



Conference

INTERNET OF THINGS ENABLING TECHNOLOGIES FROM VIRTUAL NETWORKS AND CLOUD COMPUTING TO SMART INTEGRATED COMMUNICATION SYSTEMS

CONNECTING EVERYTHING, EVERYTIME, EVERYWHERE
THE TECHNOLOGY BEHIND IOT



Dr. Ovidiu Vermesan, SINTEF, Norway

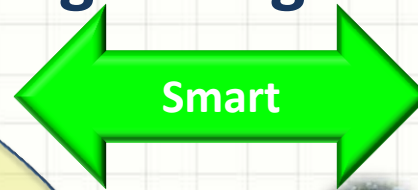
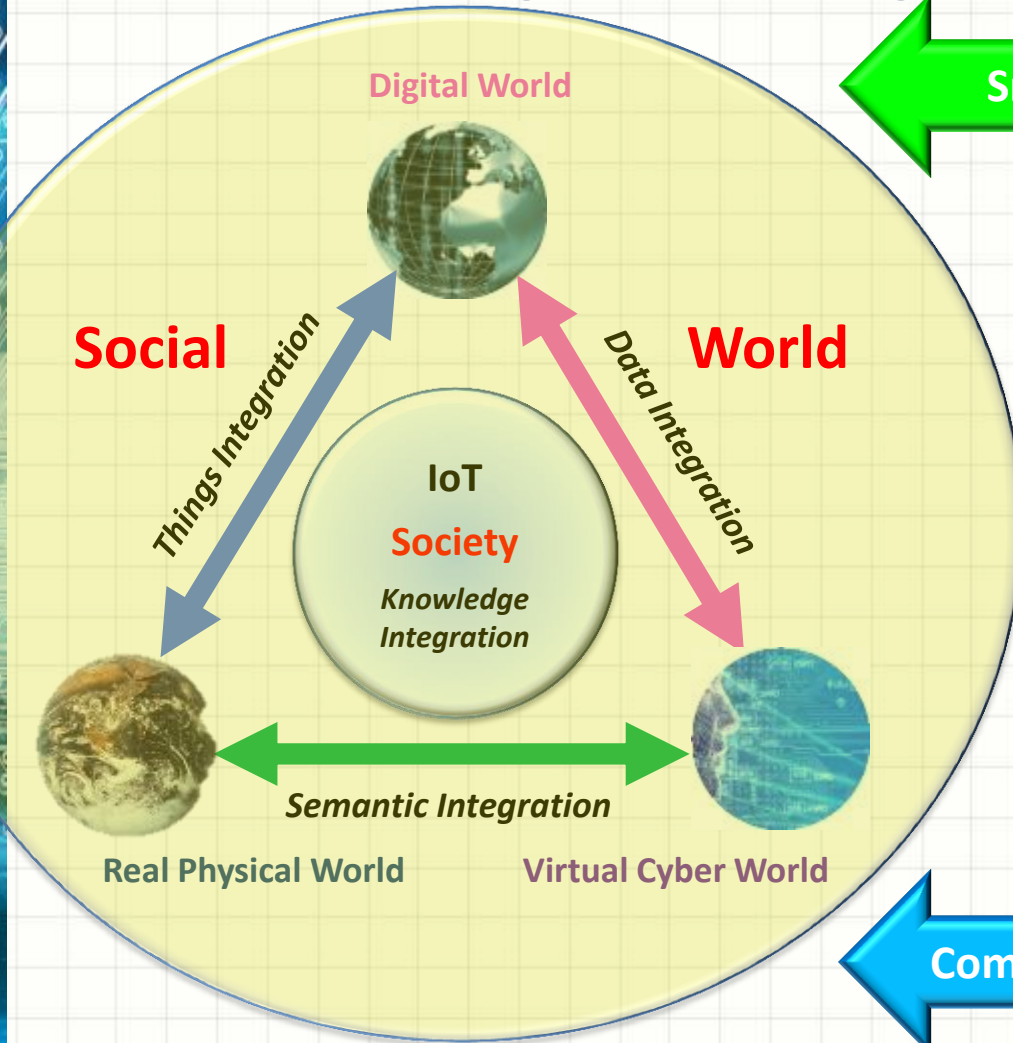
02nd of April, 2014

09:0-17:00, Telenor, Oslo, Norway.

Auditorium Voice, Telenor Expo,
Snarøyveien 30, 1331 Fornebu



Internet of Things: Knowledge Integration



Smart



Smart Transport

ITS, HEVs, EVs

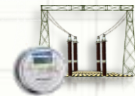
- Electric Mobility, EVs and HEVs
- High Speed Trains
- Infrastructure, V2I, V2V, V2I+I



Smart Cities

Connected Communities

- Lighting, water management
- Monitoring & security
- Traffic control



Smart Energy

Electric Grid

- Voltage and power sensors
- Meters and breakers
- Fault detection



Smart Buildings

Buildings, Smart Homes

- Thermostats, HVAC, lighting
- Presence sensors, lockers, actuators
- Meters, smart-plugs, HEC



Smart Industry

Industrial Environments

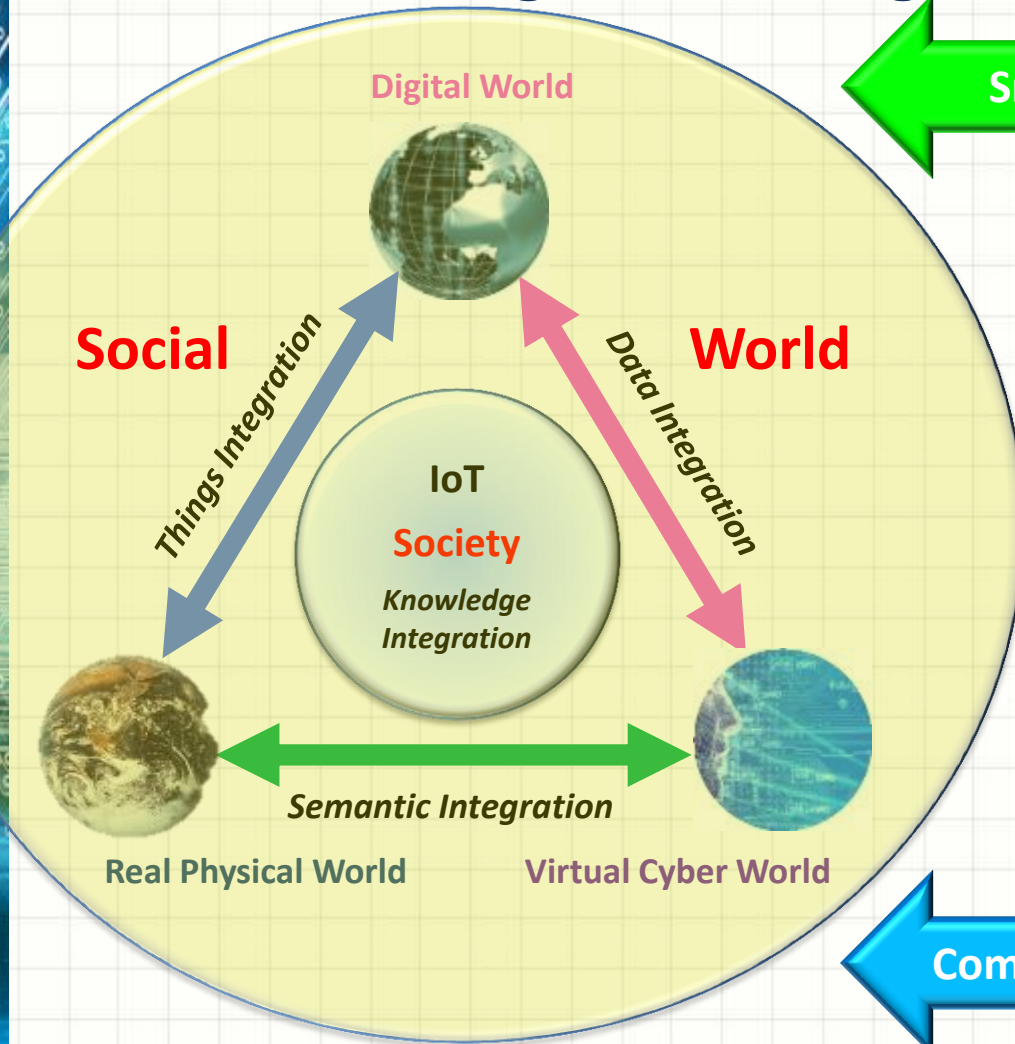
- Lightning, security, actuators
- Production control
- Robotics



Community



Internet of Things: Knowledge Integration



Smart Planet

Green Environment

- Environmental sensors
- Water, power leak detection
- Pollution, weather monitoring



Smart Living

Entertaining, Leisure

- Independence through technology
- Information when you need it
- Connected when you need it



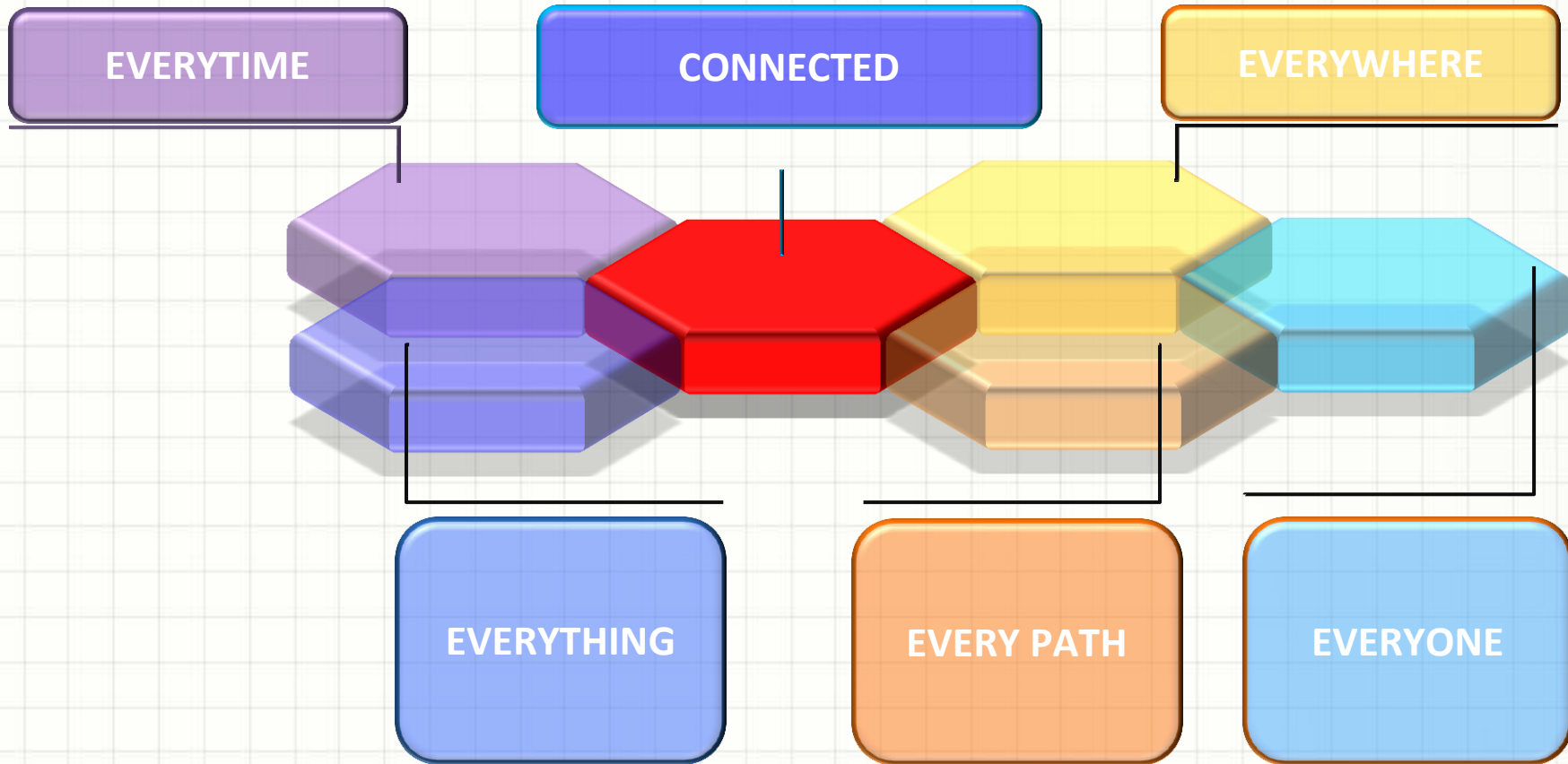
Smart Health

Healthcare System

- People monitoring
- Bio sensors, probes
- Remote health



Internet of Things





IoT Value Chain



KNOWLEDGE CREATION

Data aggregation
Cloud computing
Event management
Data processing

FUTURE NETWORKS

Software Defined Networks
Network Overlay, Virtualization
Seamless Service
Self-Management

SENSORS NETWORKS

Networks
Topology
Protocols/Standards
Re-configurability
Security.

SEMICONDUCTORS ELECTRONICS

Technology
Components, Circuits
Processors, μ Cs, NoC
More Moore
More than Moore

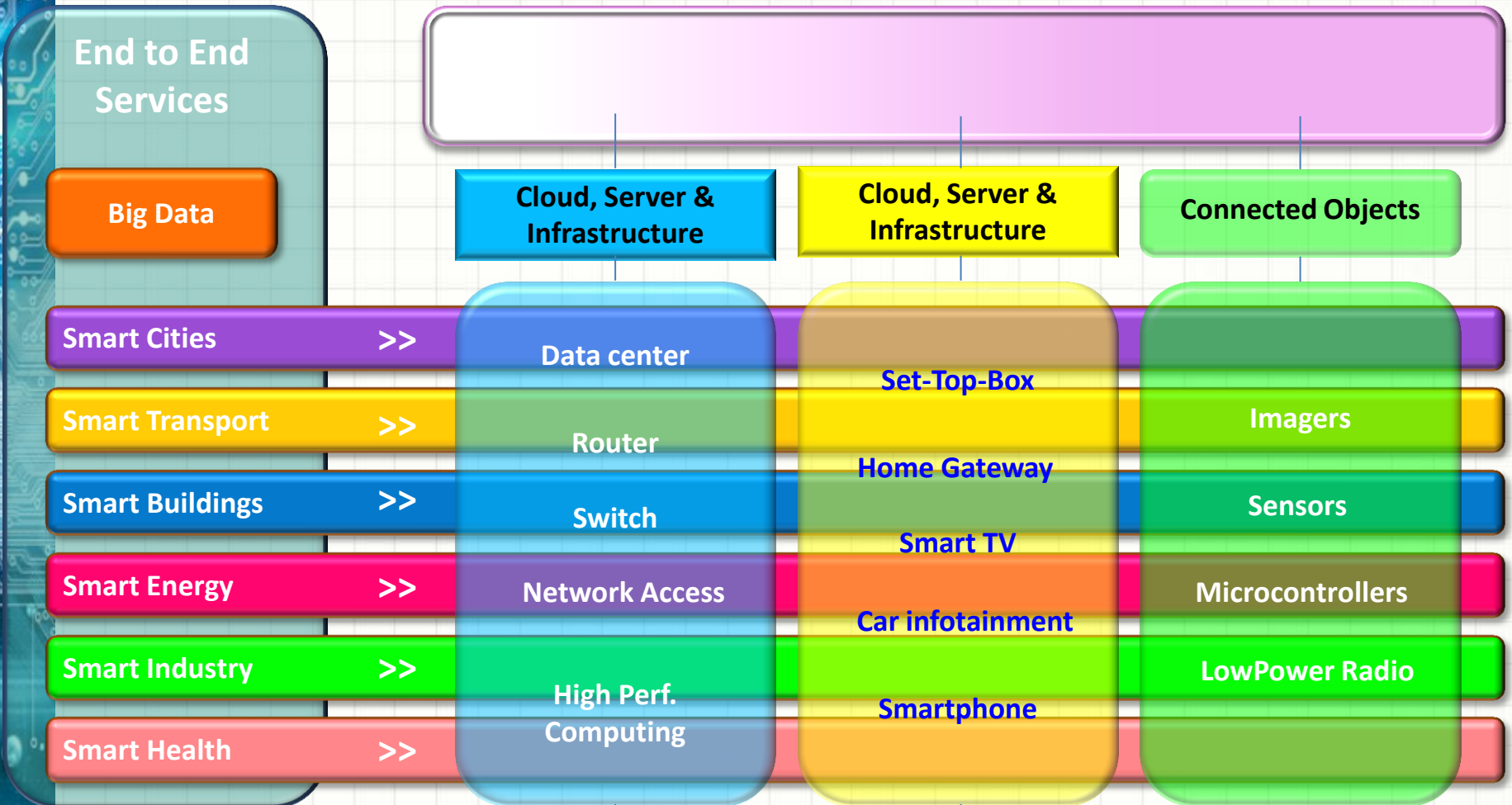
SENSORS ACTUATORS

Micro sensors
Nano sensors
Bio sensors
Lab on chip
Actuators





Internet of Things 2D Matrix





Internet of Things 3D Matrix

Security

Privacy

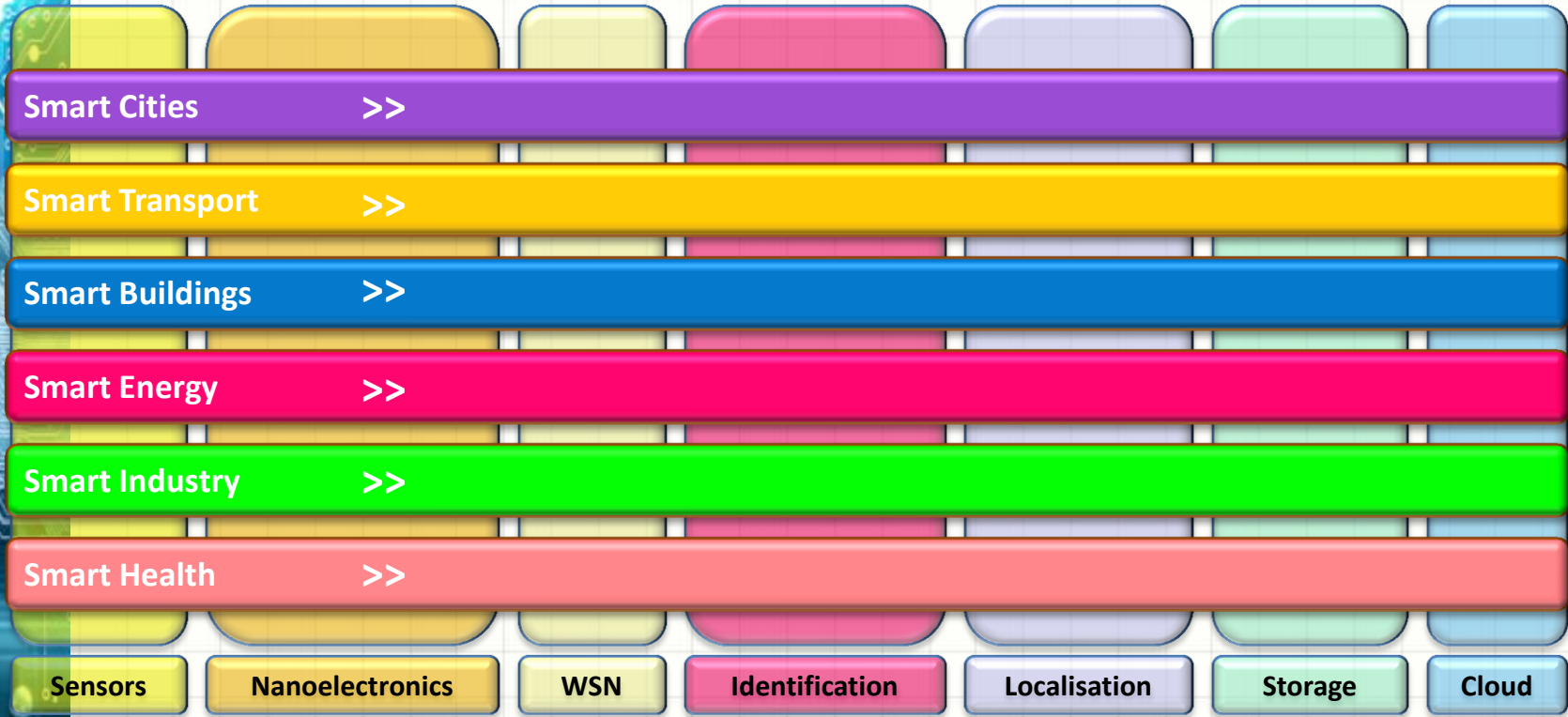
Safety

Integrity

Trust

Dependability

Transparency



Applications
Services
Domains

Enabling Technologies



IoT Model

Smart Cities

Smart Buildings

Smart Transport

Smart Energy

Smart Health

Smart Living

Application layer

IoT Applications

Service support and Application support layer

Generic Support

Specific Support

Network layer

Networking Capabilities

Transport Capabilities

Device layer

Devices

Gateways

Management Capabilities

Generic Management Capabilities
Specific Management Capabilities

Security Capabilities

Generic Security Capabilities
Specific Security Capabilities



IoT Technology Challenges

- ❖ **Connectivity:** Ubiquitous access to broadband (e.g. deployment of 3G/4G/5G networks)
- ❖ **Object identification:** Simple, unobtrusive and cost-effective system of identification
- ❖ **Real-time information:** Automated data collection from devices (e.g. sensors, actuators);
- ❖ **Smart devices:** Embedded intelligence and processing capabilities in devices (e.g. smart technologies);
- ❖ **Small scale and low power:** Advances miniaturization (e.g. nanotechnology, nanoelectronics)



Future Networks – 5G Scenarios

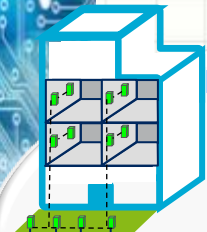
Works in a Crowd

Best Experience Follows the User

Super Real-time and Reliable Connections

Ubiquitous Things Communicating

Ultra Fast



Dense Urban Information Society

Virtual Reality Office

Shopping Mall

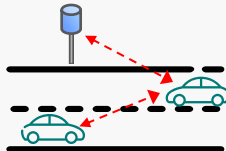


Stadium

Open Air Festival

Traffic Jam

Mobile Cloud Processing



Blind Spots

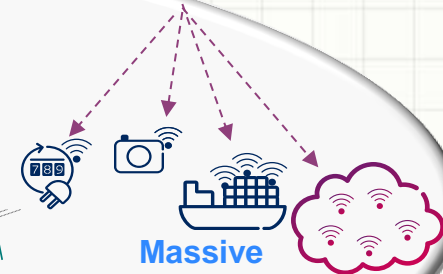
Traffic Efficiency and Safety



Emergency Communications

Teleprotection in Smart Grid Networks

Massive Deployment of Sensors and Actuators



Many simple devices, coverage (redundancy)

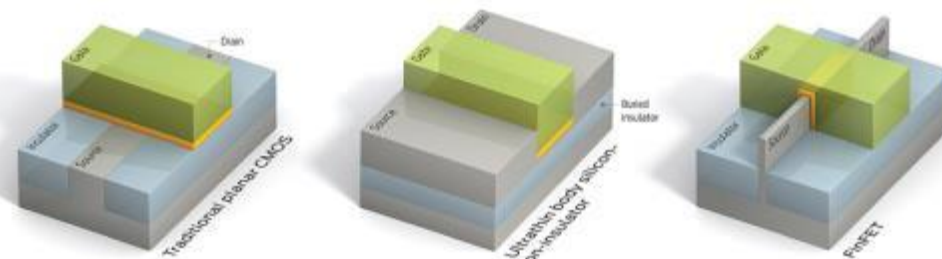
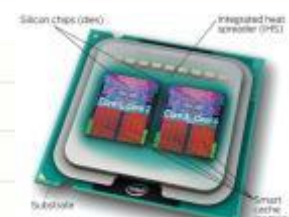
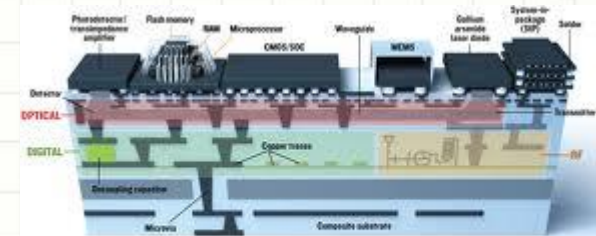
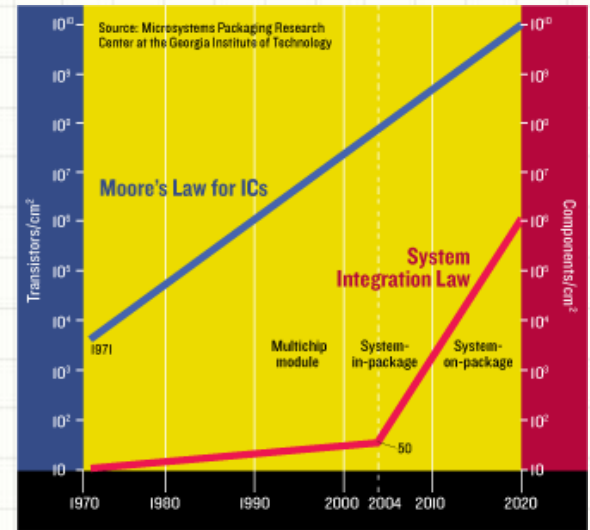
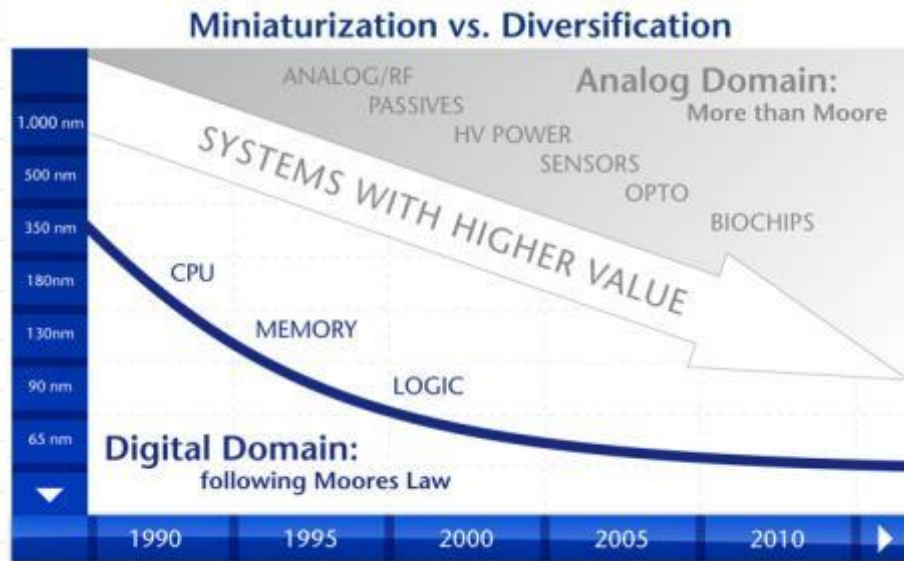
Bit-rate, delay

Accessibility, large crowds

Delay, reliability



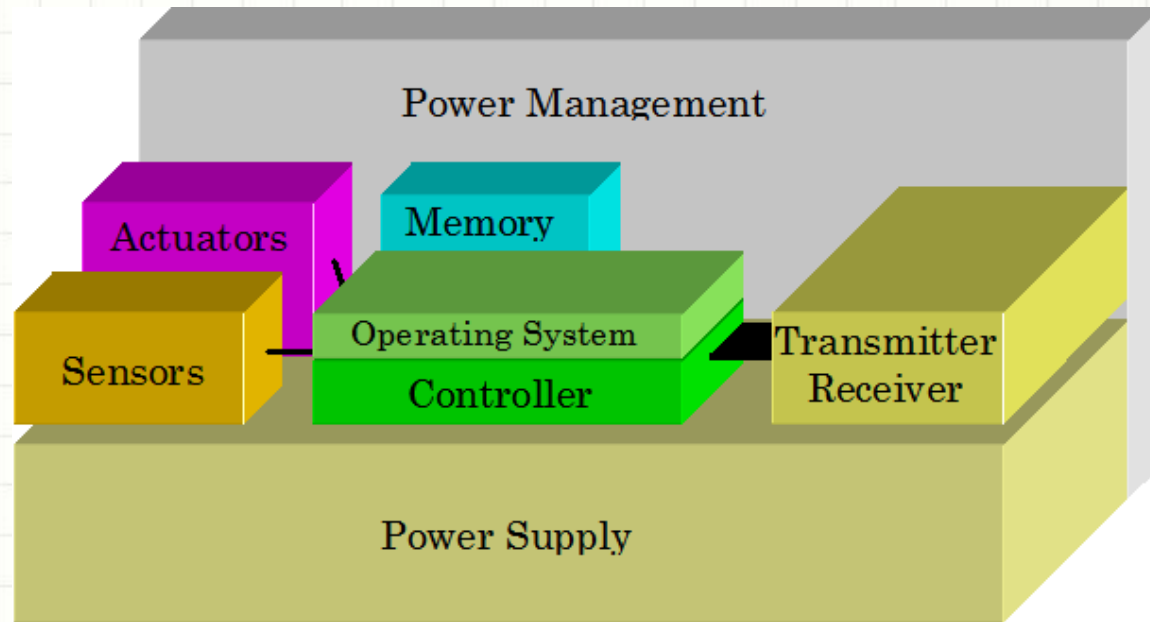
Miniaturization and Diversification





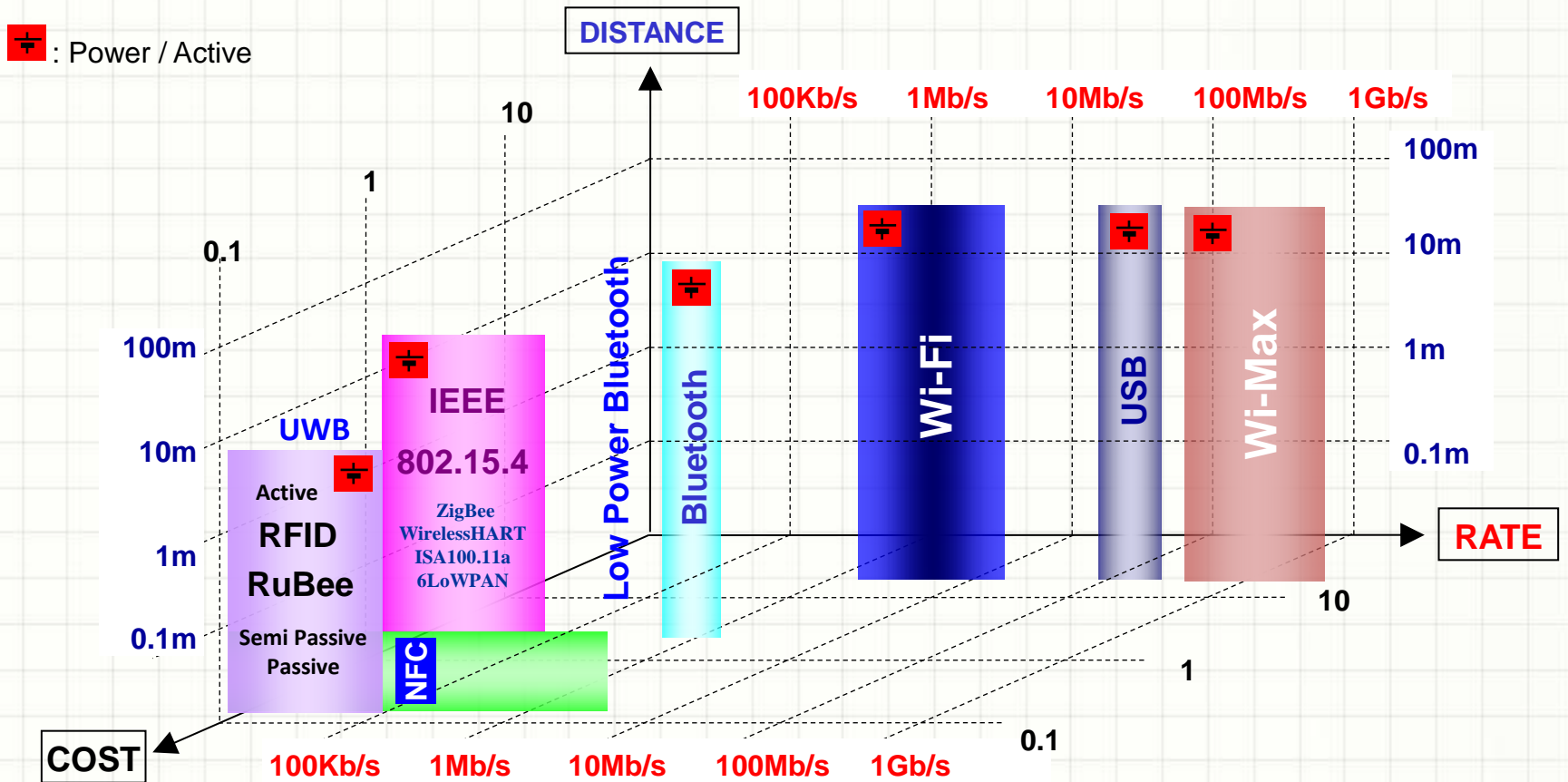
Integration

- ❖ Sense
- ❖ Actuate
- ❖ Identify
- ❖ Interact
- ❖ Interface
- ❖ Communicate





Communication Technologies





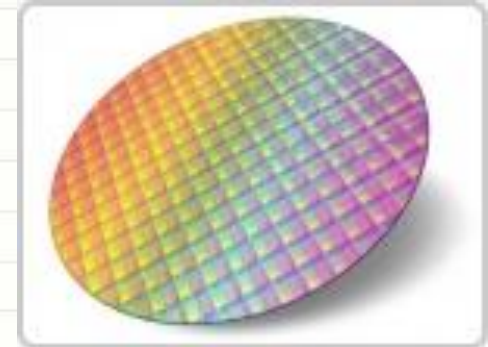
Communication Protocols

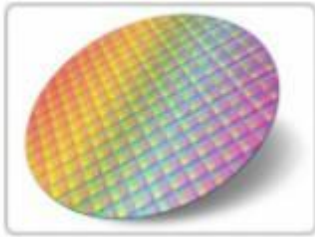
	Network Topology	Range	Frequency	Internet GW Specifications	Protocol Interoperability
ZigBee (IEEE 802.15.4)	Tree, Star, Mesh	< 100 m	868 MHz 915 MHz	+	GRIP protocol
Z-Wave	Mesh	< 30 m	900 MHz	-	None
Insteon	Mesh	~ 20 - 30 m	902 – 924 MHz	+	X10
ONE-NET	Star, Multi-hop	50 – 500 m	868 MHz 915 MHz	+	Open source
KNX	Tree	~ 50 m	868 MHz	+	Several protocols beneath
WiFi (IEEE 802.11)	Star	30 – 200 m	2.4 GHz	N/A	Several protocols on top
NFC	P2P	Few cm	13.56 MHz	N/A	N/A
DASH7	Multi-hop (two), Star	10 m – 10 km	433 MHz	+	Open source
RuBee	P2P	1 – 30 m	132 kHz	N/A	Several protocols on top
EnOcean	Star, Mesh	30 – 300 m	868 MHz 315 MHz	+	None
Bluetooth (LE)	Star	5 100 m 50 m (LE)	2.4 GHz	N/A	Several protocols on top
ANT(+)	Star, Tree, Mesh	~ 50 m	2.4 GHz	-	None



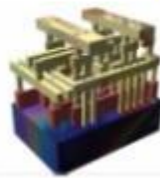
ENIAC MIRANDELA

- ❖ The MIRANDELA project aims to the Millimetre-wave and Radio-frequency integration in Nanoelectronics CMOS Platforms for Modern Wireless 5 A Communications.
- ❖ Duration:
 - 45 Months: 3 May 2010 – 2 February 2014
- ❖ Consortium
 - 26 Partners
 - 10 Countries
- ❖ Total Effort
 - 3,811 PM : 317 PY: Equivalent to 85 people full time
- ❖ Budget
 - 47,131,124 €
- ❖ Funding
 - ENIAC: 7,870,898 €
 - National: 5,738,508 €

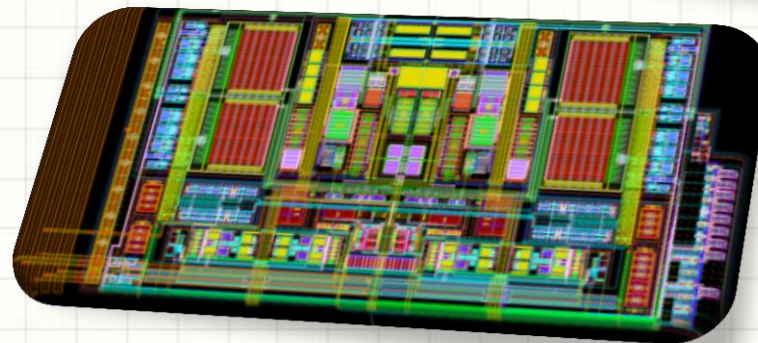
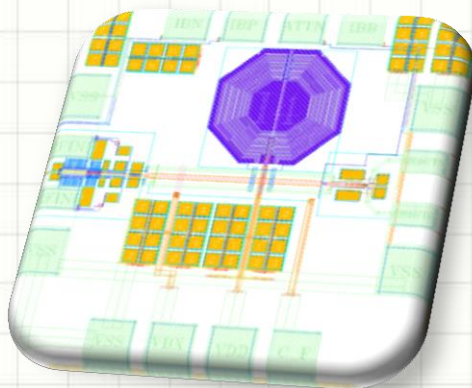
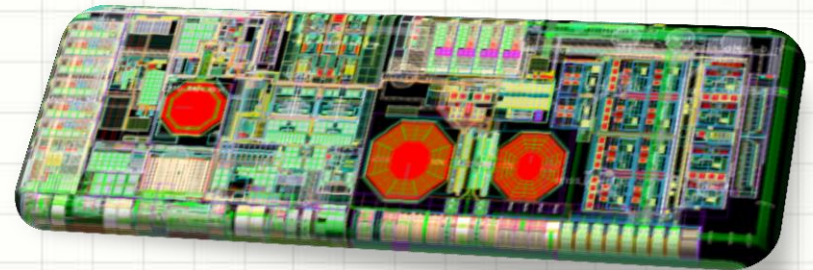


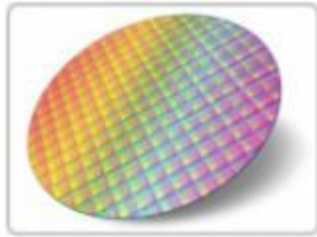


MIRANDELA

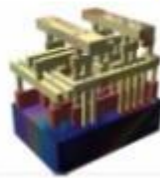


- ❖ Advanced RF solutions for RF, analog and digital communication circuits using 40 and 28nm RF CMOS technologies.
- ❖ 40nm SAR-ADC
- ❖ 28nm multi band CMOS LNA

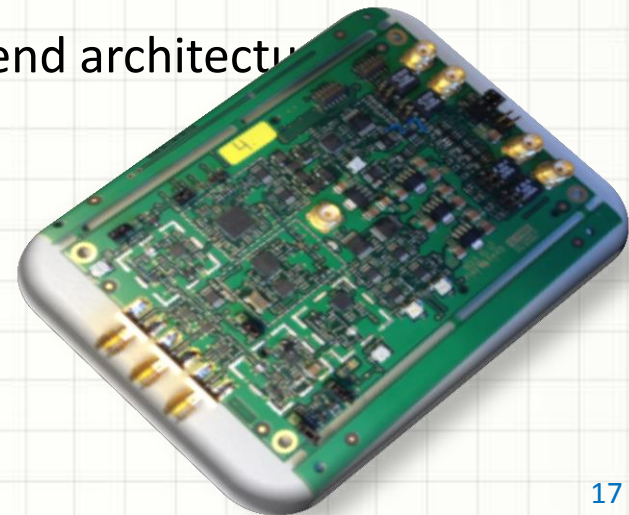




MIRANDELA



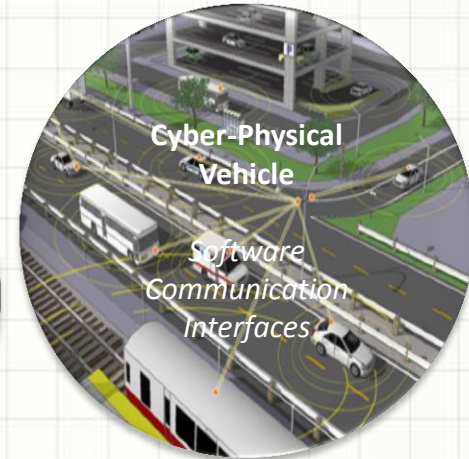
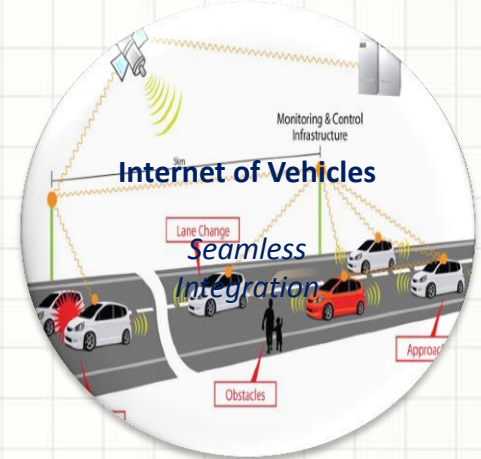
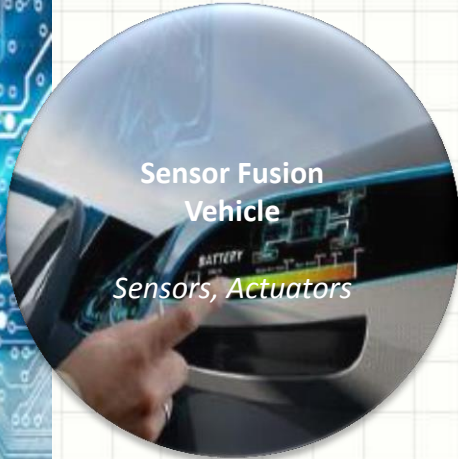
- ❖ Requirements and specifications for a low power integrated 5,8-5.9 GHz transceiver module concept combining DSRC/802.11p .
- ❖ Access to a technology and design platform for the integration of analogue, RF and MMW components, for wireless applications
- ❖ Concept for reconfigurable multi-protocol front end architecture





Internet of Vehicles - IoV

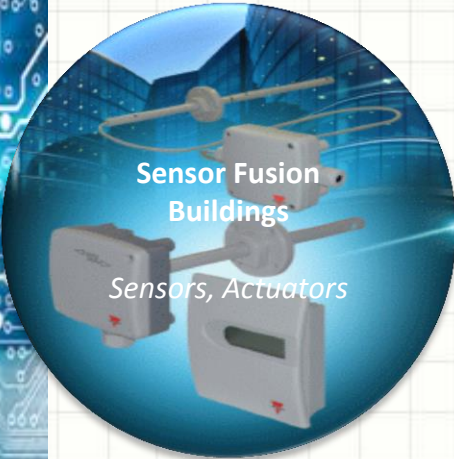
Technology Integration and Convergence





Internet of Buildings - IoB

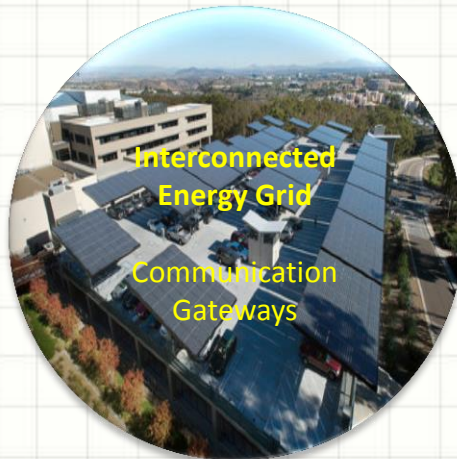
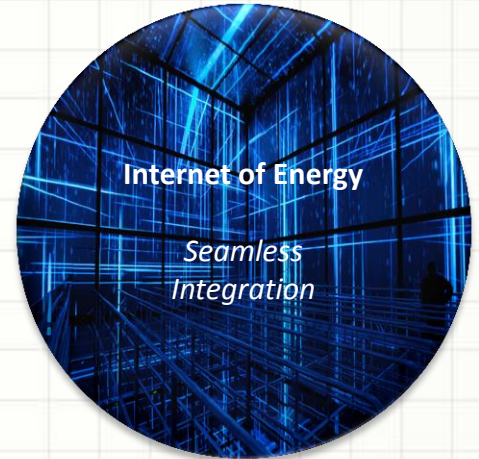
Technology Integration and Convergence





Internet of Energy - IoE

Technology Integration and Convergence





Conclusion and Summary

- ❖ IoT - context-aware
- ❖ Sensing , processing, communication
 - Cost-effectiveness
 - Low power
 - Quality and reliability
 - Security
- ❖ Low power consumption and autonomy
- ❖ Layers of local embedded processing
- ❖ Software ecosystem and software scalability

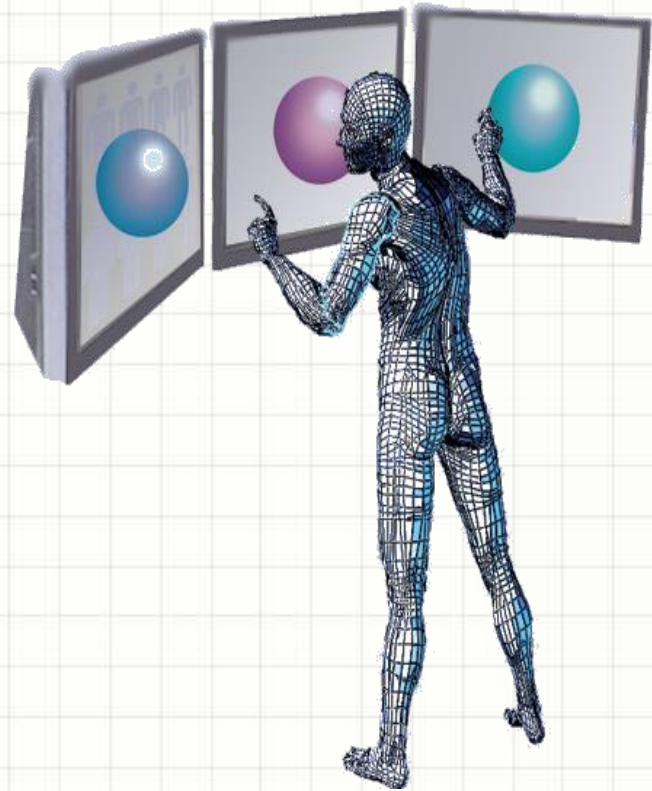
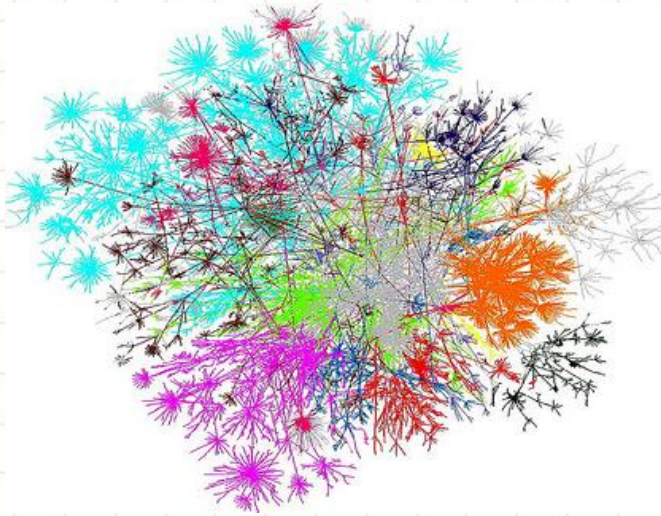


Conclusion and Summary

- ❖ Remote embedded processing (i.e. Cloud, Micro/Nano Cloud/Fog)
- ❖ Federalisations of Clouds
- ❖ Virtualisation of resources
- ❖ Convergence of platforms
- ❖ Full security across the entire signal and data path
- ❖ Data integrity
- ❖ Semantic interoperability
- ❖ Standardisation



Thank You!



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