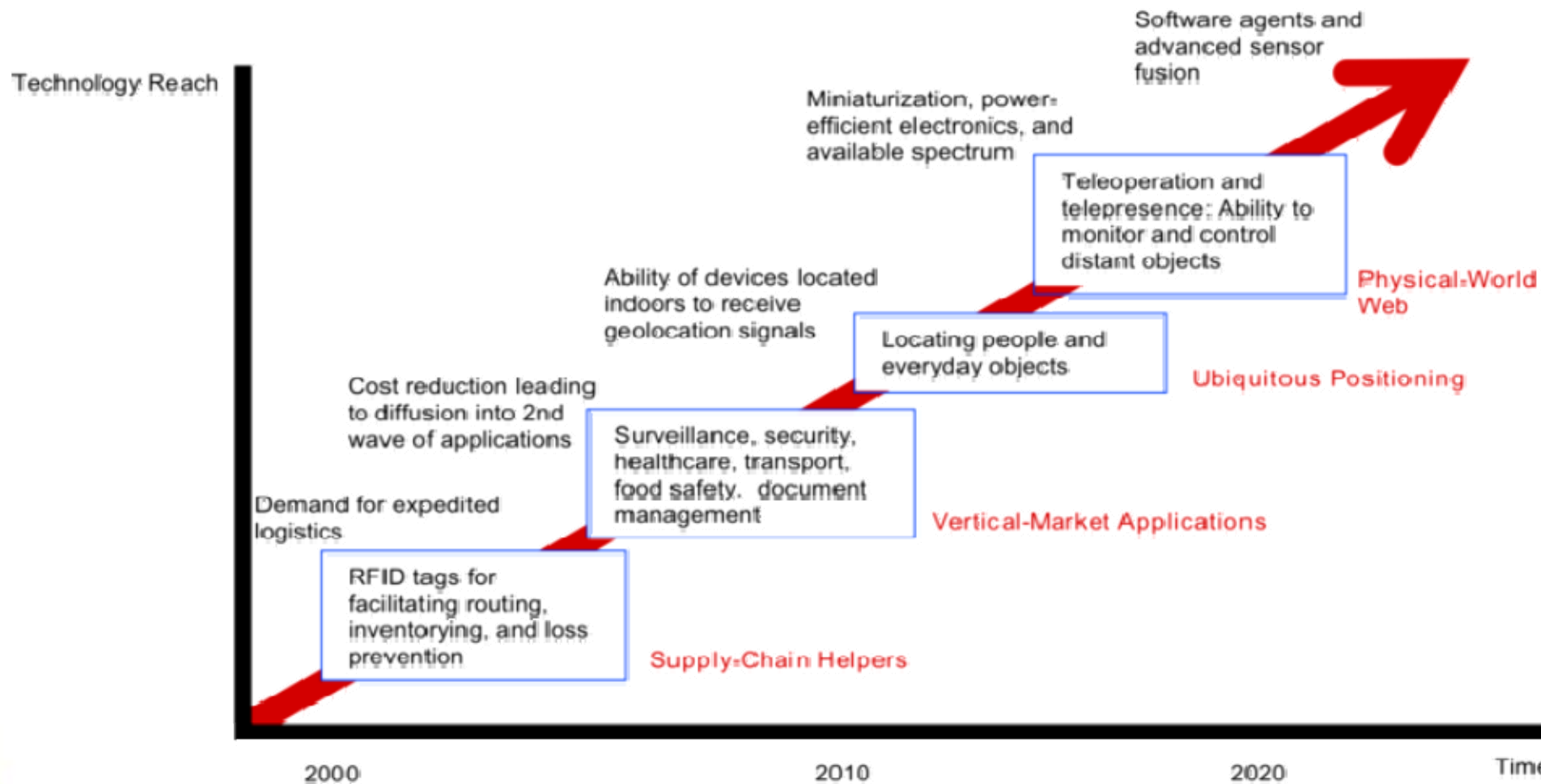
SOURCE GOLDMAN SACHS GLOBAL INVESTMENT RESEARCH

HBR.ORG

- The Internet of things: networked objects and smart devices
- IoT as a consumer driven, smart wireless device is the initial steps into a next generation of component and device cycles

# Roadmap

## TECHNOLOGY ROADMAP: THE INTERNET OF THINGS



Source: SRI Consulting Business Intelligence



# New Challenges to be Faced



- Market players will need innovative electronics components as well as specific know-how related to IoT
- IoT needs an intelligent interconnection of everyday objects
- IoT: smart, intelligent objects + intelligent, remote communication
- Systems are becoming intelligent
- Others ?