# PANEL

# Systems and Software for Cyber Smart Cities: Promises and Recent Advances

**Moderator**

**Petre Dini, IARIA, USA**

**petre@iaria.org**

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# Smart Cities: A growing reality

- **SMART CITIES | misuse, misleading, marketing, buzzwords, trendy, ...YET, A REALITY**

- **:) new car color --> a 'brand new car'. ...**
  **:) counters for street-crossing | flashing 6,5,4... --> smart cities**
- **=>> smart city**

  **| citizen-centric (utilities, comfort, health, well being, work, ambient, relaxation, culture/schools/information, protection, safety)**

  **| technologies (safety, protection, speed, scalabiltiy, mobility, etc.)**

  **| software (behavioral models, cognitive models, body-software, interactive interfaces, apps, etc.)**

  **| side-effects (health, pollution, noise, crowd-stress, excluded citizens, etc.)**

  **| cyber-aspects (attacks, instability, conflicting decisions, citizens in danger, lack of resources, poisons, health-danger, lack of services, etc. )**

# Facets of Smart Environments (Cites)

– **Urban traffic safety apps | security/communication**

– **Traffic optimizing services | special algorithms/real-time**

– **Localizing street services (gas, stations, electrical, foods, etc.) | graphics/visual/interfaces**

– **Tracking citizen | elderly | geolocation | geolocaiton in IoT |**

– **City service mapping/location | cartography software | cloud-based services | interactive software | dedicated apps**

– **Wearable smart devices | special screen/interface | special body-related software | body sensing apps | … chip for monitoring alcohol/drugs**

– **Body systems | special software execution systems | balancing procedures execution/data volumes**

– **Sensing and data processing | data fusion, data mining, pattern recognition**

– **Accessibility services | special interfaces | distributed software for bus/pedestrian/disabled drivers**

– **Forecasting services | databases, datasets, information mining techniques, machine learning**

– **Sensing and dissemination info on pollution and noise | surveillance, alarm systems, optimal traffic rerouting**

– **Public services | waste management |mobile sensing | waste estimation | redirecting services where needed**

– **City evolving services/systems | version software managements, rule-based systems, run-time updates and testing**

– **Smart utility control/measurement/payment | gas + electricity + | special/dedicated networks + software**

– **Goods/products delivery | drones systems**

–**Self-driving cars + electric cars | artificial intelligence + cognitive modeling +**

- **etc. | etc.**

# ALL-in-ONE

- **ALL-in-ONE: what we already knew, but at a higher level of citizen-oriented service**

  **(i) Algorithms | data | database | methodologies | protocols | measurements (as 60s .. 2020) |**
  **(ii) (IoT, Big Data, ML, AI, CLOUD, NFV/SDN, Fog/MEC, 5G/6G/7G, slicing, sensing, mmWave, ) (as nowadays and beyond)**

  **Additional dangers/unknown**

- **smart city: is a very complex system/environment**
- **in general: complexity decreases safety**
- **especially: uncontrolled moving entities (self-driving), incidentally dropping (drones), enormous and diversified data, heterogeneous decision-owners, conflicting decisions, situation changes**
- **help expectations: technologies (speed, accuracy), deep-analytics/thinking on data, real-time sensing, limitation of security threads (slicing, blockchains,..), wearable/implantable devices**

# Panel Experts

**Gary Weckman, Ohio University, USA**

**Data Mining and Data Analytics for modeling and analysis of complex situations such as Smart City**

**Tewfiq El Maliki, hépia HES-SO, Switzerland**

**IoT security trends and Smart City**

**Eugen Borcoci, University POLITEHNICA Bucharest, Romania**

**Dedicated technologies for smart cities: NFV+ SDN, Fog/MEC, application in 5G and smart cities.**

# Thanks

# Q&A

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# NexComm 2018

## Panel on Systems and Software

## Theme: Systems and Software for Cyber Smart Cities: Promises and Recent Advances

# Edge Computing Technologies for Smart Cities Applications

**Eugen Borcoci**
**University Politehnica Bucharest**
**Electronics, Telecommunications and Information Technology Faculty ( ETTI)**

Eugen.Borcoci@elcom.pub.ro

**NexComm 2018, Athens 22-26 April 2018**

# Edge Computing Technologies for Smart Cities Applications

- **Smart cities - need to be supported by powerful technologies**
  - ***Computing ( Cloud, Edge, …)***
  - ***Networking ( 5G, Core networks, ..***
  - ***Services ( user-friendly, flexible, on demand, …)***
- **Cloud computing (CC)** is more and more used, including private/local and mixed cloud development
- However, **centralization** of traditional CC (processing and storage) may lead to some **limitations**
- **Novel services and applications like IoT, mobility-related, .. would be better served by decentralized systems**
- **Edge networking devices and even user terminals – more powerful** in terms of processing, storage, communication capabilities

# Edge Computing Technologies for Smart Cities Applications

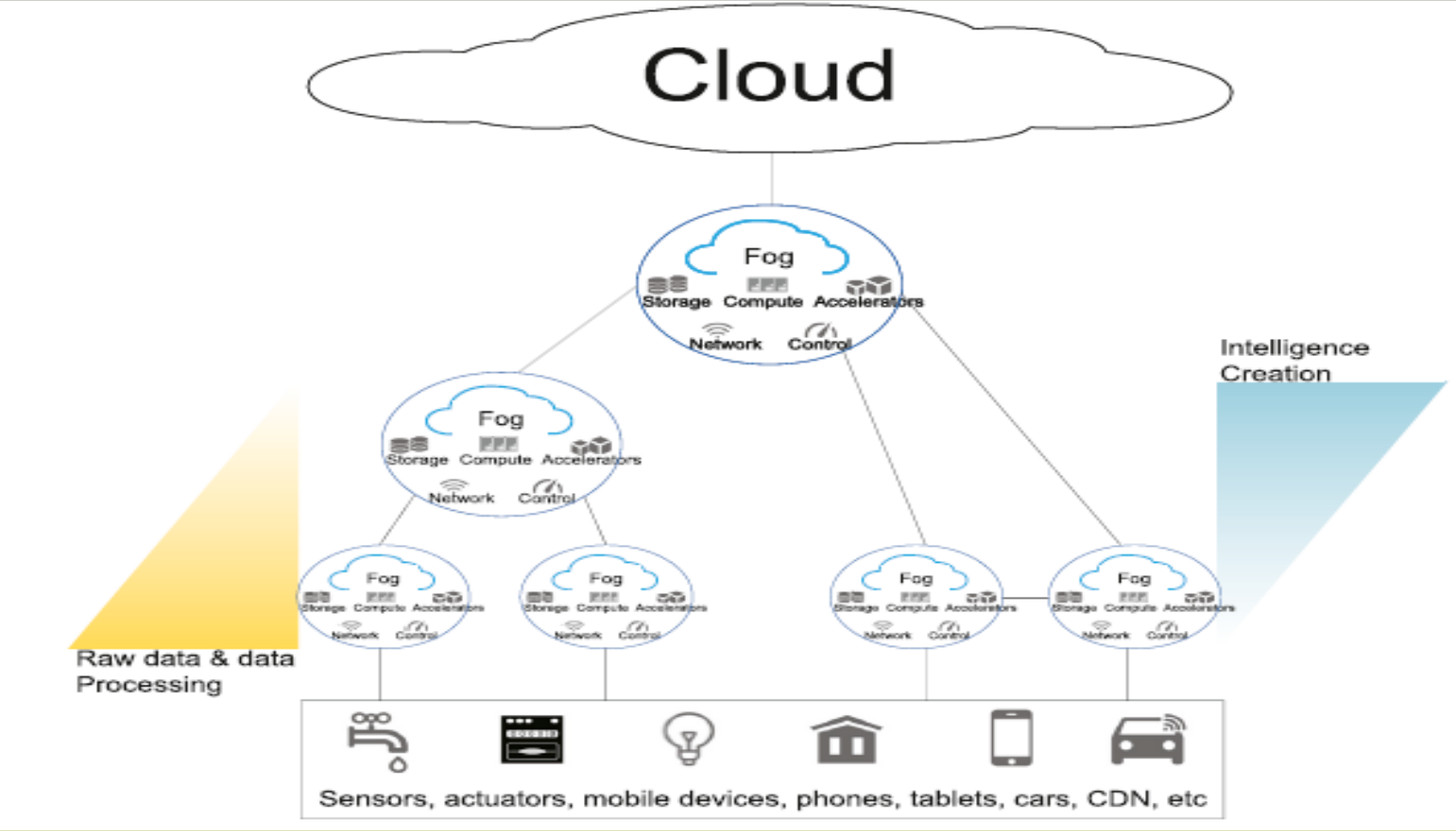
- **Edge computing solution**
  - **Fog Computing, Mobile Edge Computing, Cloudlets, Microdata centers, ..**

- **Fog Computing (FC)** - (*CISCO* ~ 2011) extends the CC to the edge of networks, in particular wireless networks for IoT
  - FC nodes (FCNs) are typically located away from the main cloud data centers, i.e., at the network edge
- **Mobile Edge Computing (MEC)** – *ETSI* - an industry spec. ~2014.
  - MEC pushes the CC capabilities close to the **Radio Access Networks** in 4G, 5G
  - ETSI is developing a system architecture and std. for a number of APIs
- **Cloudlet** –*Carnegie Mellon University* ~2013)
  - A cloudlet is middle tier of a 3-tier hierarchy: 'mobile device – cloudlet – cloud'
  - Cloudlet ~ "data center in a box" whose goal is to "bring the cloud closer"'.
- **Micro datacentre** –*Microsoft Research- ~2015*
  - Extension of today's cloud data centers (as Microsoft Azure)
  - to meet new application demands (mobility, latency, power consumption, ..)

- **They include partially overlapping concepts and are also complementary**

# Edge Computing Technologies for Smart Cities Applications

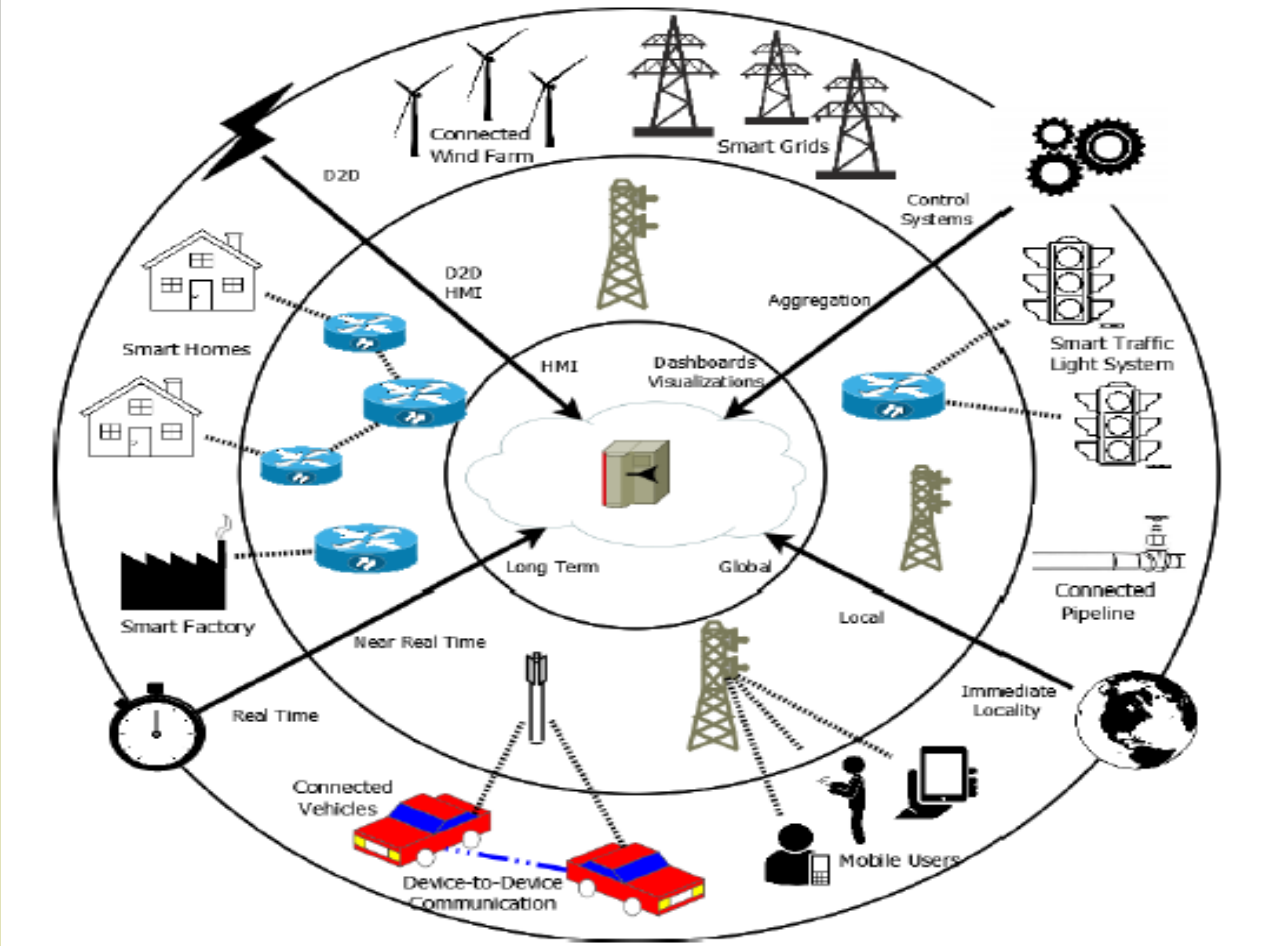
- **Fog Computing**




*Source [1 ]: Yuan Ai, et.al., "Edge computing technologies for internet of things: a primer" Digital Communications and Networks xxx (2017) 1–10 , https://www.sciencedirect.com/science/article/pii/S2352864817301335* http://arxiv.org/abs/1601.02752

# Edge Computing Technologies for Smart Cities Applications

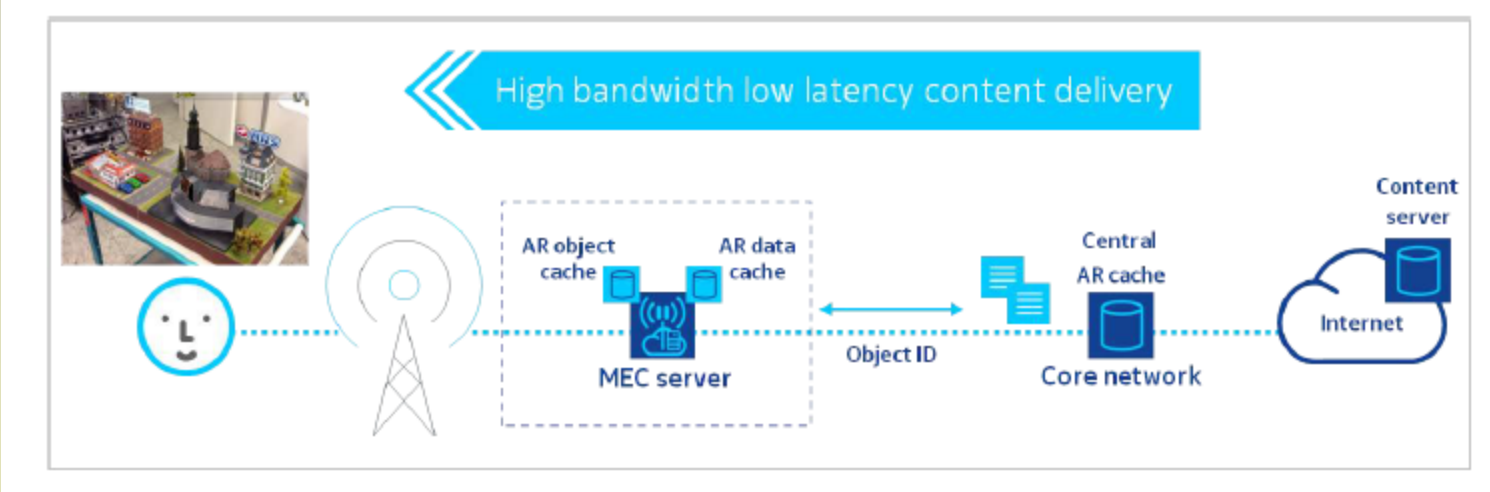
- **Fog/Edge (FC) use cases examples**




*Source [2]: A.V. Dastjerdi, et.al., "Fog Computing: Principles, Architectures, and Applications", 2016, Book Chapter in Internet of Things: Principles and Paradigms, http://arxiv.org/abs/1601.02752*

# Edge Computing Technologies for Smart Cities Applications

- **MEC Use Cases examples**
- **Augmented Reality (AR) content delivery**
  - An AR app. on a smart-phone or tablet - overlays augmented reality content onto objects viewed on the device camera
  - App. on the MEC server can provide local object tracking and local AR content caching
    - RTT is minimized and throughput is maximized for optimum QoE
    - Use cases: offer consumer or enterprise propositions, such as tourist information, sporting event information, advertisements etc.

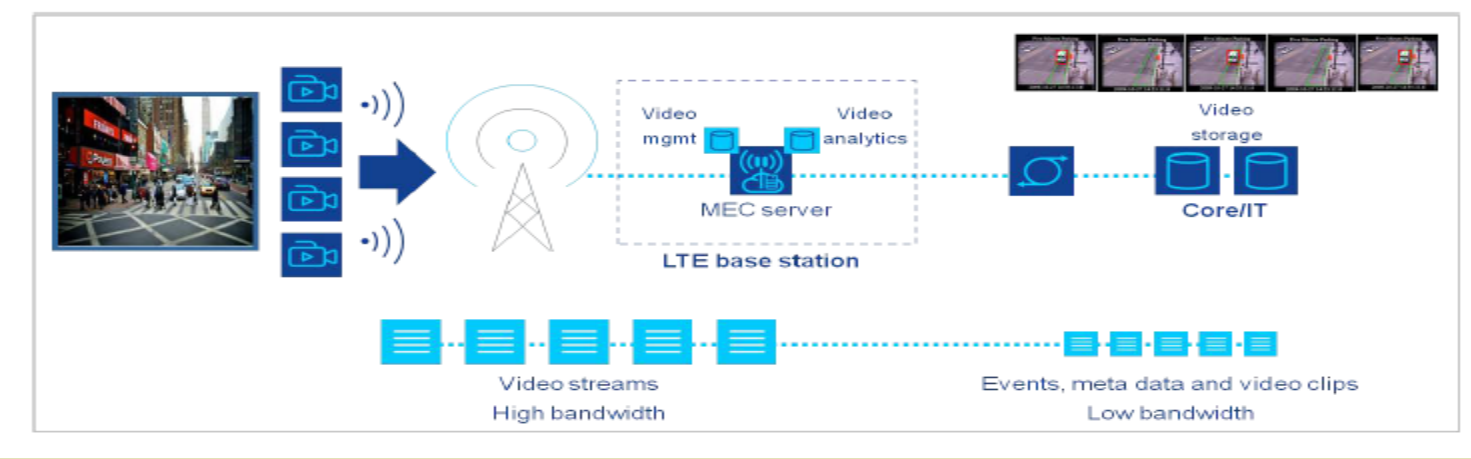



*Source [3 ]: https://portal.etsi.org/Portals/0/TBpages/MEC/Docs/Mobile-edge_Computing_-_Introductory_Technical_White_Paper_V1%2018-09-14.pdf*
*Mobile-Edge Computing – Introductory Technical White Paper*

# Edge Computing Technologies for Smart Cities Applications

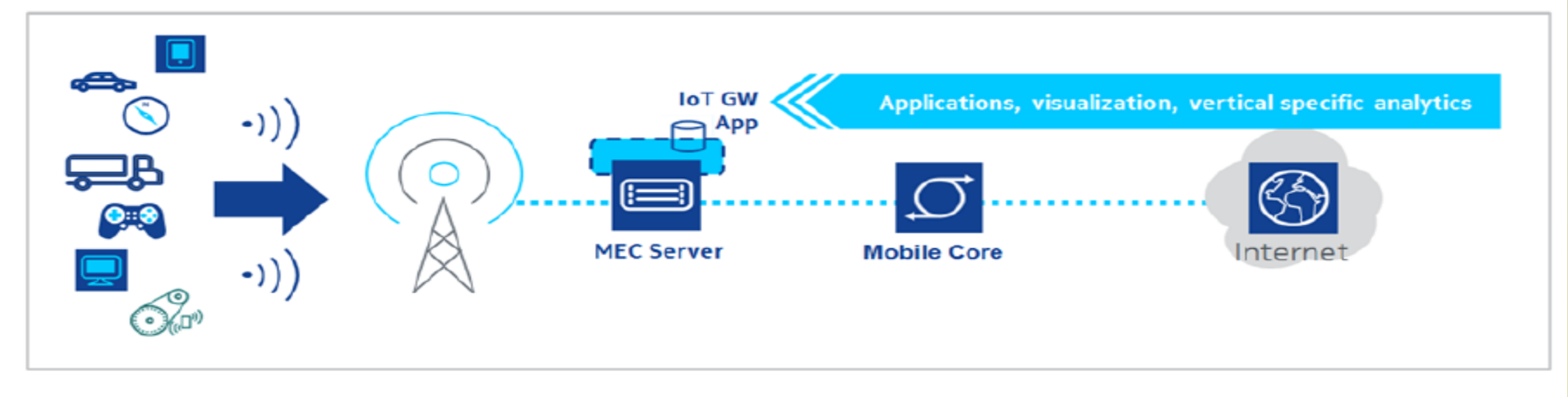
## MEC Use Cases examples

- **Video Analytics**
  - distributed video analytics solution: efficient and scalable mobile solution for LTE
  - The video mgmt. application transcodes and stores captured video streams from cameras, received on the LTE uplink
  - The video analytics application processes the video data to detect and notify specific configurable events e.g. object movement, lost child, abandoned luggage, etc.
  - The application sends low bandwidth video metadata to the central operations and management server for database searches. Applications : safety, public security to smart cities



# Edge Computing Technologies for Smart Cities Applications

- **MEC Use Cases examples**
- **Internet of Things (IoT)**
  - IoT generates additional messaging on telecoms networks, and requires gateways to aggregate the messages and ensure security and low latency
  - Required: real time capability; grouping of sensors and devices is needed for efficient service
  - IoT devices are often low (processor, memory capacity)→ need to aggregate various IoT messages connected through the mobile network close to the devices
  - This also provides an analytics processing capability and a low latency response time.




*Source [4 ]: Yun Chao Hu et.al., "Mobile Edge Computing A key technology towards 5G" ETSI White Paper No. 11 September 2015, ISBN No. 979-10-92620-08-5*

# Conclusions

- **Edge computing – strong candidate to support smart cities applications**
- Need of harmonization between different actors
  - Std. organizations
  - Research groups, academia
  - Forums
  - Industrial actors
  - ….

  - related to (vision/concept, architecture, specification, deployment, implementation, etc.)

# Edge Computing Technologies for Smart Cities Applications

## References


1. Yuan Ai, et.al., “Edge computing technologies for internet of things: a primer” Digital Communications and Networks xxx (2017) 1–10 , https://www.sciencedirect.com/science/article/pii/S2352864817301335 http://
2. A.V. Dastjerdi, et.al., “Fog Computing: Principles, Architectures, and Applications”, 2016, Book Chapter in Internet of Things: Principles and Paradigms
3. Mobile-Edge Computing – Introductory Technical White Paper https://portal.etsi.org/Portals/0/TBpages/MEC/Docs/Mobile-edge_Computing_-_Introductory_Technical_White_Paper_V1%2018-09-14.pdf
4. Yun Chao Hu et.al., "Mobile Edge Computing A key technology towards 5G" ETSI White Paper No. 11 September 2015, ISBN No. 979-10-92620-08-5

h e p i a
Haute école du paysage, d'ingénierie
et d'architecture de Genève

Hes·so
Haute Ecole Spécialisée
de Suisse occidentale
Fachhochschule Westschweiz
University of Applied Sciences and Arts
Western Switzerland

# Security trends IoT
## SmartCity

*Pr. Tewfiq El Maliki*

# IoT faces new attacks : Context

- September 2016, 1Tbps DDoS attack
- **Attacks launched by a botnet composed of 150’000 IoT devices**
- System & application complexity growth
    - Brittle, unmanageable, insecure

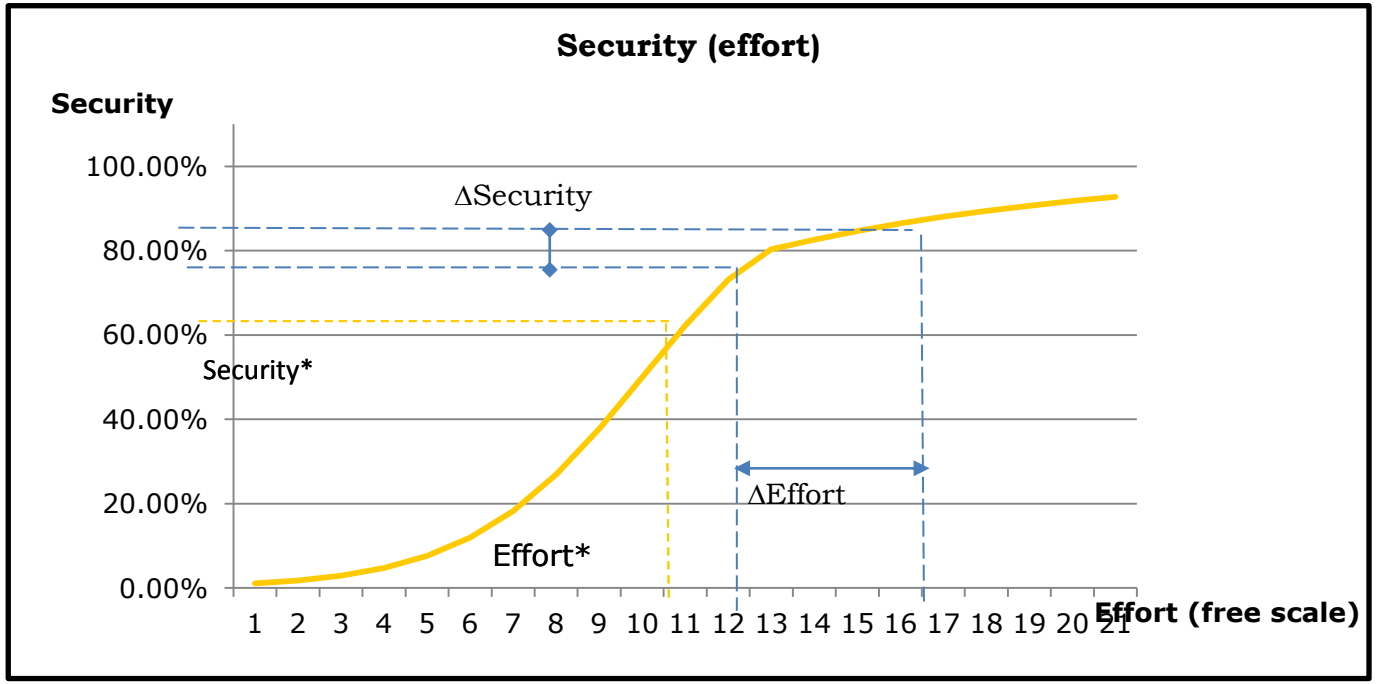
# Attaques on Self-organized Network : More than 30

- *Jamming attack*
- *Wormhole attack*
- *Blackhole attack*
- *Byzantine attack*
- *Traffic analysis*
- *Routing Attacks:*
  - *Routing Table Overflow*
  - *Routing Table Poisoning*
  - *Packet Replication*
  - *Route Cache Poisoning*
  - *Rushing Attack*
- *Resource consumption attack*
- *IP Spoofing attack*
- *State Pollution attack*
- *Sybil attack*
- *Fabrication*
- *Modification*

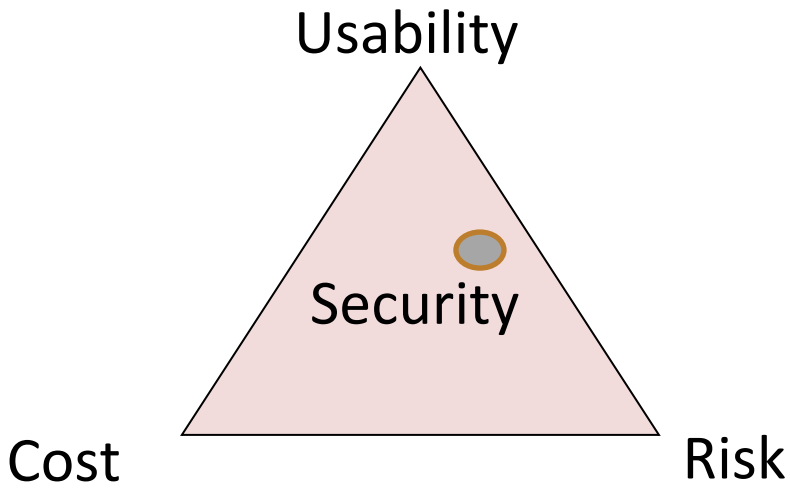
- ***Location disclosure attack***
- ***Session Hijacking attack***
- ***Repudiation attack***
- ***Denial of Service attack***
- ***Flooding attack***
- ***Colluding misrelay attack***
- ***Device tampering attack***
- ***Gray hole attack***
- ***Link spoofing attack***
- ***Neighbor attack***
- ***Jellyfish attack (Subset blackhole)***
- ***Packet dropping attacks***
- ***Impersonation or Spoofing attack***

- ***Sleep deprivation torture***
- ***SYN Flooding attack***
- ***Malicious code attacks***
- ***Illusion attack***
- ***Link withholding attack***
- ***Bogus attack***
- ***Identity disclosure attack***

# Security vs. Cost



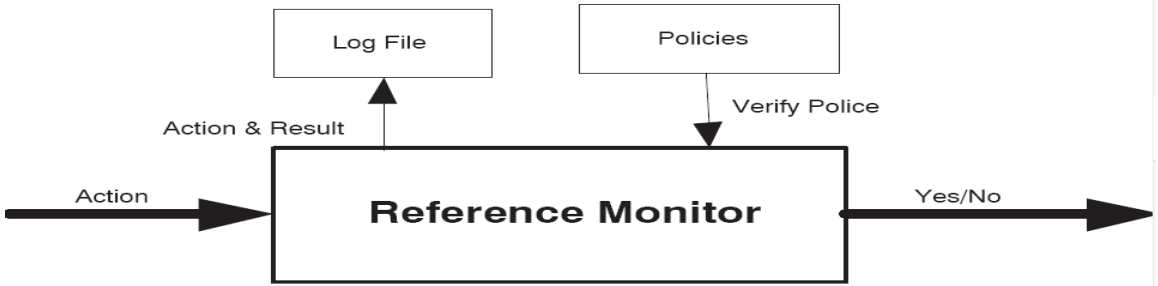
# Static vs. dynamic security

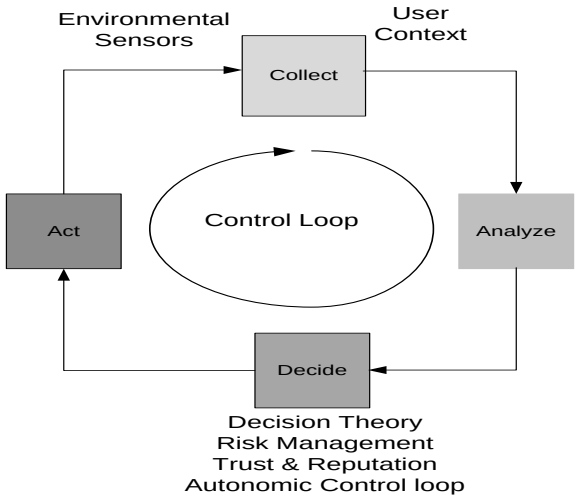


# How to solve security problems?


# Reference Monitor and control Loop

- The concept was introduced in (1972)
  Autonomic system Started by IBM in 2001



# Security of IoT

Motivation

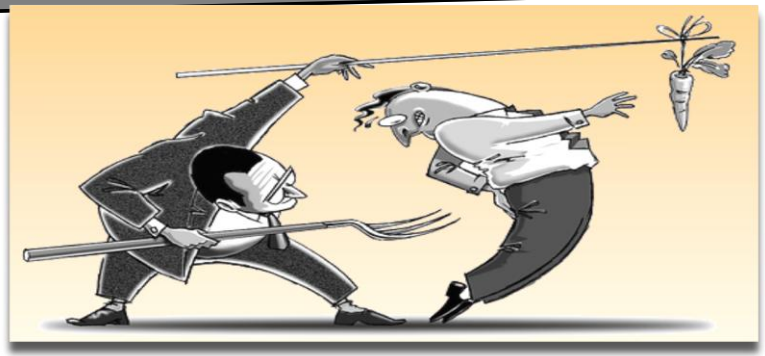
Complexity # security Ab initio

Diversity of attacks # Cross layering security

Context changing # security adaptation by looping

Cost # security #usability

Software and hardware security



Simple is difficult

If there are problems, engineers will live


# Data Analytics and Data Mining for modeling and analysis of Smart Cities

**Gary Weckman**

**Ohio University, USA**

# Concerns for data

- developing data repositories and mining packages to address a number of problems related to smart cities
- identify irregular patterns and bottlenecks which will aid city to optimize their transportation
- integrate this information with real time traffic data and weather conditions to develop more accurate predictions to help commuters
- unavailability of realworld datasets and test environments to evaluate models and techniques have slowed progress

# Critical Research Challenges

- economic (who pays?)
- policy (privacy and data access)
- technology (cybersecurity, precision timing, and data analytics)
- overall coordination (standards and interoperability).
- different collection sources
- various sensors
- network infrastructures
- consolidate in a usable format
- quality of information

# Vision of smart city

- integrate information communications technology

  physical infrastructures

  transportation

  improving living standard

  large-scale applications in cities

- collect reliable real-world dataset for modeling
- aid decision-making for improved services
- analyzing massive data generated by different sensors
- incorporate analytics platforms and tools that are able to handle diverse datasets
- design platforms and solutions that can coordinate functions across a smart city

# Review research efforts in smart cities

- create adequate insight on the development
- develop a tool using real-time extraction of real-world data that can be useful in research and development for advancing the concept
- explore existing tools and communication networks
- support smart city communications

- Goal: collect and analyze real-world data from real sources to aid in developing models that will improve smart city planning