Panel on SMART/MOBILITY/SPWID

Topic: Mobile Services in Smart Cities

The Sixth International Conference on Smart Cities, Systems, Devices and Technologies

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Mobile Services in Smart Cities

- **Moderator**
  Lasse Berntzen, University College of Southeast Norway, Norway

  Panelists
  Adrian Florea, Lucian Blaga University of Sibiu, Romania,
  Alex Galis, University College London, UK
  Gerhard Chroust, Johannes Kepler University Linz, Austria
  Khalil El-Khatib, University of Ontario, Canada
  Peter Larkin, Swiss Re, Switzerland

Moderators comments

- Panel had different approaches to the topic, ranging from virtual networks (slice networking) and sensor technology to human-centric solutions.
- Future panel debates could focus on integration of smart city solutions (big topic) to privacy concerns related to smart cities (another big topic).

Smart city challenges:
Modeling / monitoring crowds / traffic in order to reduce gas emissions & noise volume

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Main problem:

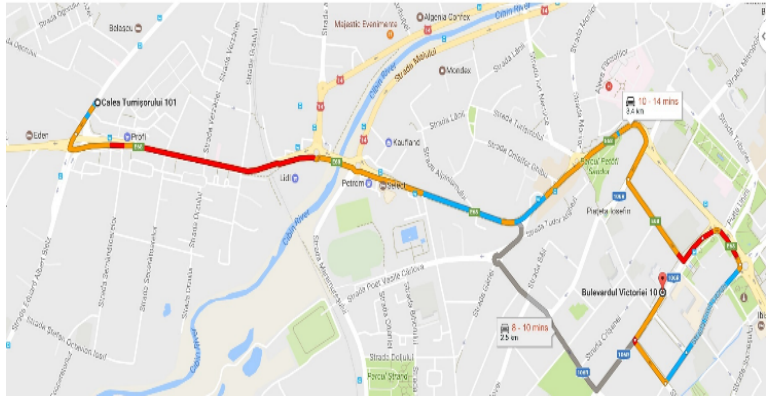
- **Heavy traffic, the speed of the traffic flow and inefficient modes of transport in urban areas are directly responsible for air pollution and noise ➔**
- **Negative impact on cardiovascular, respiratory and neuro-behavioural diseases**

Challenge:

- **Correlating real data about *air quality* & *noise volume* with *traffic measurements* and setting some limit thresholds.**
- **Real-Time Estimation of Pollution Emissions and Dispersion from (Heavy) Traffic**
- **Modeling real time traffic in order to reduce gas emissions & noise volume.**

Main Goals

- **Develop a low-cost platform for smart city monitoring, display information and outdoor advertisement.**
- **The platform will be used to monitor air quality, temperature, humidity and noise, as well as counting the number of vehicles and people over time within a specific area.**



- **Determine the experiment accuracy by comparing collected data with well-known information from other sources about which route is heavy traffic (Beat the traffic, Waze, Google Traffic, etc).**
- **Impacted communities would benefit from accurate and timely localized knowledge of air pollution levels for immediate protection as well as for longer term mitigation of high pollution areas and traffic planning**

Solutions

- **The municipality may improve the air quality by optimizing traffic**
- **Gamification (application for mobile phone) - using on large scale of common means of transportation or other alternatives**
- **Developing mobile phone Apps to provide in real-time air quality index, decongested routes, notifications for exceeding certain thresholds, rescue information**
- **Collecting enough data and store in databases in order to apply data analitycs tools to forecast further the environment conditions**

Slice Networking in support of Mobile Services in Smart Cities

- Slices - Background and Context
- Key Challenges in support of Network Services
- Concluding Remarks & Acknowledgement

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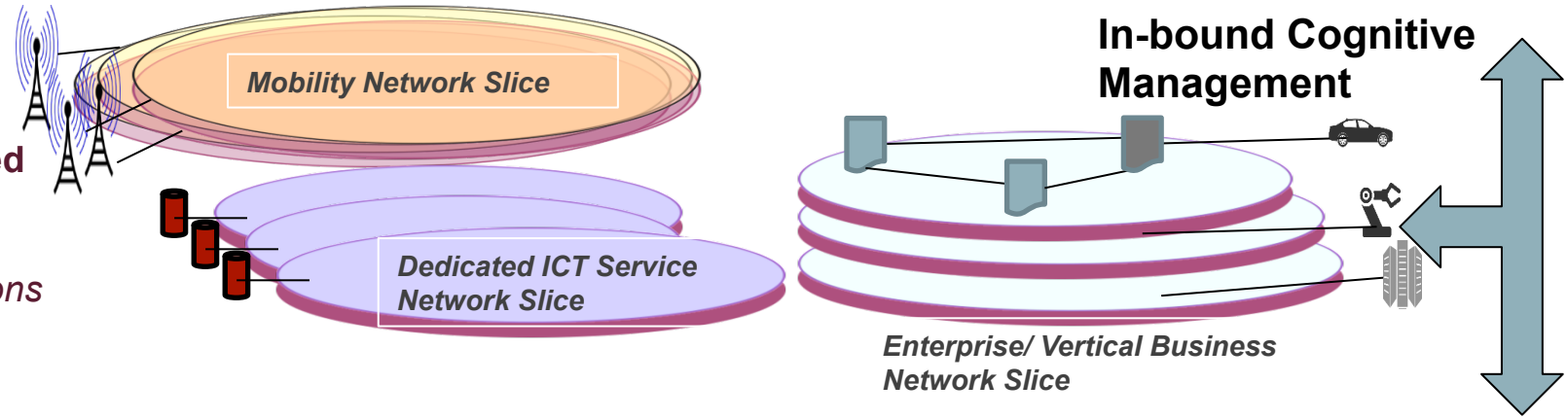
Smart Networks

- Transition from network devises to network functions and virtual network functions with inbound management
- Dynamically adapting the network to meet future demands requires
- Creating the dynamic, configurable, programmable, resilient, cost effective E2E network
- A programmable network operating system with simple interface to the network (smart network fabric)

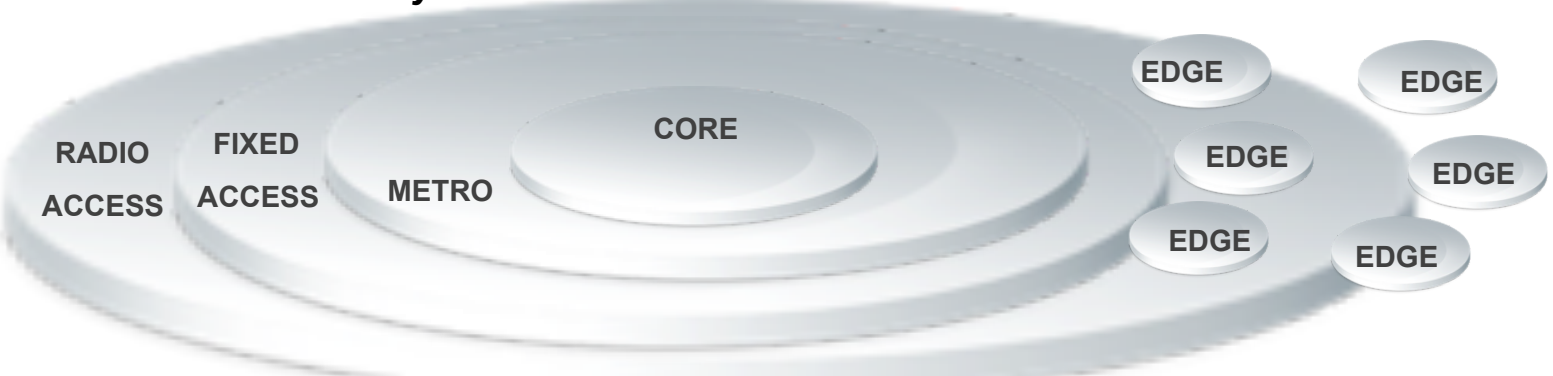
E2N Multi-Domain Orchestration
E2E coordination, conflict resolution, multi-domain information exchange

Service Adapted Network Slices
Enabled by Network Functions Including NFV



Smart Network Fabric: E2E Multi-Domain Network Operating System Facilities
Network Abstraction, Allocate (virtual) network resources, Maintain network state, Ensure network Reliability in a multi domain environment

Smart Cloud & Network Fabric
Enabled by Programmability Including SDN



Definitions of Network Slicing & References(II)

I - Slicing Resources:

Slice capabilities (2009) "Management and Service-aware Networking Architectures (MANA) for Future Internet" – A. Galis et all - Invited paper IEEE 2009 Fourth International Conference on Communications and Networking in China (ChinaCom09) 26-28 August 2009, Xi'an, China, http://www.chinacom.org/2009/index.html

3 Slices Capabilities

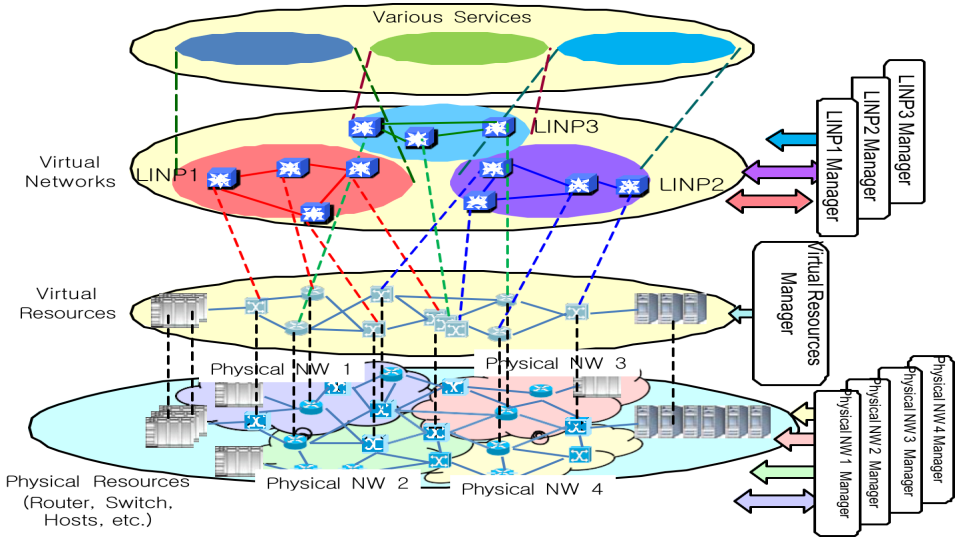
- "Resource allocation to virtual infrastructures or slices of virtual infrastructure."
- "Dynamic creation and management of virtual infrastructures/slices of virtual infrastructure across diverse resources."
- "Dynamic mapping and deployment of a service on a virtual infrastructure/slices of virtual infrastructure."

17 Orchestration capabilities

19 Self-functionality mechanisms

14 Self-functionality infrastructure capabilities

ITU-T Slicing (2011) as defined in [ITU-T Y.3011], [ITUTY.3012] is the basic concept of the Network Softwarization. Slicing allows logically isolated network partitions (LINP) with a slice being considered as a unit of programmable resources such as network, computation and storage.

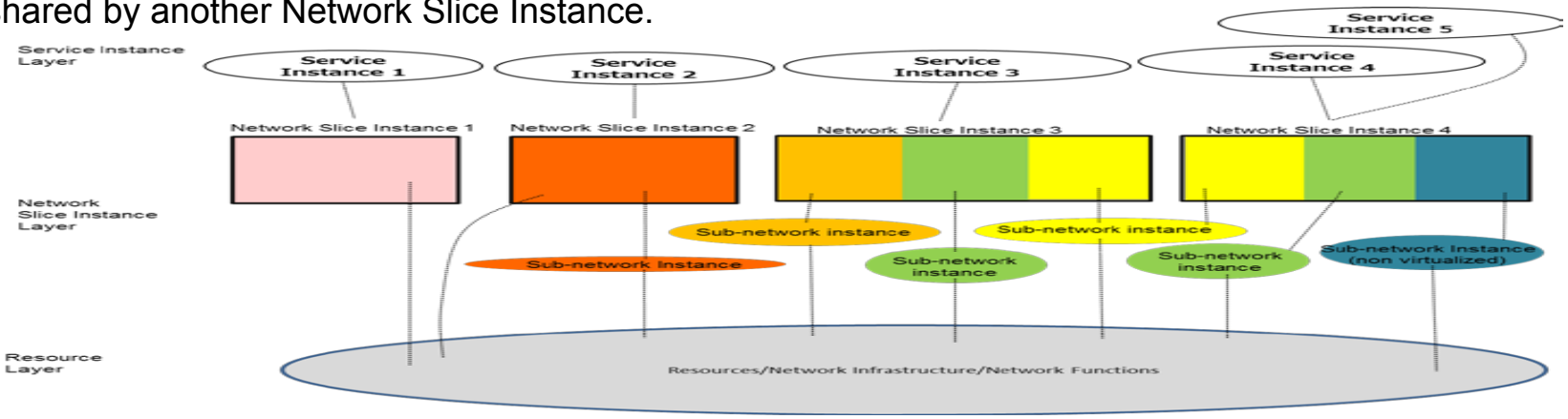


Definitions of Network Slicing & References(III)

II- Network Slicing :

NGMN Slice capabilities (2016) - consist of 3 layers: 1) Service Instance Layer, 2) Network Slice Instance Layer, and 3) Resource layer.

- The Service Instance Layer represents the services (end-user service or business services) which are to be supported. Each service is represented by a Service Instance. Typically services can be provided by the network operator or by 3rd parties.
- A Network Slice Instance provides the network characteristics which are required by a Service Instance. A Network Slice Instance may also be shared across multiple Service Instances provided by the network operator.
- The Network Slice Instance may be composed by none, one or more Sub-network Instances, which may be shared by another Network Slice Instance.



3GPP TR23.799 Study Item "Network Slicing' **2016**

ONF Recommendation TR-526 "Applying SDN architecture to Network Slicing" **2016**

IETF Draft draft-gdmb-netslices-intro-and-ps-02 2016- 2017

EU 5GPPP

- **15 Large Scale Research projects – all based on Network Slicing** (https://5g-ppp.eu) **(2015- 2018+)**
- **White Paper on 5G Architecture centered on network slicing** (https://5g-ppp.eu/wp-content/uploads/2014/02/5G-PPP-5G-Architecture-WP-July-2016.pdf) **(2016)**

(Proposal) Unified Slice definition

Slice as a union of subsets of resources & NFVs at a given time

(1) The Service Instance component

- represents the end-user service or business services.
- an instance of an end-user service or a business service that is realized within or by a NS.
- would be provided by the network operator or by 3rd parties.

(2) A Network Slice Instance component

- represented by a set of network functions, and resources
- forms a complete instantiated logical network to meet certain network characteristics required by the Service Instance(s).
- provides network characteristics which are required by a Service Instance.
- may also be shared across multiple Service Instances

(3) Resources component – it includes: *Physical, Logical & Virtual resources*

- *Physical & Logical resources* - An independently manageable partition of a physical resource, which inherits the same characteristics as the physical resource and whose capability is bound to the capability of the physical resource. It is dedicated to a Network Function or shared between a set of Network Functions;
- *Virtual resources* - An abstraction of a physical or logical resource, which may have different characteristics from that resource, and whose capability may not be bound to the capability of that resource.

(4) Slice Capability exposure component

- allow 3rd parties to access via APIs information regarding services provided by the slice (e.g. connectivity information, QoS, mobility, autonomicity, etc.)
- allow to dynamically customize the network characteristics for different diverse use cases within the limits set of functions by the operator.
- it includes a description of the structure (and contained components) and configuration of the slice instance.

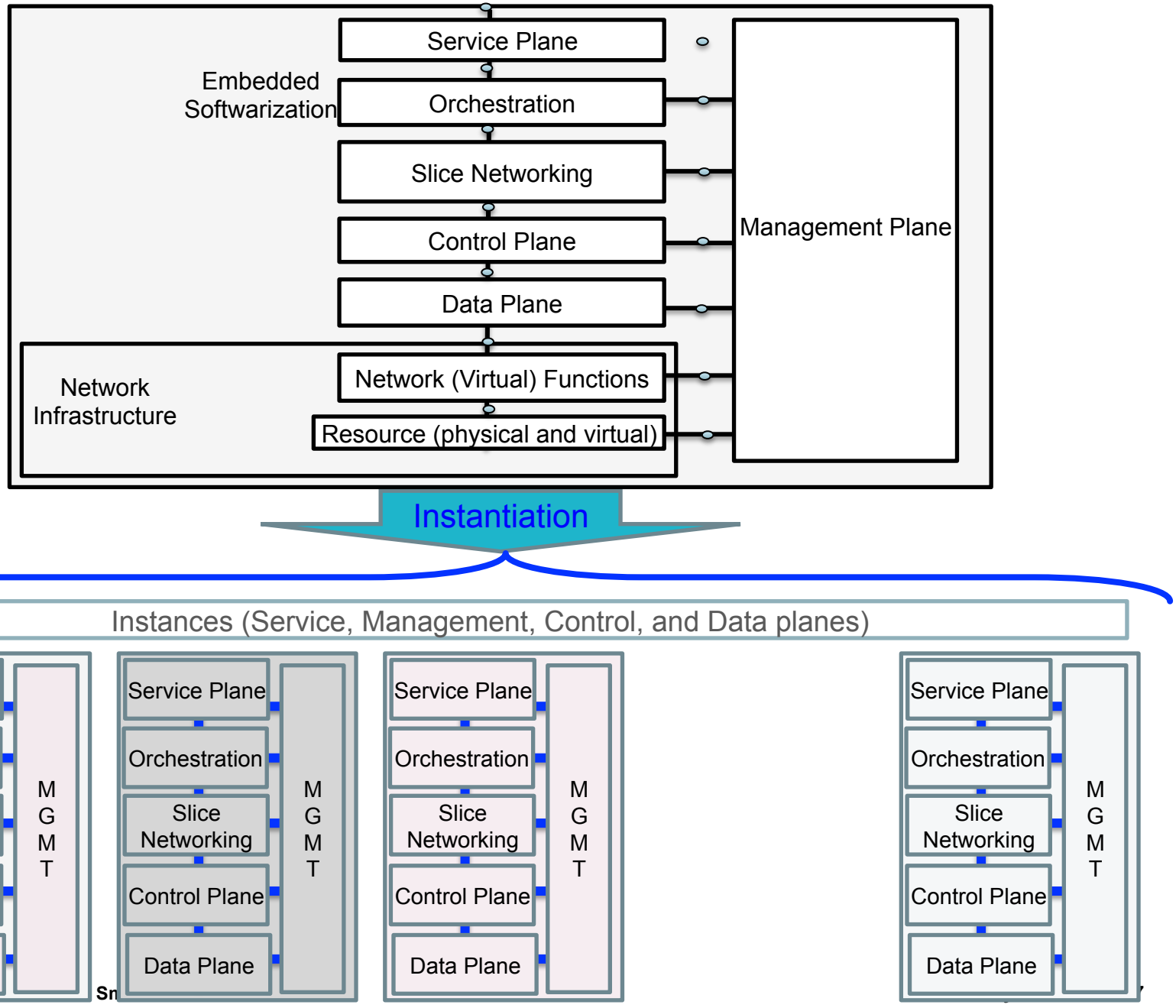
NS Key Characteristics→ No1 Engineering Priority in 5G

- **A managed group of infrastructure resources, network functions and services** (e.g. Service Instance component, A Network Slice Instance component, Resources component , Slice Capability exposure component).
- **NS is programmable and has the ability to expose its capabilities**. The behaviour of the network slice realized via network slice instance(s).
- Concurrent deployment of **multiple logical, self-contained and independent, shared or partitioned networks on a common infrastructure platfor**m.
- Supports **dynamic multi-service support, multi-tenancy** and the integration means for vertical market players.
- **Service customized Network Slices (enabled by NFV principles) + Smart Network Fabric for coordinating/orchestration, control of network resource**
- **NSs** simplifies the provisioning of services, manageability of networks and integration and operational challenges especially for supporting communication services.
- **Network operators/ ISP can exploit network slicing** for
  - reducing significantly operations expenditures, allowing also programmability necessary to enrich the offered tailored services.
  - means for network programmability to OTT providers and other market players without changing the physical infrastructure.
- **Considerably transform the networking perspective** by
  - abstracting, isolating, orchestrating and separating logical network behaviors from the underlying physical network resources.

Network Slice Usage Scenarios

- Mission-critical Ultra low latency communication
- Massive-connectivity machine communication (e.g. Smart metering, Smart grid and sensor networks)
- Extreme QoS
- Independent QoS isolation design
- Independent operations and management
- Independent autonomic management functionality
- Independent cost and/or energy optimisation
- Independent multi-topology routing
- Mobile Services in Smart Citie
- Sharing Infrastructure: Enablers for sharing infrastructure safely and efficiently (Multi-tenant)

Network Slice Life Cycle Management



Summary & Concluding Remarks

- **Slice Networking** would considerably ***transform the networking perspective*** by
  - **abstracting,**
  - **Isolating at a sub-network level,**
  - **separating logical network behaviours from the underlying physical network resources**.
  - **dynamic management of network resources by managing resource-relevant slice configuration; simplification and reduction of operations expenditures**
  - **Support for rapid service provisioning including Mobile Services in Smart Cities**

Acknowledgement - 5GPPP EU Research Projects

- **5GEx – "5G Multi-Domain Exchange" https://5g-ppp.eu/5gex/**
- **5G SONATA – "Service Programming and Orchestration for Virtualized Software Networks in 5G" https://5gppp.eu/sonata/.**

Thank you

Q&A

Supporting Active and Healthy Aging (my-AHA)

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Objective of AHA

Active and Healthy Aging (AHA) :

AHA: my-AHA - Europ. Union - Horizon-2020 Project No 689592, 2016-2019

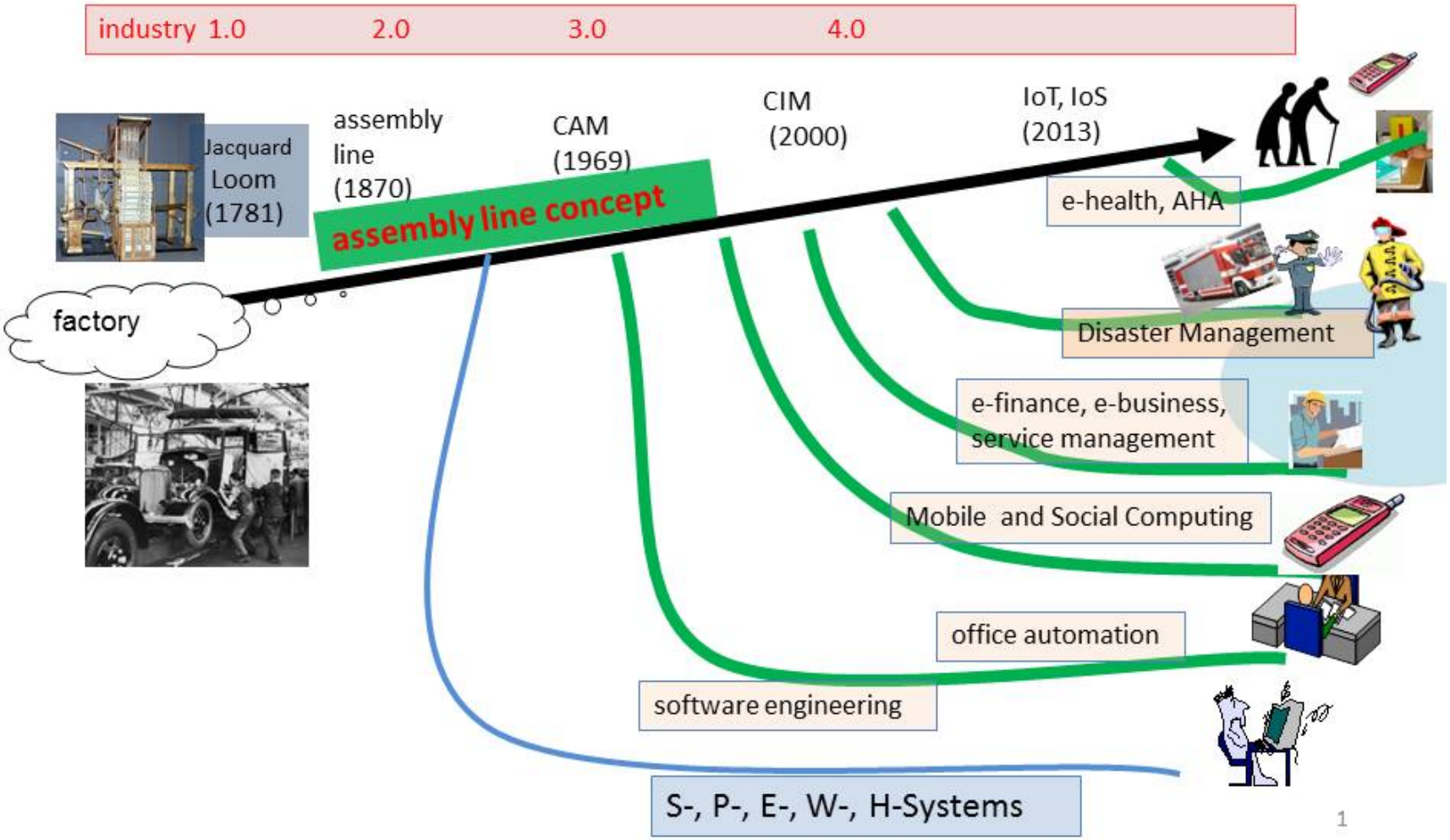
- demographic changes (Western World)
- concern of a sustainable society
- Seniors actively and passively involved in AHA
- compensate physical and mental deficiencies of Seniors
- Automation + Technology for Process Support
  (like "Industry 4.0")

Vision

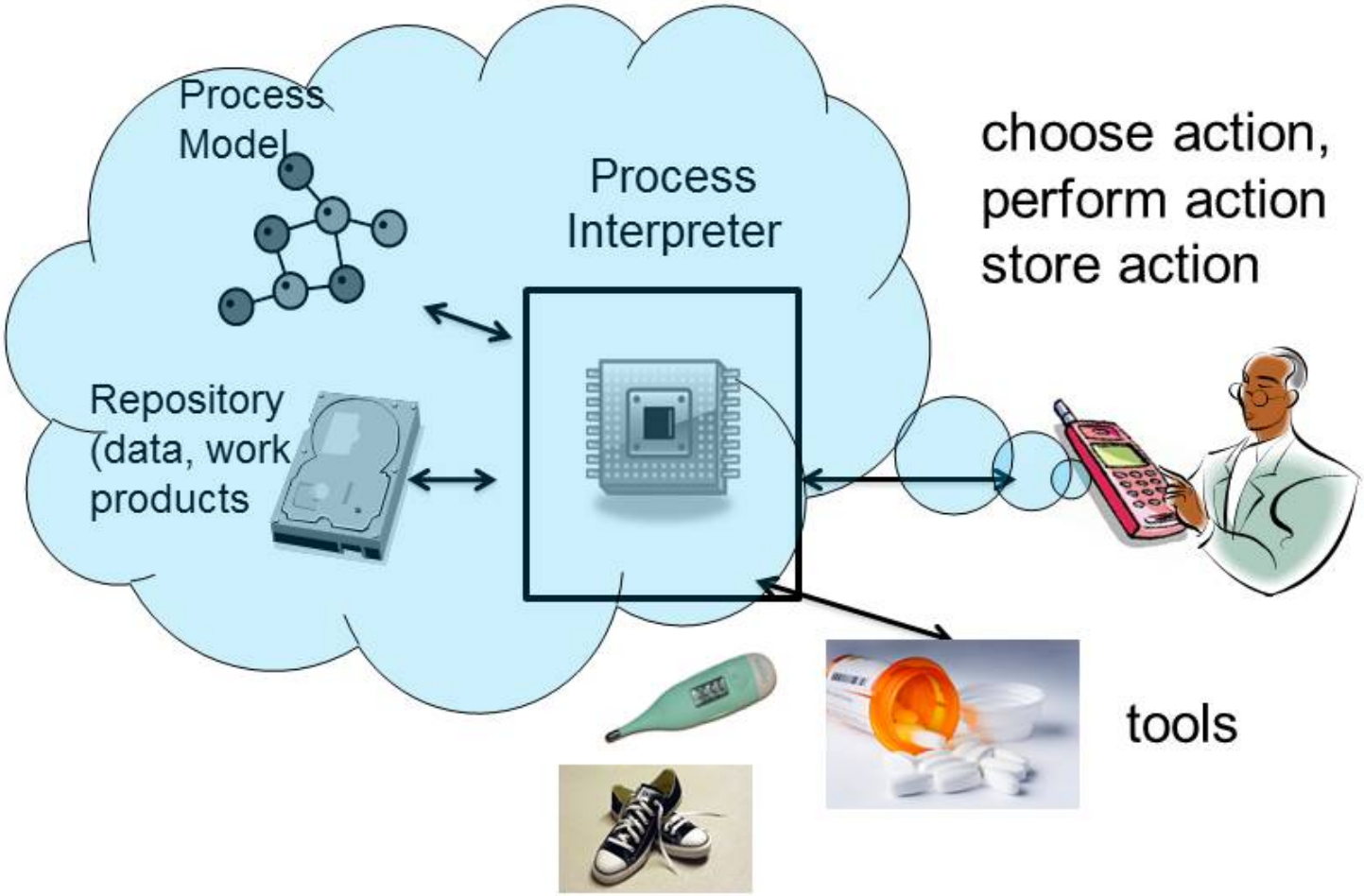
Curing ->	cAring ->	well-faring
diseases	compensating frailties	pro-active care
ex-post	ad-hoc	future-oriented
	observing, recognizing	checking, warning, reminding

Initiate healthy activities (personal and social)

Evolution of Industry 4.0



Interfaces for AHA

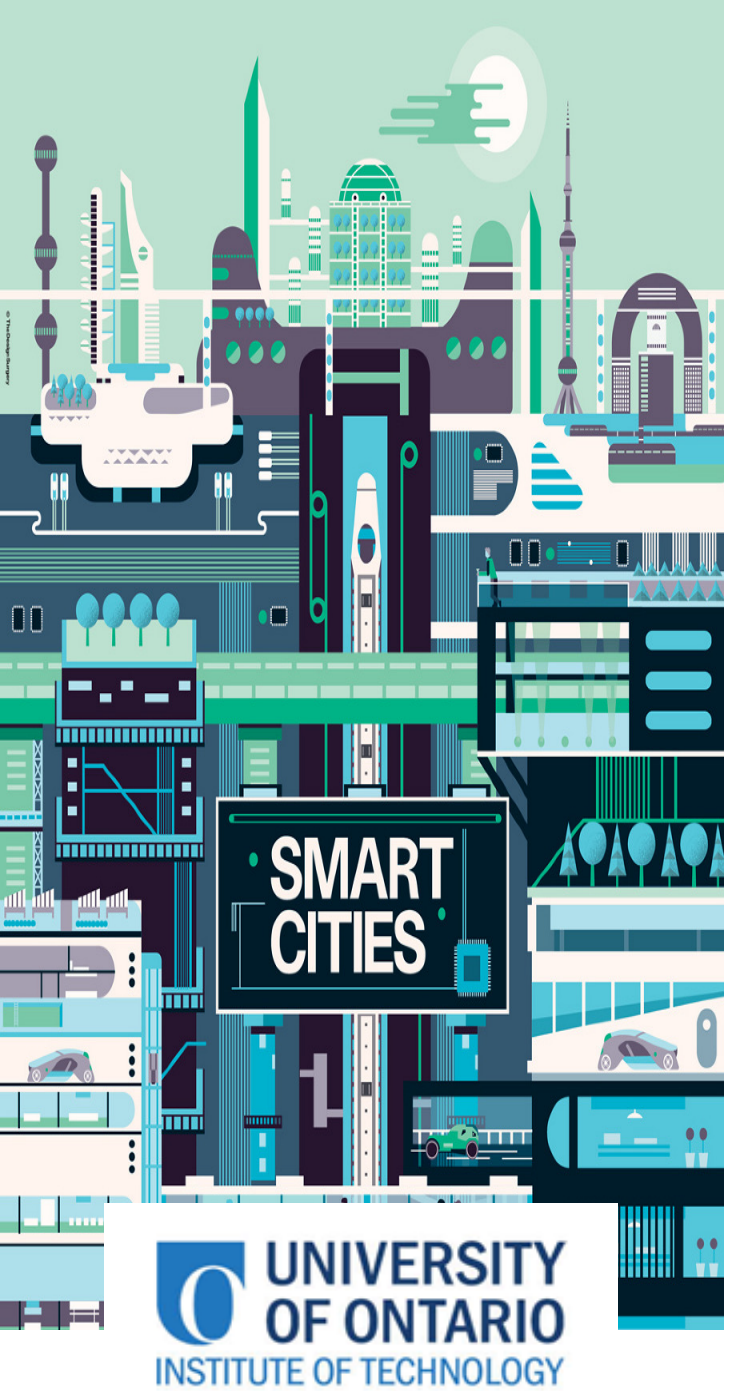


Various Approaches

- **hData** : collect data and interpret them
- **Saluto-Genesis**: focus on HEALTH, not on disease
  on PREVENTION not cure!
- **Frailty Prevention**: physical and cognitive!

Conclusion and Further Work

- Process view for AHA promising
- offers better and more effective control
- relieves support personnel
- allows comparison and assessment of AHA-processes (quality and capability)
- social, cultural, and economic difficulties
- 'look and feel' of interfaces crucial



Communities and Mobility in Smart Cities

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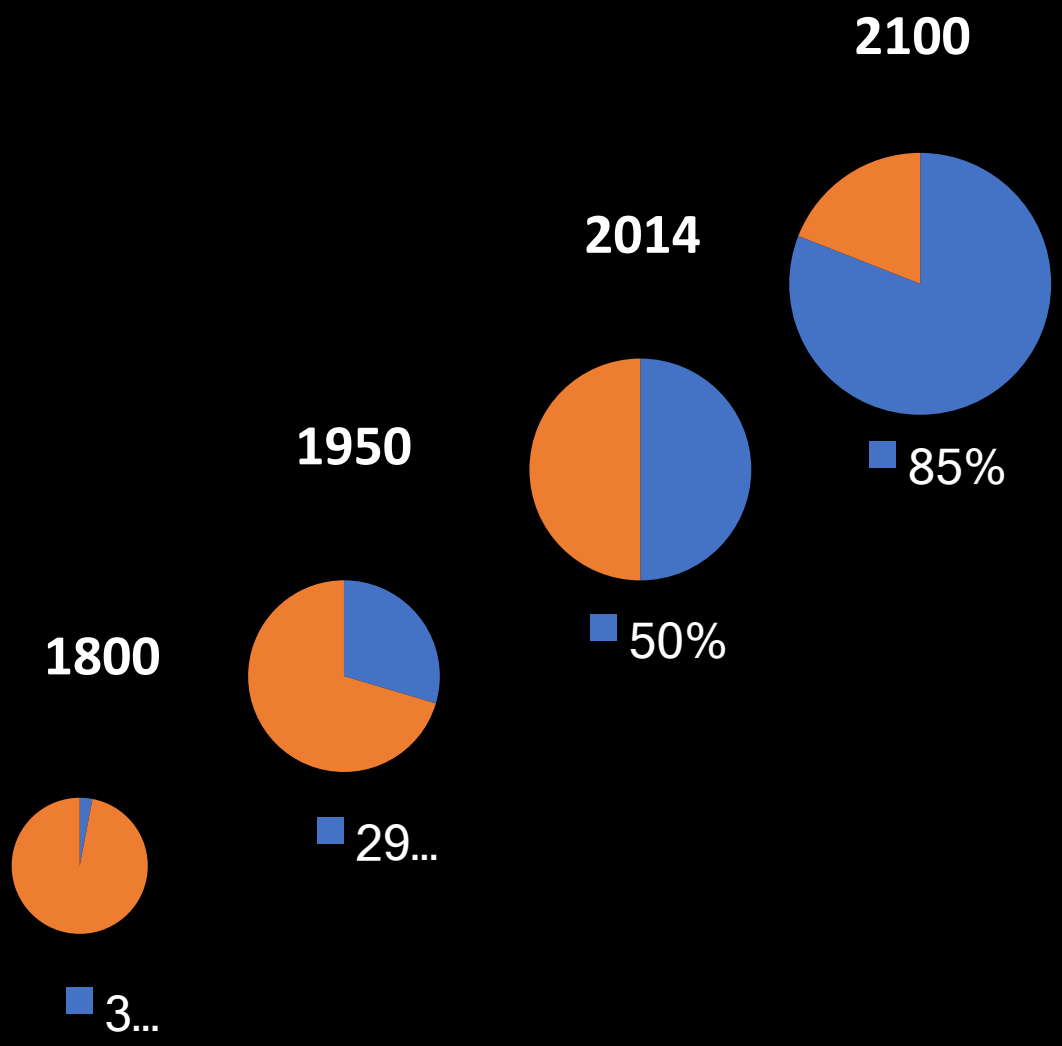
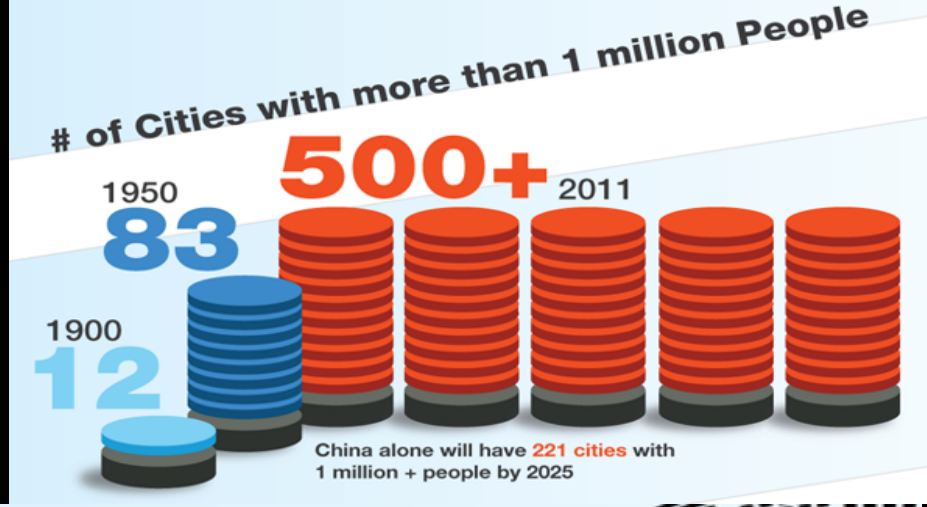
The World Is Urbanized





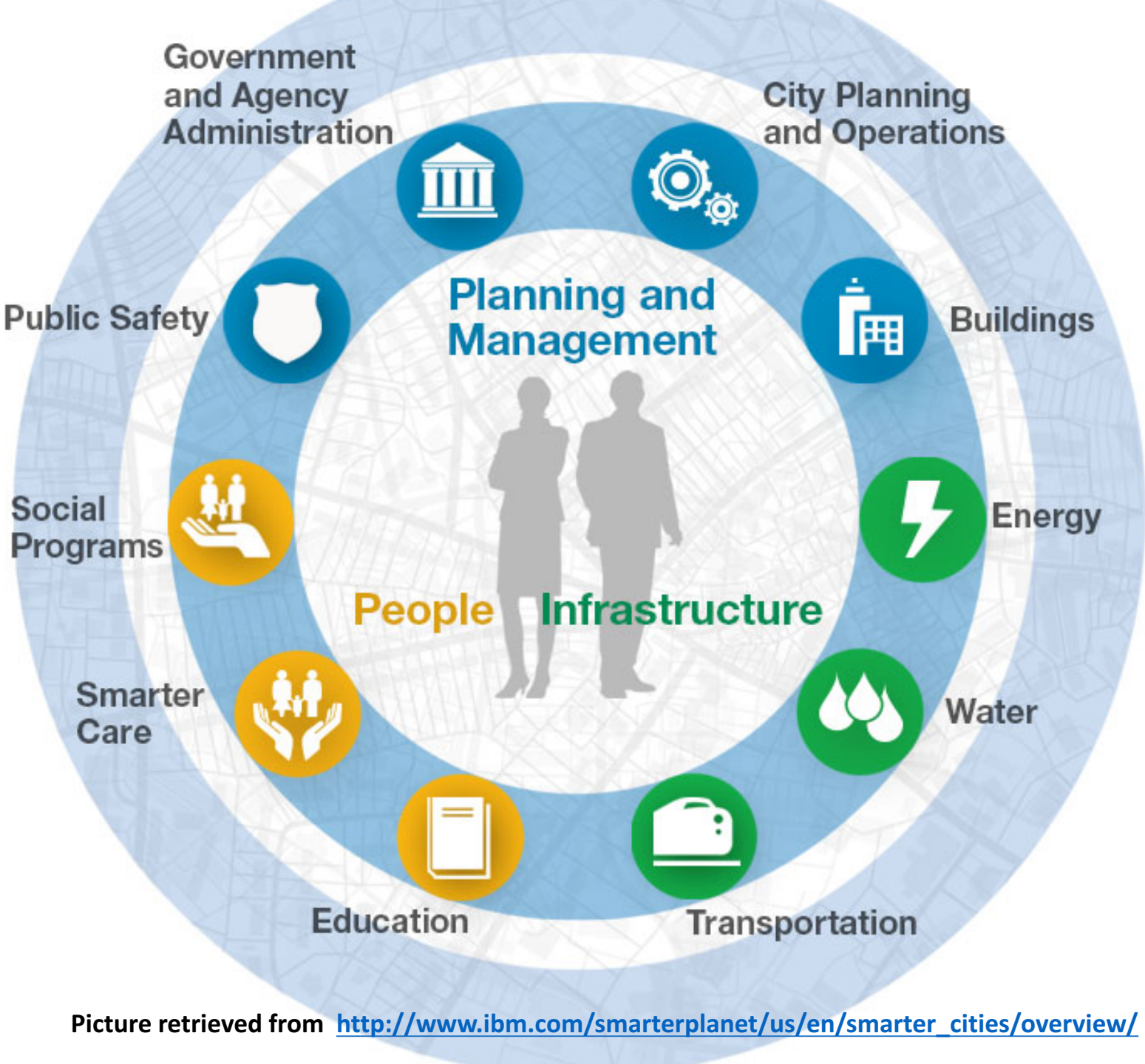
Pictures retrieved from: https://www.postscapes.com/anatomy-of-a-smart-city/

Challenges

- ✓ Air pollution
- ✓ Traffic congestion
- ✓ Housing requirement
- ✓ Health concern
- ✓ Energy and waste management

Smart City

- Provide infrastructure for citizen to easily access many services
- Provide infrastructure for governing bodies to manage the resources in a city
- Use ICT to sense, analyze and integrate the information in running cities



Picture retrieved from http://www.ibm.com/smarterplanet/us/en/smarter_cities/overview/

Research Challenges

- Architecture
- Data Delivery
- Heterogeneity
- Varied communities and human grouping
- Data quality and redundancy
- Incentive mechanism
- Information management and analysis
- Big data and scalability
- Predictive analysis
- Privacy

Smart City as Communities

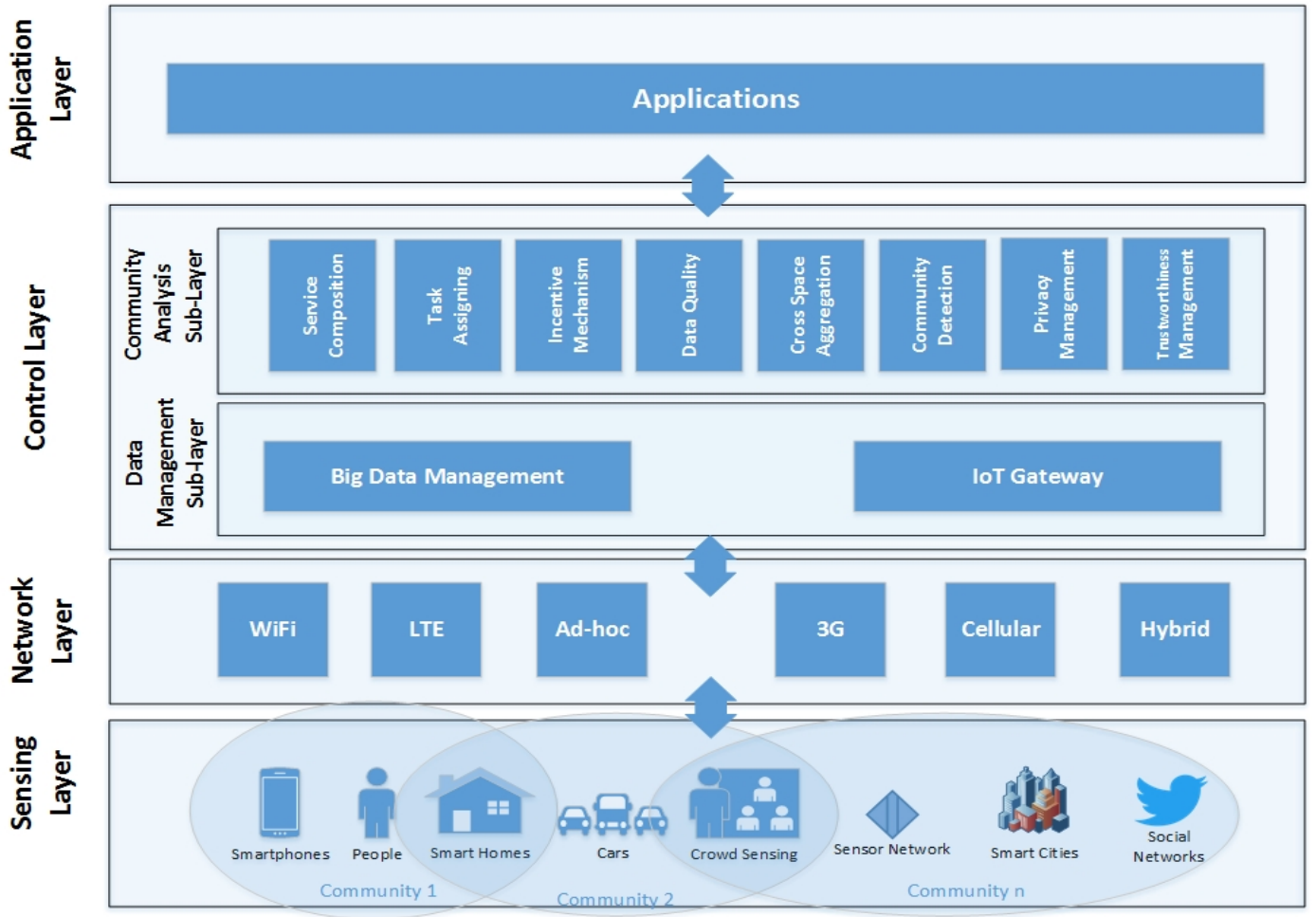
- A community is a group of people or objects that have common characteristics and are tightly connected via various social and physical processes.

- Smart city citizens and objects can be seen as multiple **communities**

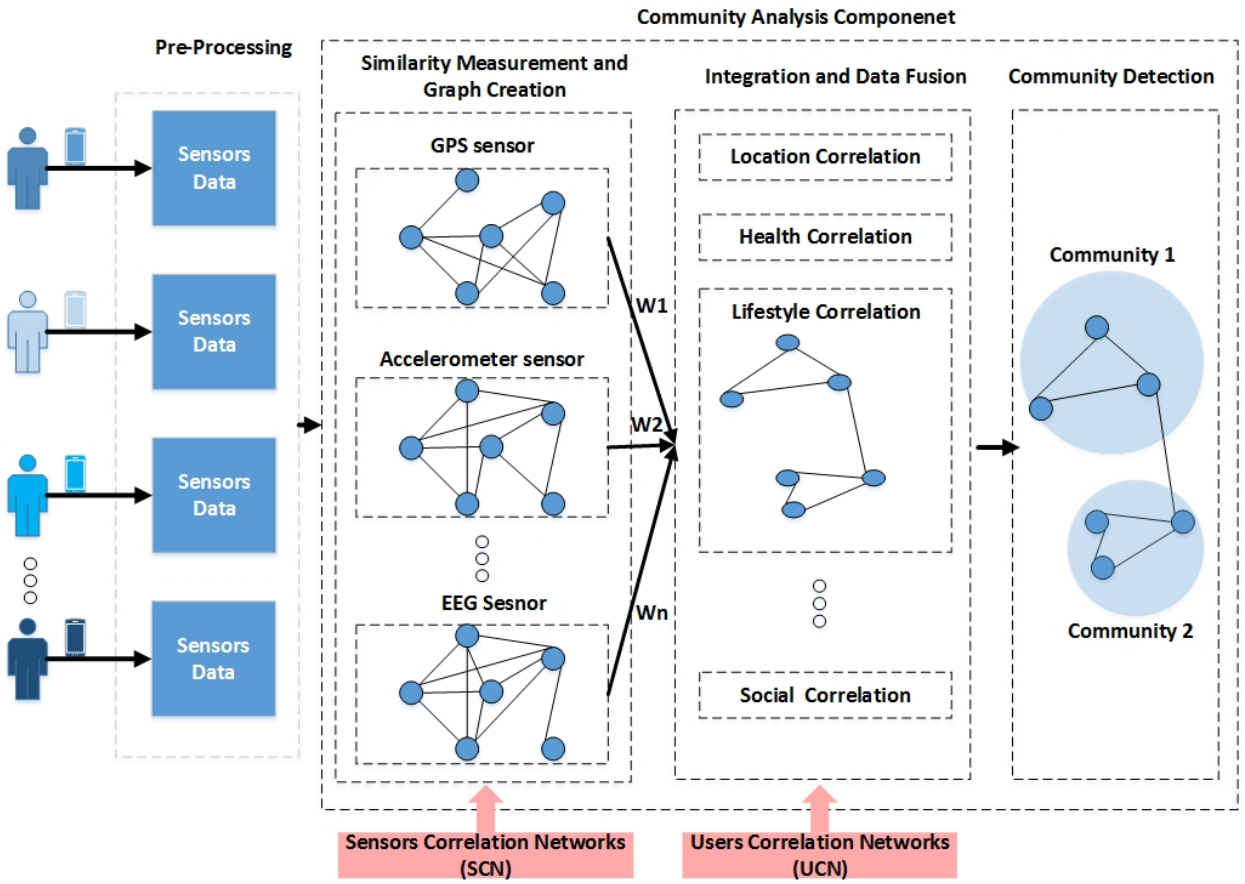
Picture retrieved from: http://systemsforaction.org/news

Framework for Community-Oriented Smart City

- Big data management
- IoT gateway
- Service composition
- Task assigning component
- Incentive mechanism
- Data quality
- Cross space aggregation
- Community detection
- Privacy management
- Trustworthiness management



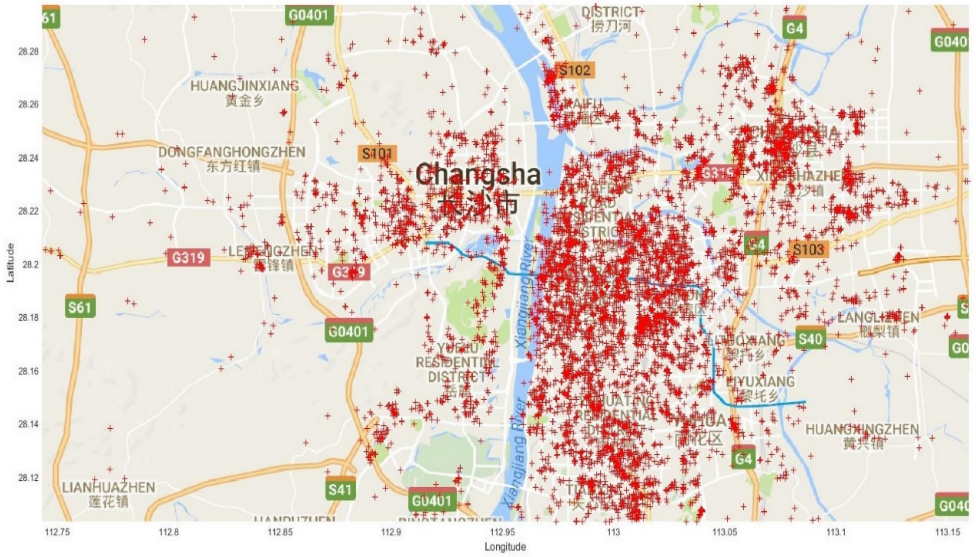
Community Detection

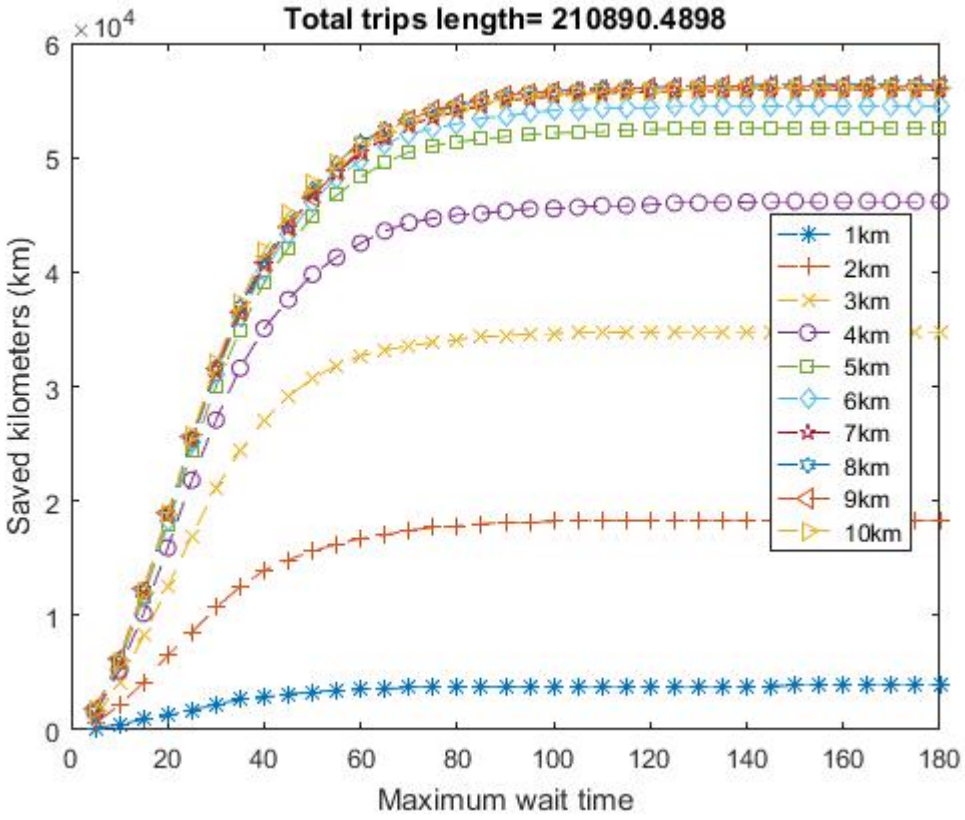


- Preprocessing
- Similarity Measurement
- Graph Creation
- Integration
- Community Detection

Investigating the Potential of Ridesharing to Reduce Vehicle Emissions

Similarity Function	Euclidean
Maximum distance between trips (Kilometers)	1–10
Number of clusters	11,000
Maximum schedule time (Minutes)	5–180
Total trip length (Kilometer)	210,890
Total number of trips	20,018
Total number of Vehicles	8900





Picture retrieved from https://www.slideshare.net