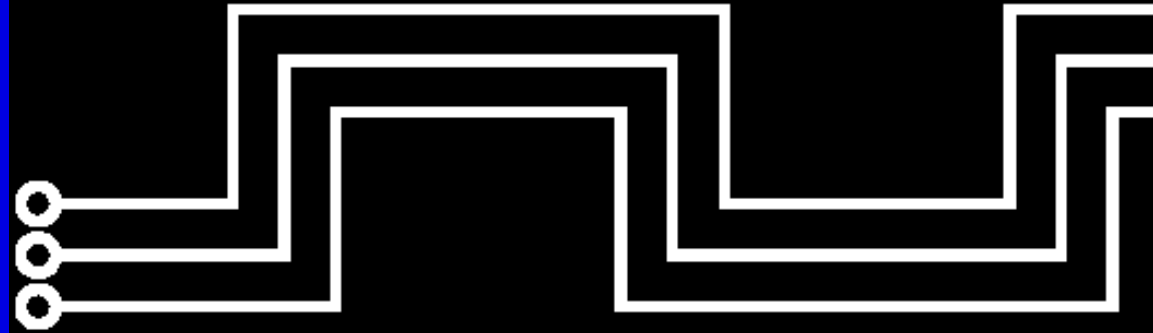




Smart City and complexity

Leonard Walletzký



When we want to speak about smart city

Definition of Smart City

Role and design of Services within the Smart City

Modeling the services

Definition of Smart City

Why do we need „correct“ definition of Smart City?

Many cities claim to be smart

Obviously, the implementation of ICT plays key role in city „smartness“

Smart City Council definition:

- A smart city is one that has digital technology embedded across all city functions

But is it just usage of ICT that does the city smart?

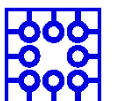
Possible definitions

A smart city is a place where traditional networks and services are made more efficient with the use of digital solutions for the benefit of its inhabitants and business.

- European Commission definition - https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en

Smart City is a concept that encompasses a set of advanced services, utilizing ICT in innovative ways to enable efficient city management and improve habitation, resilience, and sustainability. It aims to deliver the highest value possible to citizens and other stakeholders through an interconnected network of services. The value proposition of a Smart City (and its services) should be formulated in a clear and understandable manner for the final recipients of the service

- Definition, developed in SeSLab, reformulated by AI



Main research questions

Do

How

Wh

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Wh

othe

How to formulate the rules to create effective, flexible the requests of administration, citizens and other relat



The illustration shows a city skyline with various buildings and infrastructure. At the top, it says "SMART CITY BUILDING TOMORROW'S CITIES". Below this, several sectors are highlighted with icons and labels: INDUSTRY (factory), SECURITY (lock), RETAIL (shopping cart), SOCIETY (group of people), HEALTHCARE (heart), HOME (house), ENERGY (power plug), and MOBILITY (car). The city is connected by a network of dotted lines, representing smart infrastructure and connectivity. A hot air balloon, a train, and a bus are also visible in the scene.



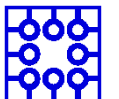
Smart City Services

There are many different services, used in Smart City, with different role and customers

- Traffic control
- Route optimization
- Waste services
- Energy grid
- Camera systems
- Monitoring systems

How are they related or connected? What tasks do they really fulfill?

We are solving a problem of complex environment



What is the complexity?



- **Complexity** characterizes the behavior of a system or model whose components interact in multiple ways and follow local rules, meaning there is no reasonable higher instruction to define the various possible interactions

What are complex services?

Services acting in complex environment

There is not clear way how to define the process of service provision

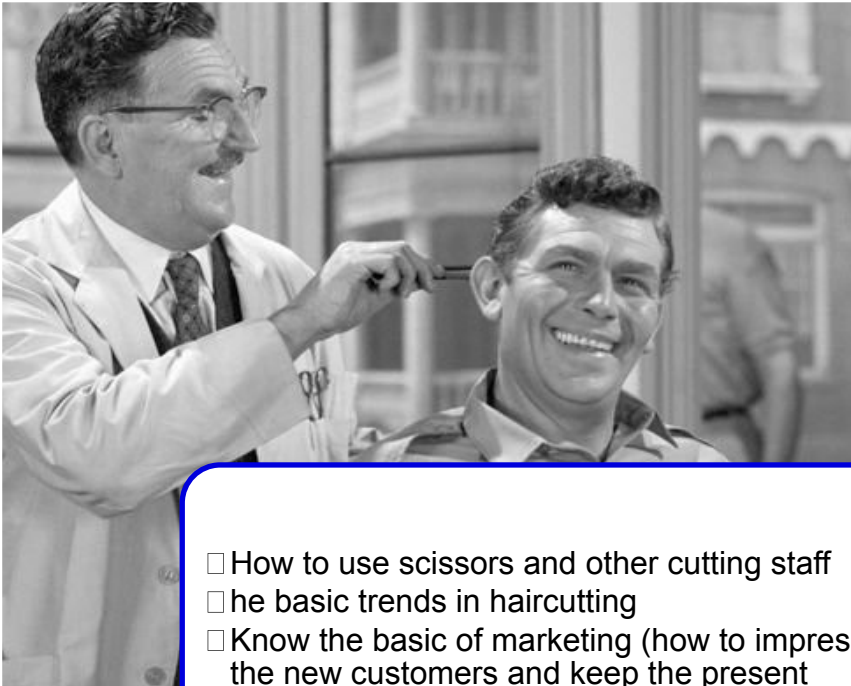
The final value depends on

- Response of customer
- The resources currently used
- Interaction with other entities in the environment

All services became more complex

Example: Hairdresser

1960



- How to use scissors and other cutting staff
- The basic trends in haircutting
- Know the basic of marketing (how to impress the new customers and keep the present ones)
- Know the basic of taxation and bookkeeping

2024



Help of Service approach

The key element of all services is:

- Value – usefulness or utility for the receiver of the service
- Value proposition – description of the value in the language of receiver

Based on this we divided the Smart City services to the layers depending on their value proposition.

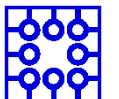
- Do they serve for final user (citizen, administration) or are they just „inputs“ for other services?

IT services

Supporting services

Smart services

Smart features



Value and its features

Value is considered to be an improvement in a system, as perceived by the system itself or by the ability of the system to be integrated in its environment.

Value creation takes place as a potential resource has become an effective specific benefit.

Value co-creation has a win-win logic that considers the interaction among different entities represented by various service systems and by the desire to reach collective mutual satisfaction, in which the active contribution is multiple, the integration is maximum, and complementarity is fundamental.

The contributions of knowledge, the application of skills, the ability to configure and reconfigure, and the desire to maintain relationships with long-terms subjects considered strategic all represent the elements of a systemic way of being adaptive.

Value is perceived and determined by the customer on the basis of value in use (through the previously defined consumption process);

Smart features

On top of the Smart Services Structure

Their value proposition is formulated for the city citizen

They are about to define the perception of Smart City

Smart Energy, Smart Mobility, Smart Environment

Smart Services

They support Smart Features

- Value proposition is formulated in the way to be understood by Smart Features Providers

But they can be used also directly by city citizens

- Than they have also the second (or more) value proposition

Smart Buildings, E-mobility, Traffic control

Supportive services

They are design to support Smart Services

- They serve for more than one Smart Service
- They are still very complex

They have specific value proposition

- Can't be understood by citizens
- The formulation is more on expert level
- There can be one, general value proposition for more Smart Services

Smart Grid, Smart Charging, Smart Monitoring

Supportive IT services

Implementation of the services rely on the ICT infrastructure

- In many cases the services are sharing the infrastructure
- We need to avoid possible turbulences (overloading of the infrastructure)

From the IT architecture perspective, we can identify two sub-categories

- Hardware
- Software

Hardware

It represents all „tangible“ parts of Smart City infrastructure - it contains

Sensors – to measure and collect information about different devices.

Actuators – to command devices when urged by control mechanisms.

Servers – to store data and run computation and processing.

Network – to mediate communication among other elements of the infrastructure.

Software

OPEN DATA – they are to the development of the innovative applications, based on the datasets the city currently has.

Referred to Software IT Services

■ Data collection – the service of gathering different types of data from different sources (devices, sensors, etc.).

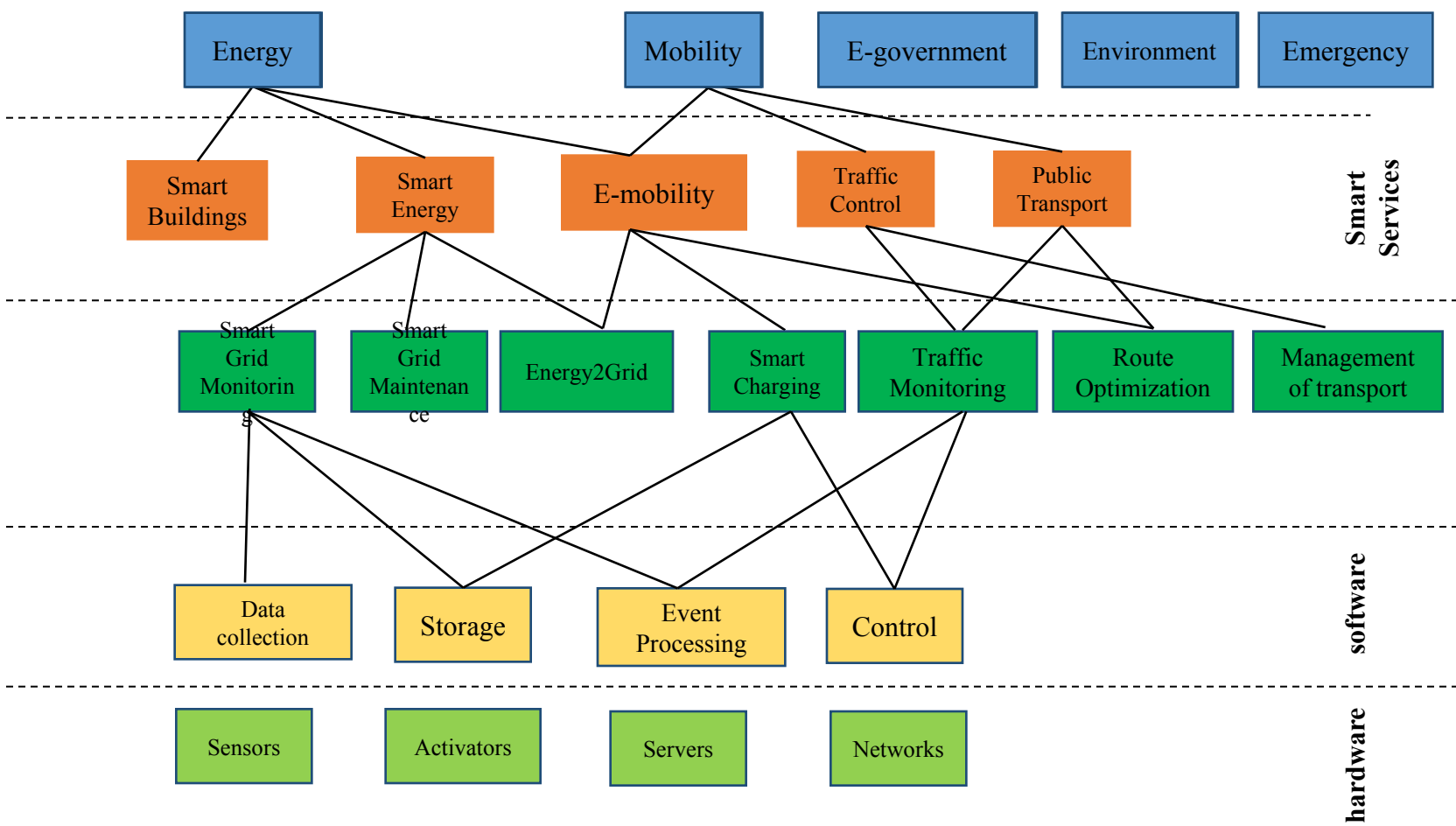
■ Storage – the service enabling to store the selected data for their later use and processing.

■ Event processing – online and offline processing of events necessary for later decision support.

■ Control – commanding of devices in the infrastructure (for instance to switch on/off or to update their software).

Layered model Smart City

Smart Citizen



Features

Smart Services

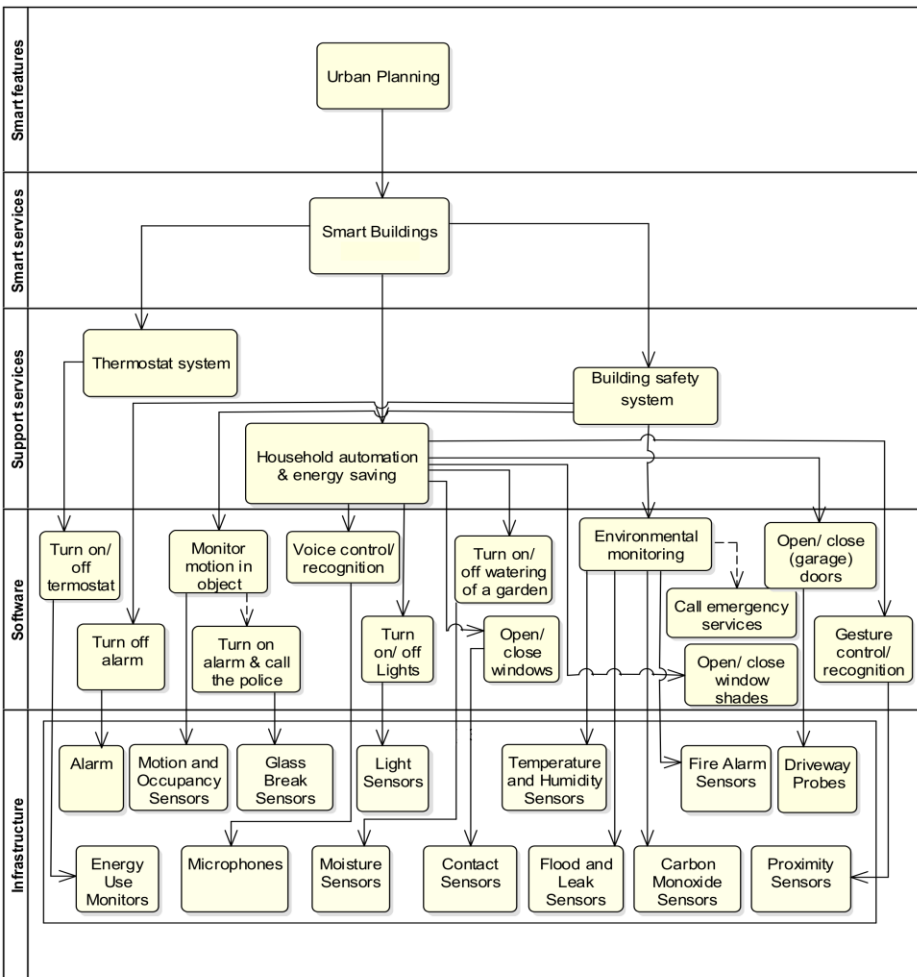
Supporting services

software

hardware

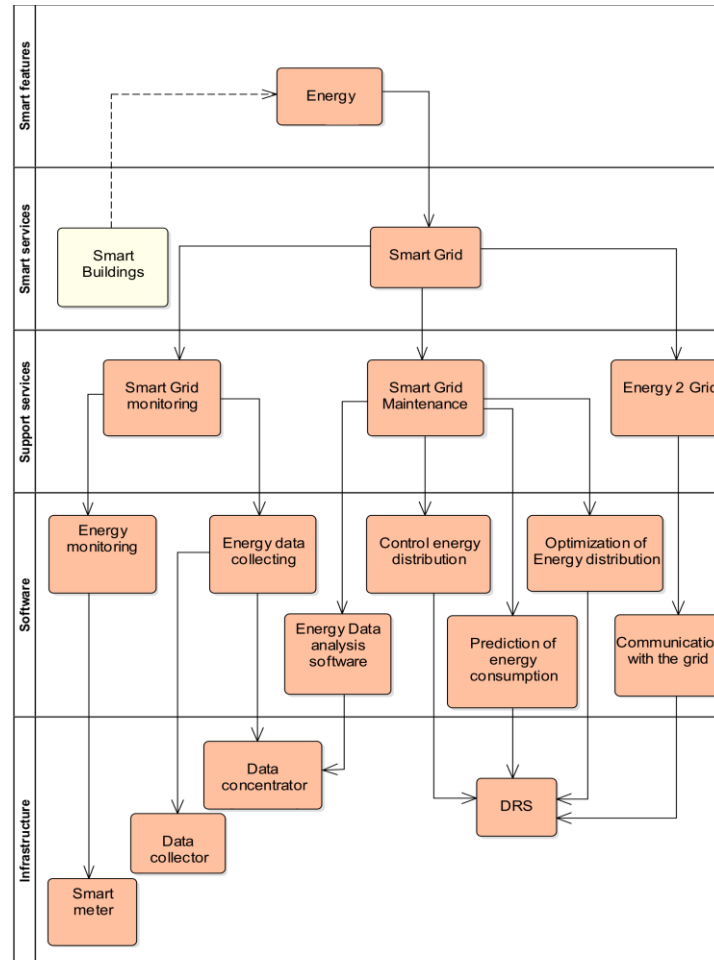
Waltzky L., Buhnova B., Carrubbo L. (2018) Value-Driven Conceptualization of Services in the Smart City: A Layered Approach. In: Barile S., Pellicano M., Polese F. (eds) Social Dynamics in a Systems Perspective. New Economic Windows. Springer, Cham

Detailed Layers' analysis

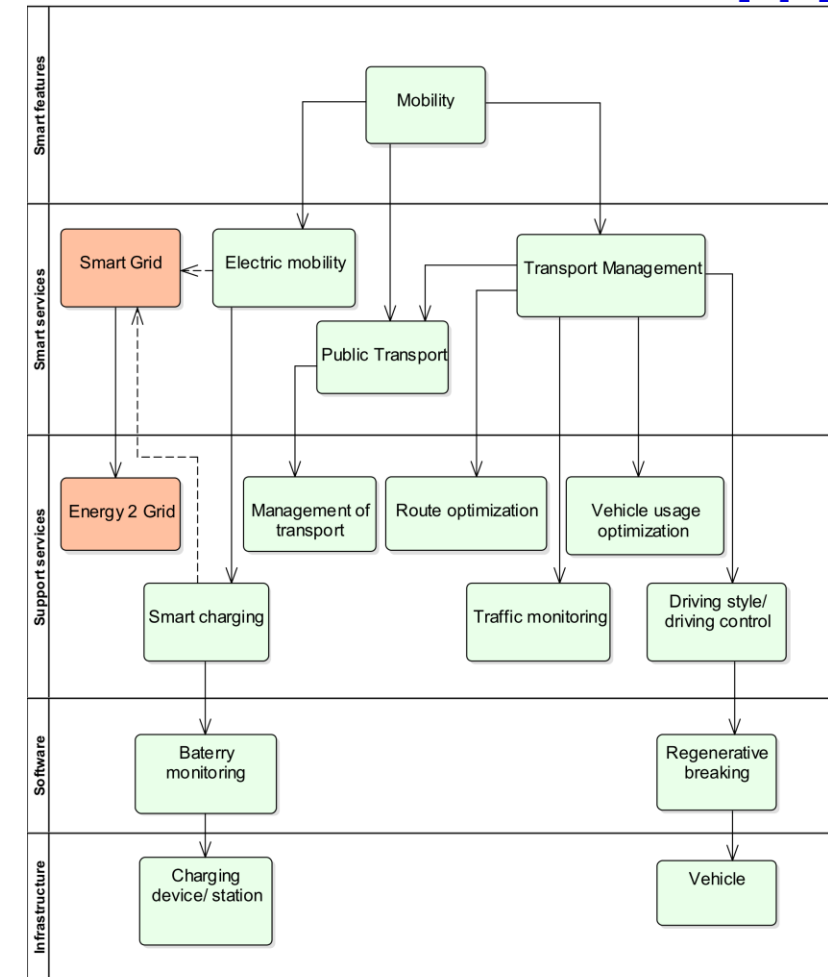


Urban planning

Walletzky L., Buhnova B., Carrubbo L., Kazickova, T., Ge, M. (2020) Layered Landscape of ICT and Citizen Services in the Smart City



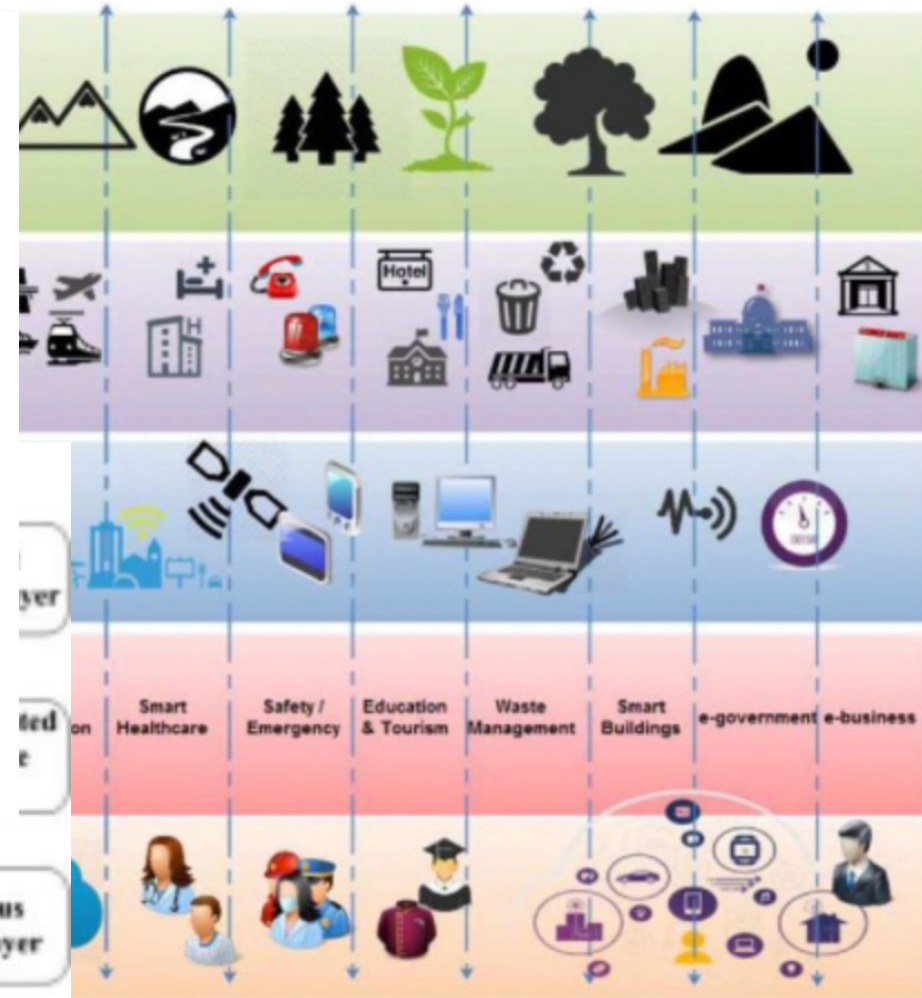
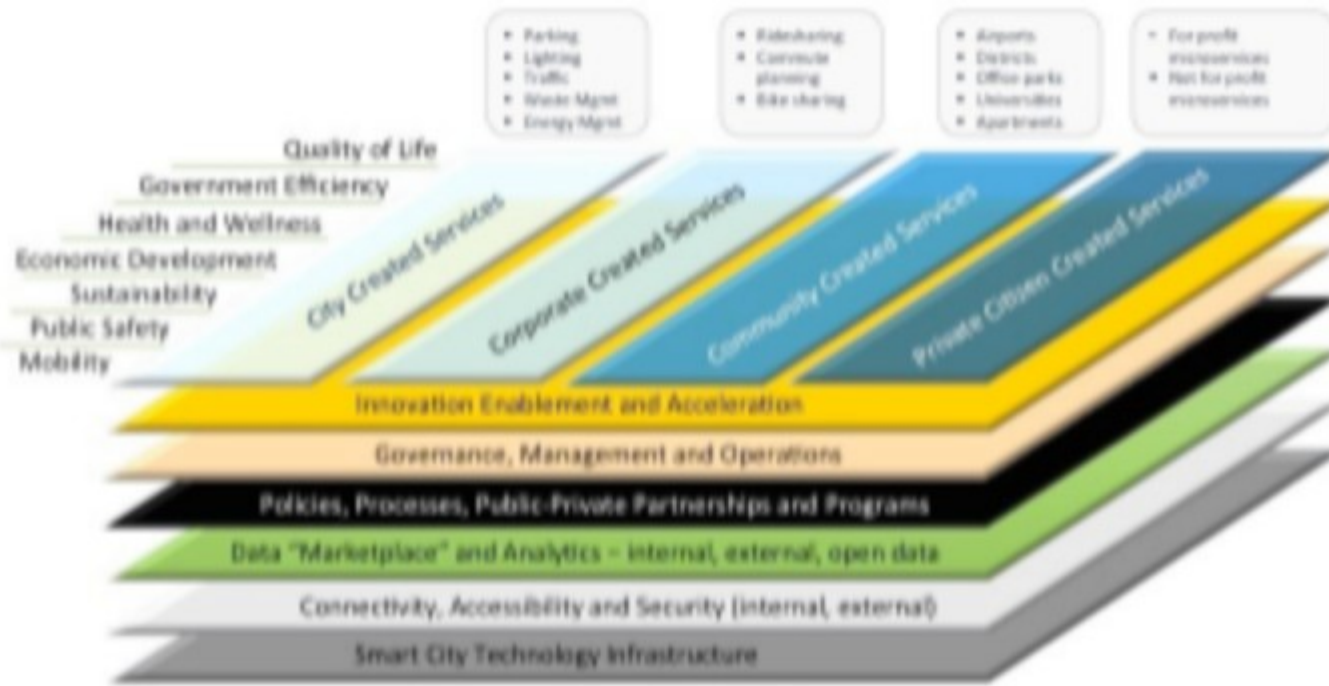
Smart Energy



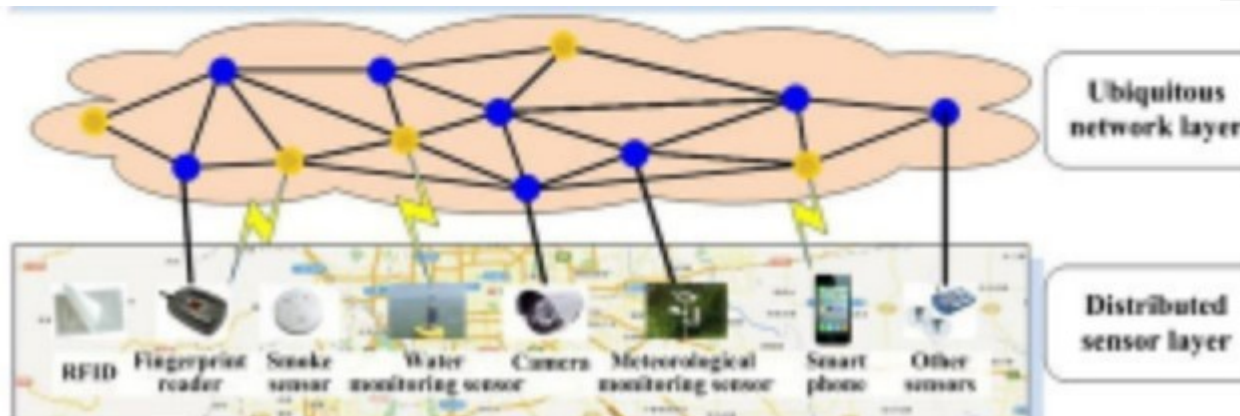
Mobility



The journey continued



Multi-tier ICT architecture for smart city [31]



The main requests to the model

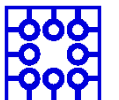
Understandable to the most of actors (common language)

Reflecting the structure and dependencies of the service

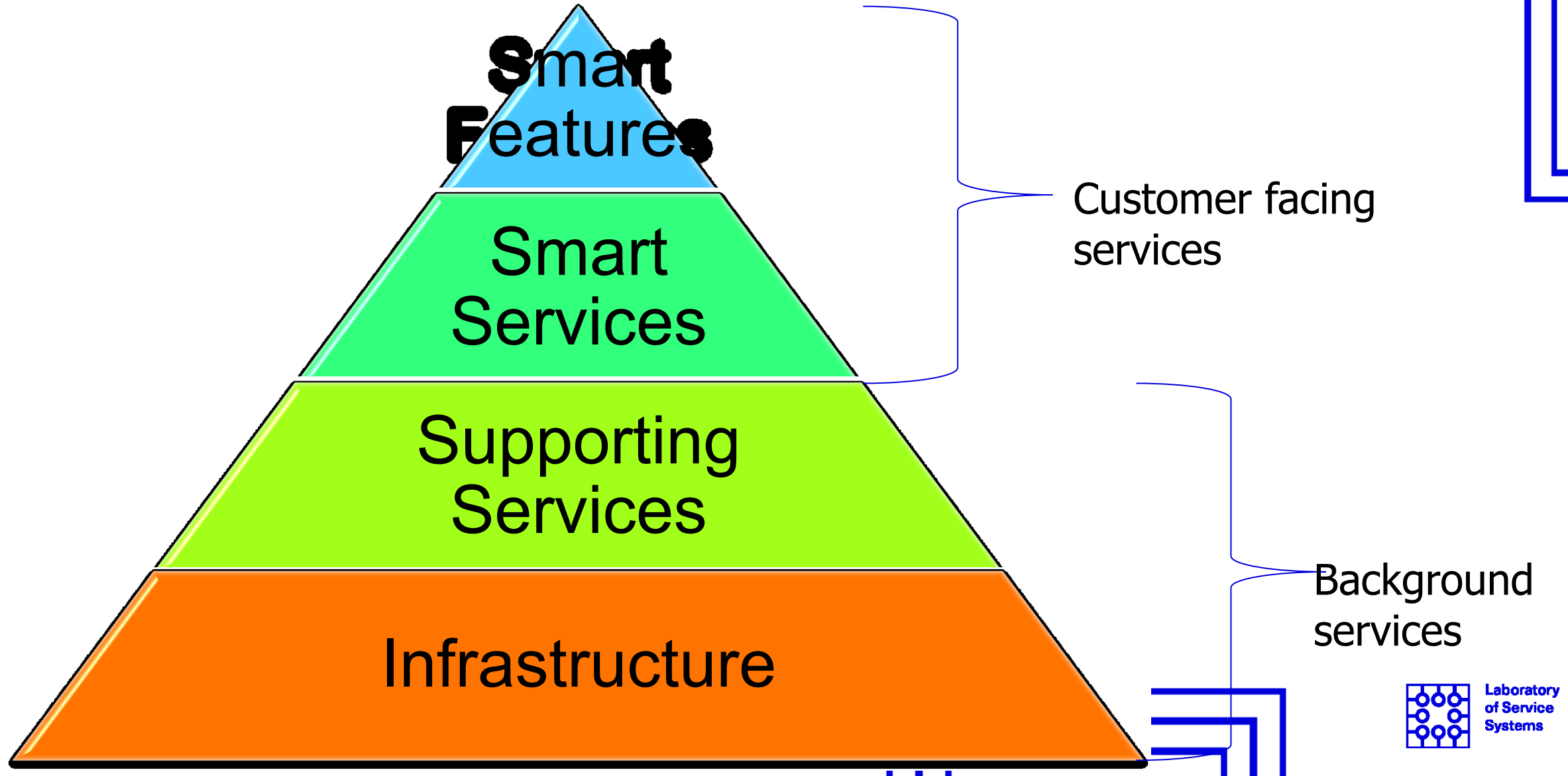
Enabling the value analysis

Multicontextual

None of the studied models (including ours) does not fit to all points



New developed model

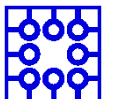


Why do we need such complicated structure?

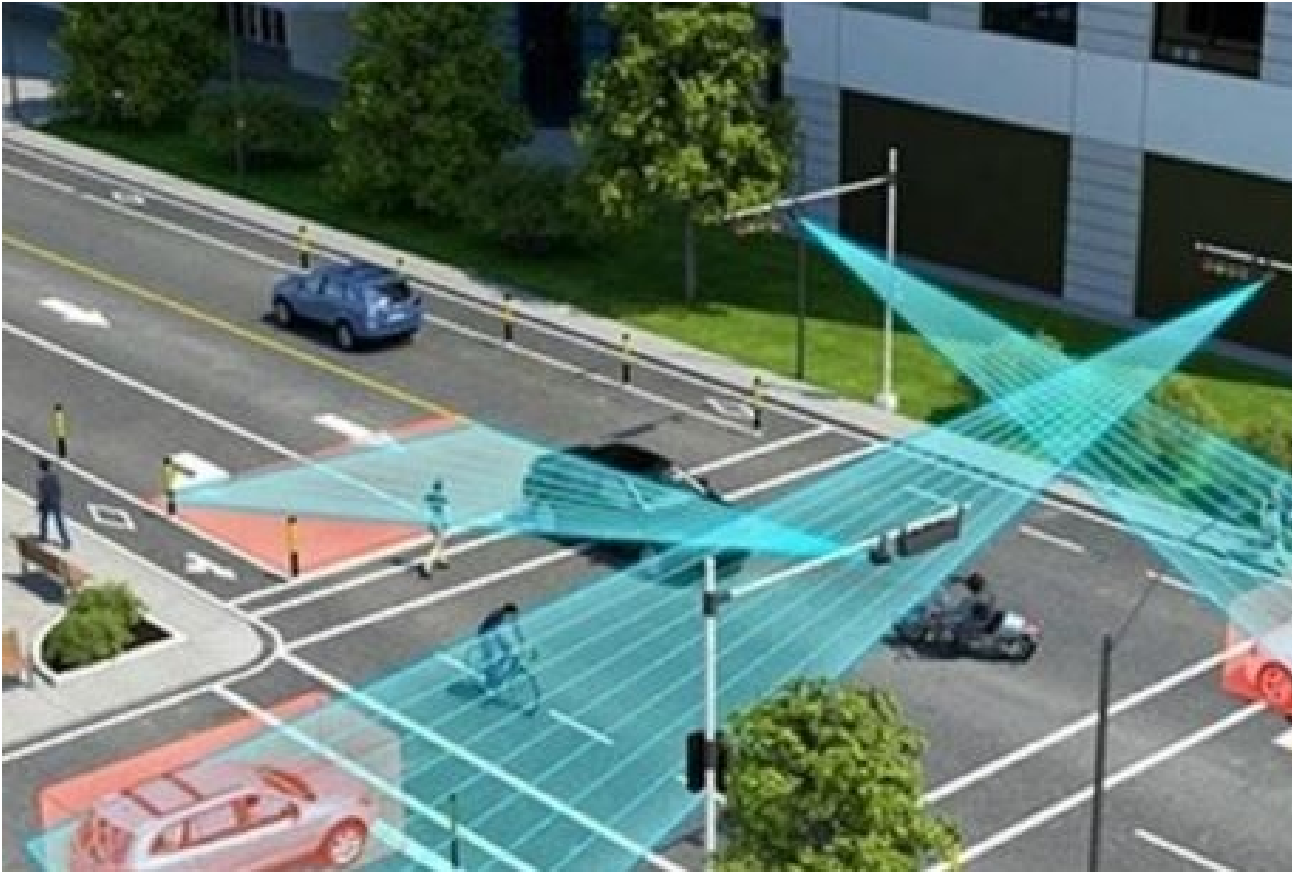
To understand the relations, consequences and links is the key to avoid the risks

The source of the risk can be hidden „somewhere“ in the structure of services

The correction can have unexpected consequences



Example I. - cameras



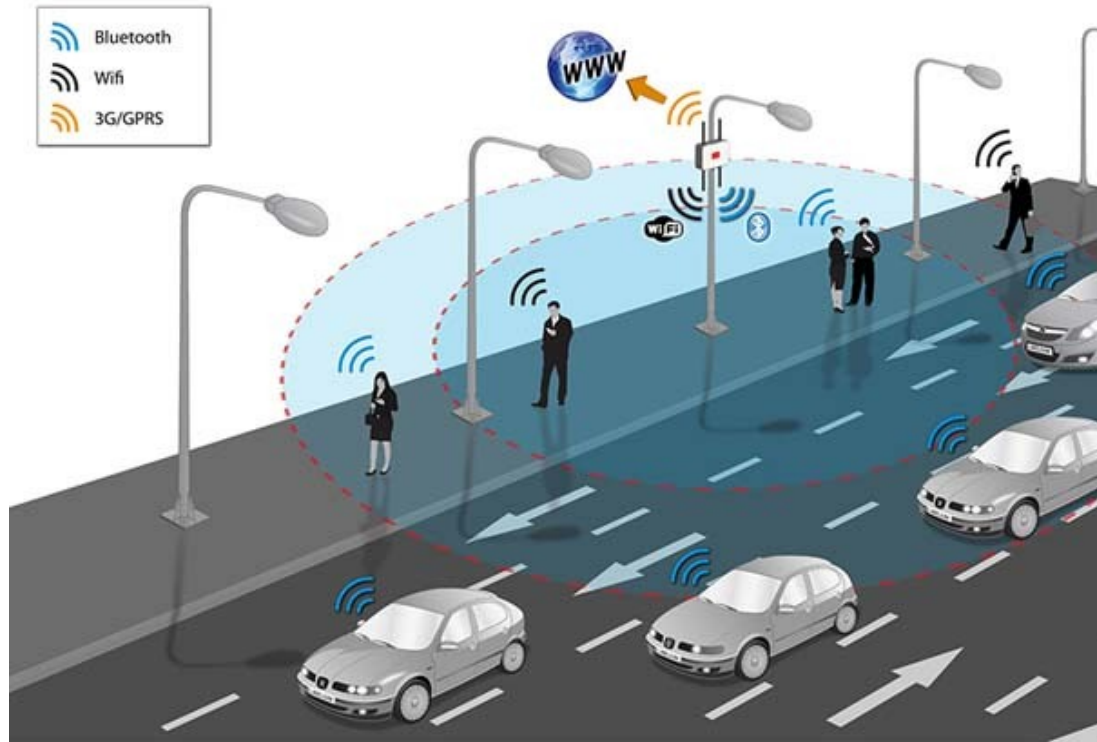
Every city want to prevent accidets, criminality and other negative events

A lot of the cities are equieped with the cameras (simple or with AI)

BUT

- Are the cities also familiar with the risks?
- Cybersecurity risks – admin password: <http://www.insecam.org/en/bytype/Foscam/>
- The cameras can be hacked and used for penetration of the system

Example – Smart lighting



The positives are obvious

Energy saving

More installed features

- Wi-Fi connection
- Mobile charging
- Many additional sensors for monitoring

Light is adapted to current situation

- Sunrise and sunset
- Nobody and nothing on the street

Self check to prevent mis functionality

Can we find any negative experiences?

Example I – Install when you are ready

One Czech city decided to use the government support to change really old equipment of public lightning to the completely new devices. They select the company and ordered smart lightning, equipped also with sensors, monitoring the air pollution, noise, and other aspects of city life. All devices were already support for Wi-Fi and there were no needs for additional investment to the infrastructure.

After installation they found they are not getting any data during a day. Why it was possible?

Explanation

The new public lighting was connected to the old infrastructure and it was automatically turned on only during a night. During a day it was automatically turned off with no power.

The city had to invest more money into new infrastructure – it was necessary to change everything including wires.

The official start of a new technology was postponed for 2 years.

Ok, but if we have a good infrastructure....?

Example 2 – Sometimes Smart is not enough....

In another Czech city the smart lightning was installed, including completely new infrastructure. Everybody was excited. The lights were lowering and increasing the intensity of light according of pedestrian or car presence on the street.

After some time a several accidents happened on the streets. The car drivers could not see the pedestrians and bikers on time.

All participants and witnesses reported a very slow or delayed response of lamps

After a year the city changed smart laps back to „silly“ lamps

Explanation

The lamps were equipped with movement sensors to increase the light intensity when the car was coming

The problem was that they assumed the car speed will be not higher than 50 km/h. But, especially during the night, it was.

The lamps were not able to react on time for higher speed and turned on after the car was gone

Nobody analyzed the situation before and there were no will correct it after

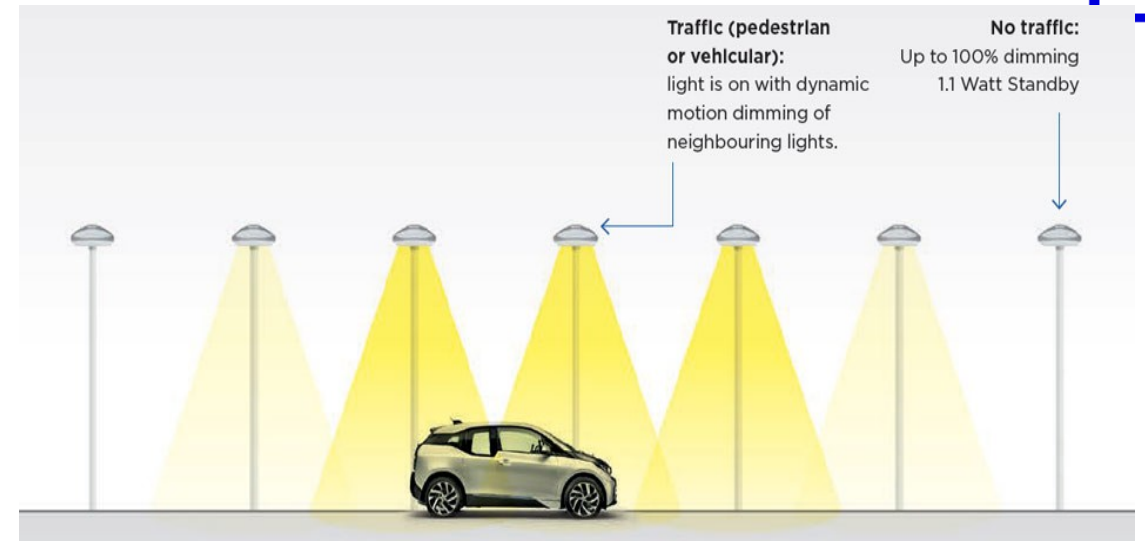
Possible solution

In other Czech city they solved situation in different way

They cooperate with innovative startup to create software to enable the lamps to communicate with each other

They created solution when the lamp can inform the others the car is coming, can measure its speed and if it is over the limit, inform the police

The effect was that the accidents simply disappeared.



Conclusion

Smart City is more complex and complicated environment than we expected

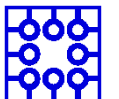
Design of the services within the Smart City is complicated and hard to manage, there are many stakeholders with different goals and interests

Some consequences are hard to find

- They would appear in other context
- Improvement in one context leads to the failure in another (f.e. overload of infrastructure)

The competencies and knowledge needed for the Smart City Service design needs to be investigated

The main goal is to ensure an easier and more efficient way of the Smart Services design and realization



Sources

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