

**Real-time Solutions**

**for**

**Smart Road-Transport  
Systems**

# Transport Disaster

**We have to look for real-time solutions**

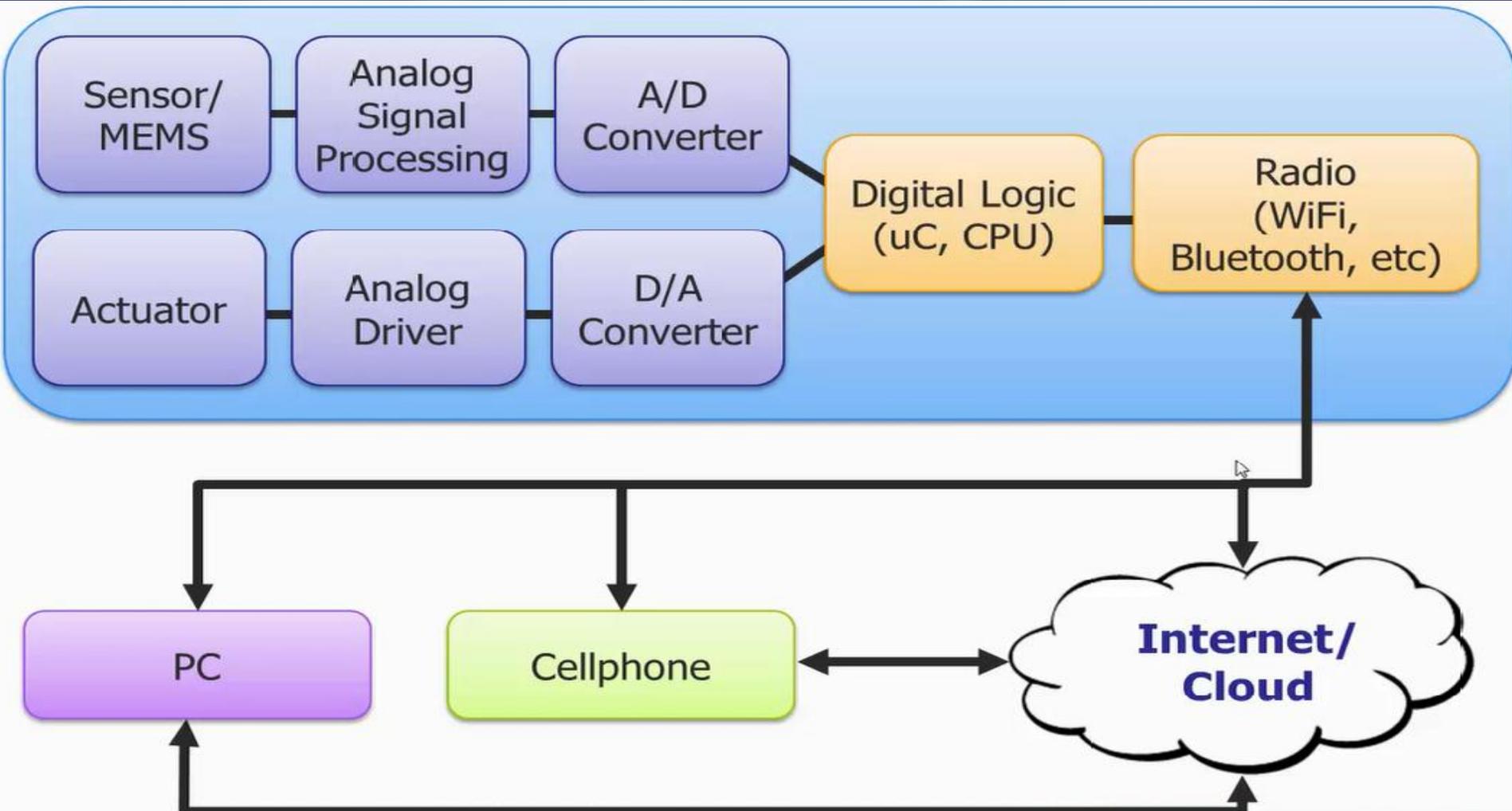
# **Interdisciplinary Approach**

- 1. Data Mining & Machine Learning**
- 2. ICT Technology (HWdSW)**
- 3. System on Chip (VH)**
- 4. IoT Technology**
- 5. The Smart sensor + MEMS**
- 6. Cosmos Technology**

A bright meteor streaks across a dark night sky, leaving a long, glowing trail that curves from the upper left towards the lower right. The background is a deep, dark blue-black, with the meteor's path being the primary source of light. The text '1. The Smart sensor + MEMS' is overlaid in a bold, orange-yellow font in the upper left quadrant.

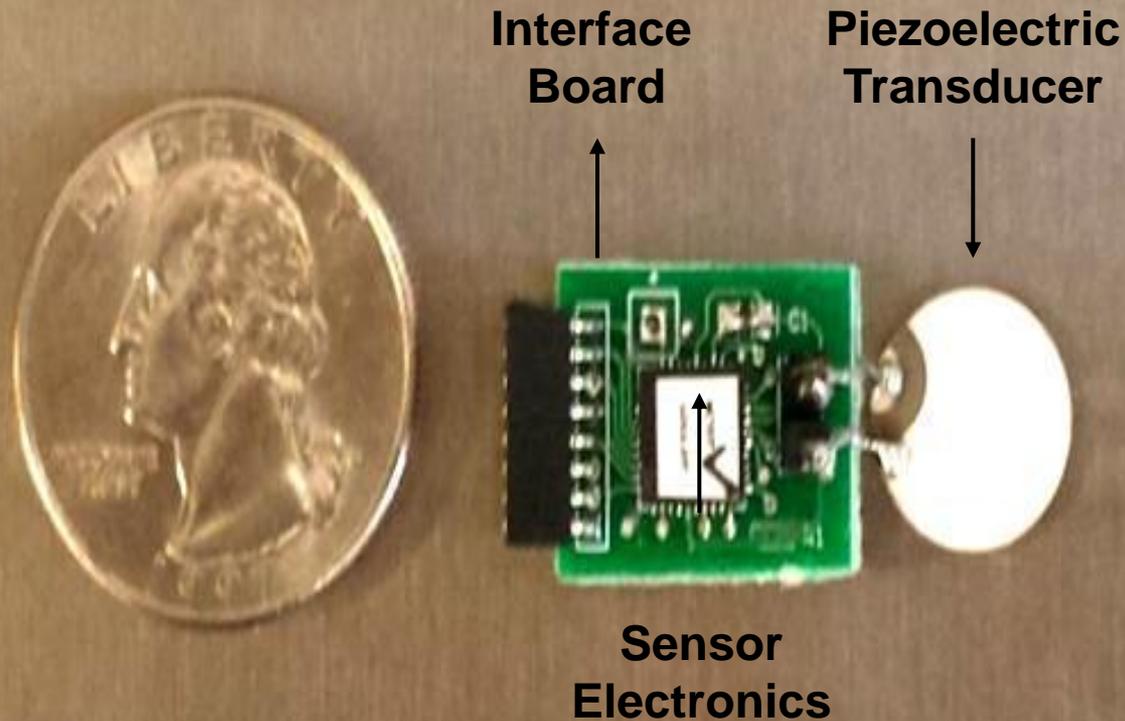
# 1. The Smart sensor + MEMS

# Wireless Sensor + MEMS



Univ. Washington solution & Univ. Michigan solution

# The Self-powered Wireless Sensors (SWS):



The continuous long-term health monitoring of pavement structures for damage diagnosis (Michigan University)

## 2. Cosmos Technology

A satellite is shown in space, with its solar panels extended. The Earth's horizon is visible in the background, showing a blue and white atmosphere against the blackness of space. The satellite has a complex structure with various instruments and a large antenna.

- Czujniki dalekiego zasięgu oraz
- GPS

# M2M Communication

2GHz MSS  
Satellite Direct

**The interconnections are dynamic  
and flexible, changing in realTime**

- **M2M Communication**
- **M2M Data/BigData**

KU-Band  
Feeder Links

AT&T 2G/3G Cellular Network

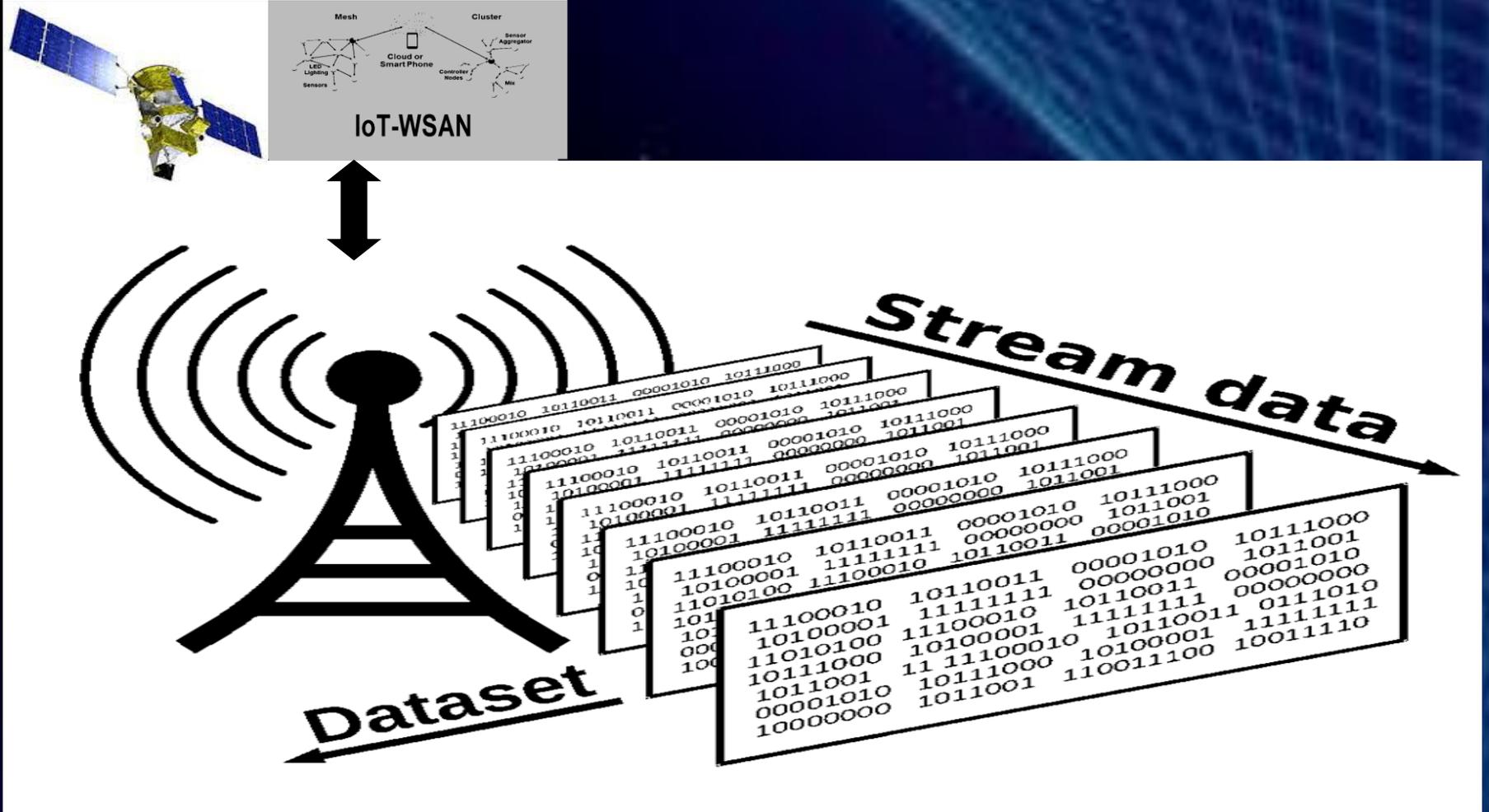
Geographically  
Diverse  
Earth Stations

Standard Communication Networks

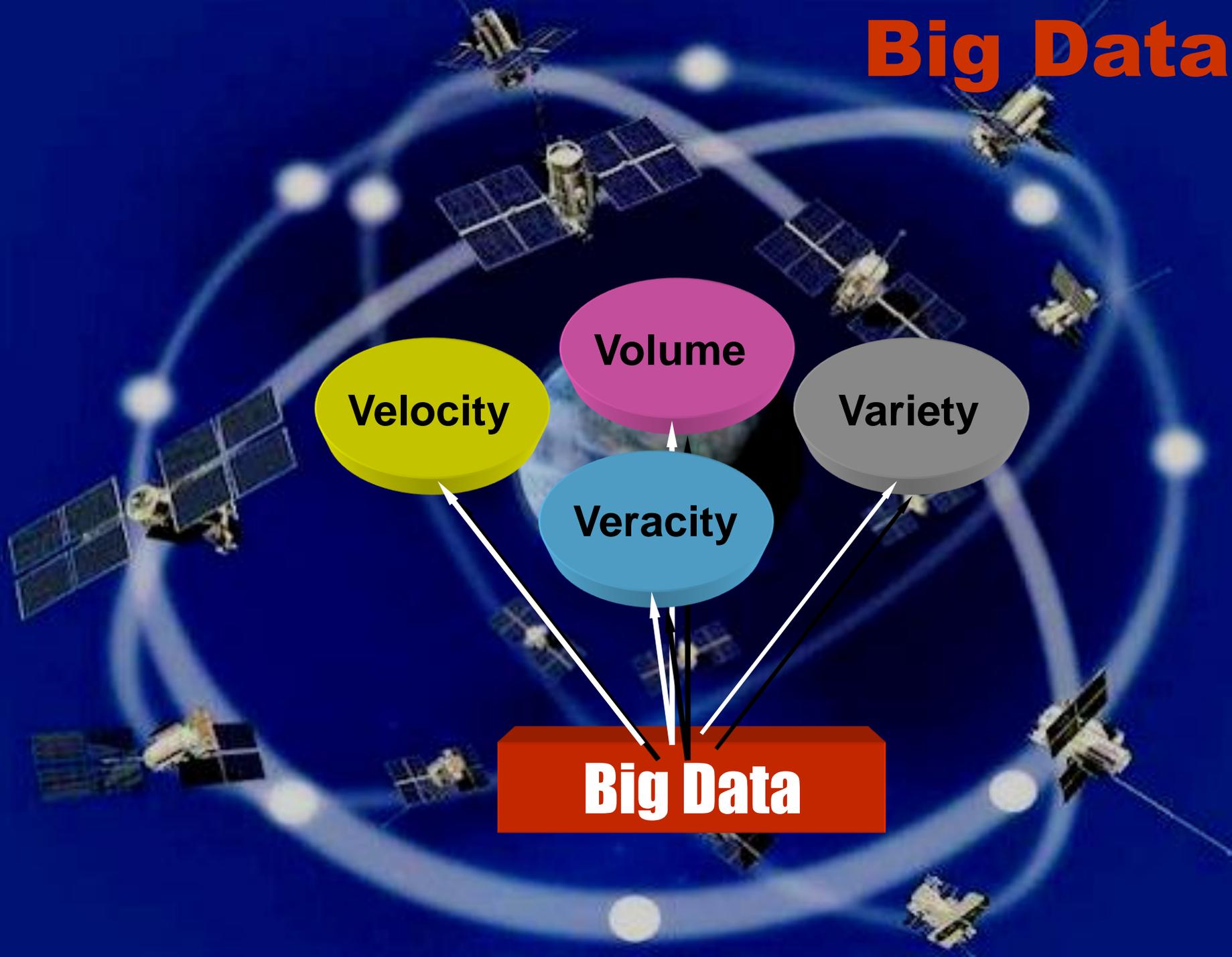
IP Cloud/  
PSTN



# M2M Data/BigData



# Big Data



**Velocity**

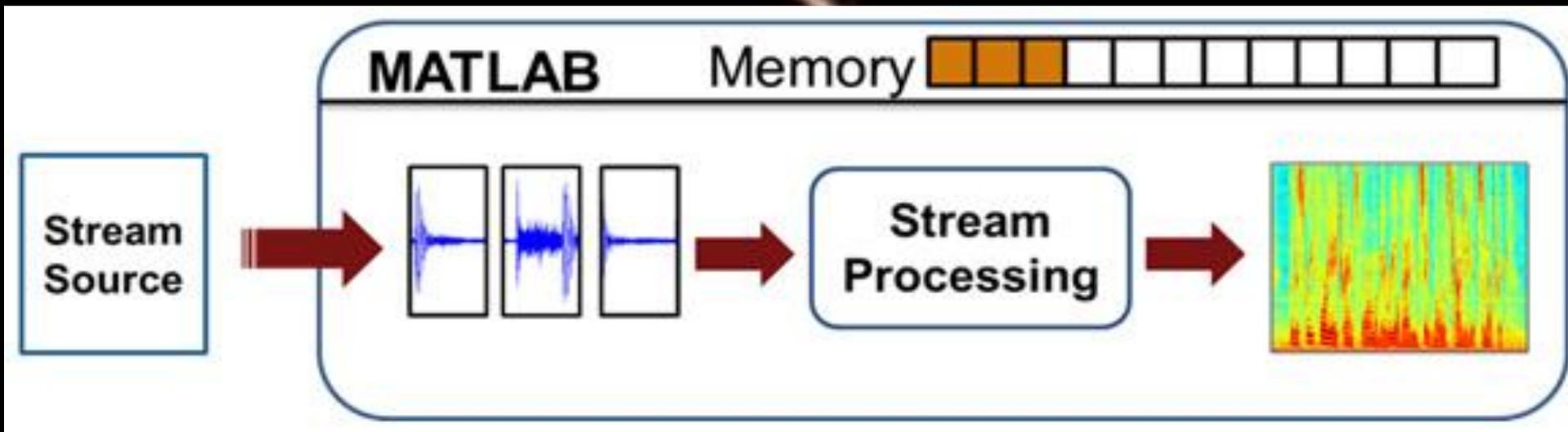
**Volume**

**Variety**

**Veracity**

**Big Data**

# BigData Processing

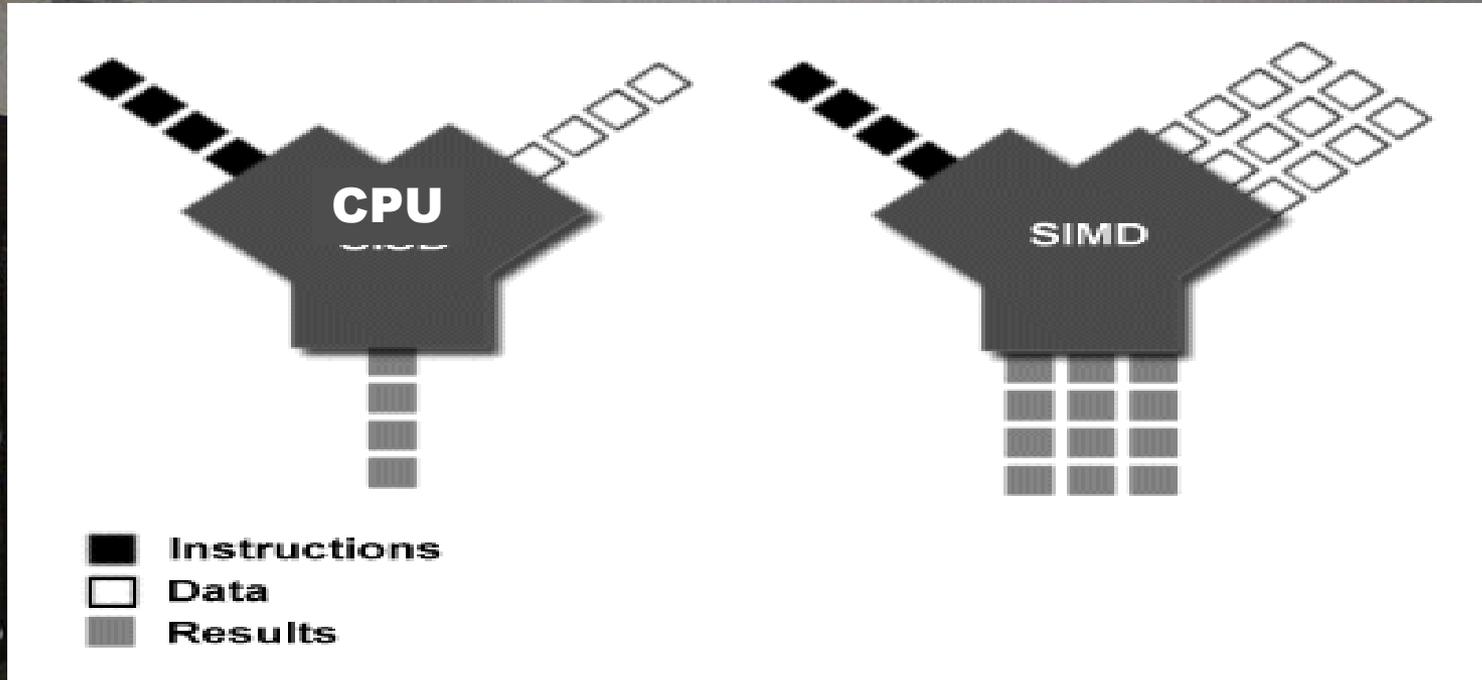


**Map-Reduce Process**

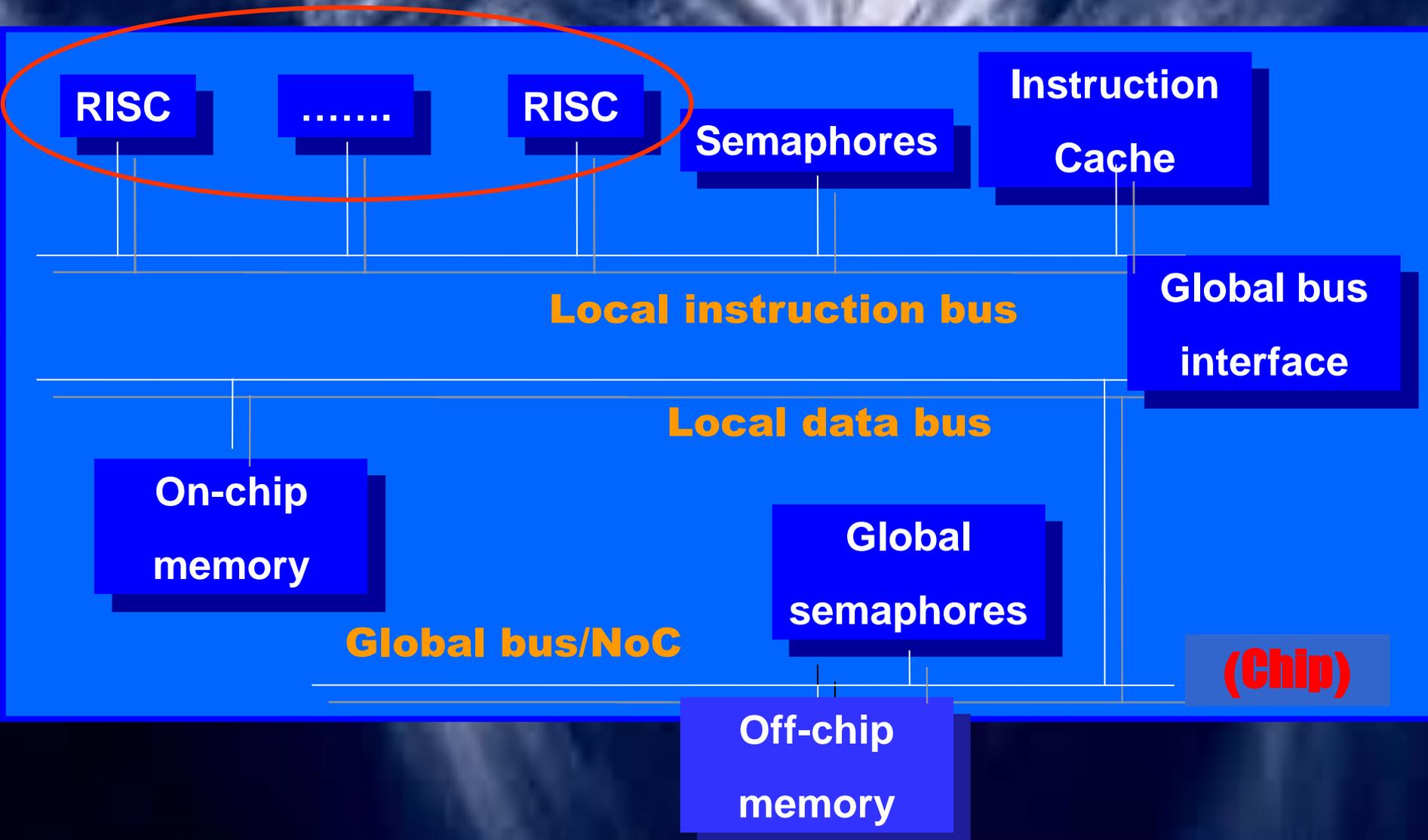
# **5. System on Chip**

**(Virtual Hardware)**

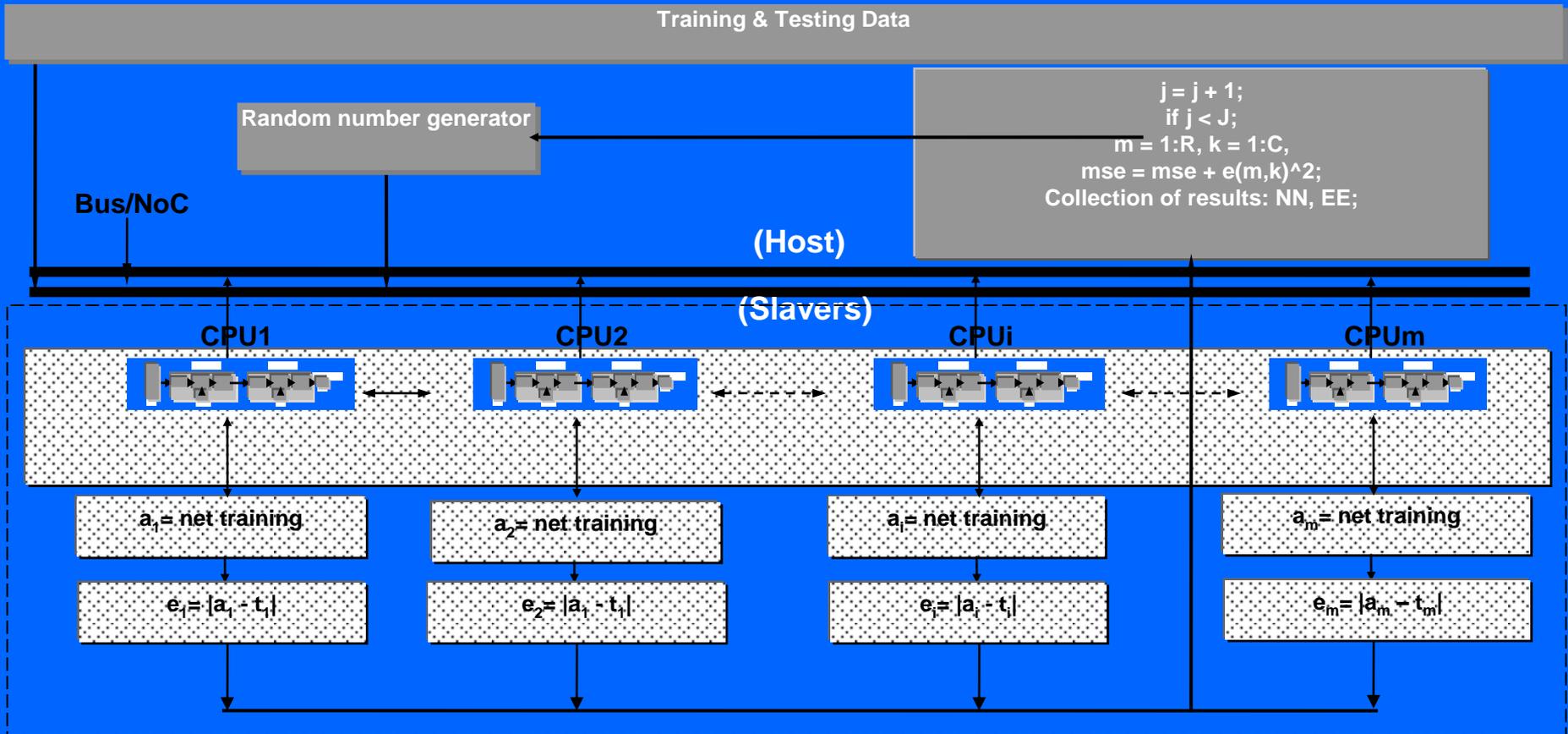
# CPU, & SIMD



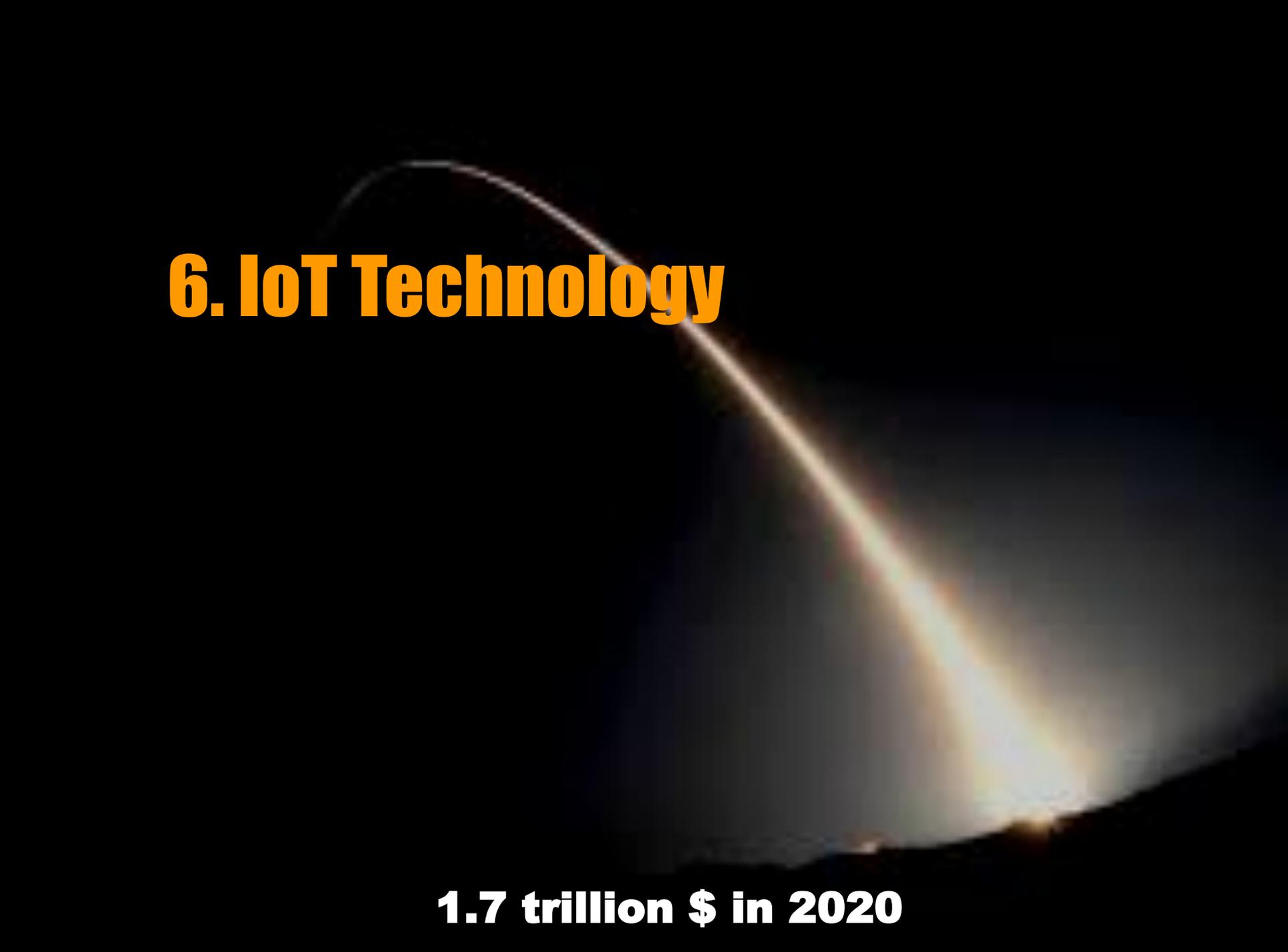
# New Architecture - MPSoC



# Detection of threats occurring on the steel bridge

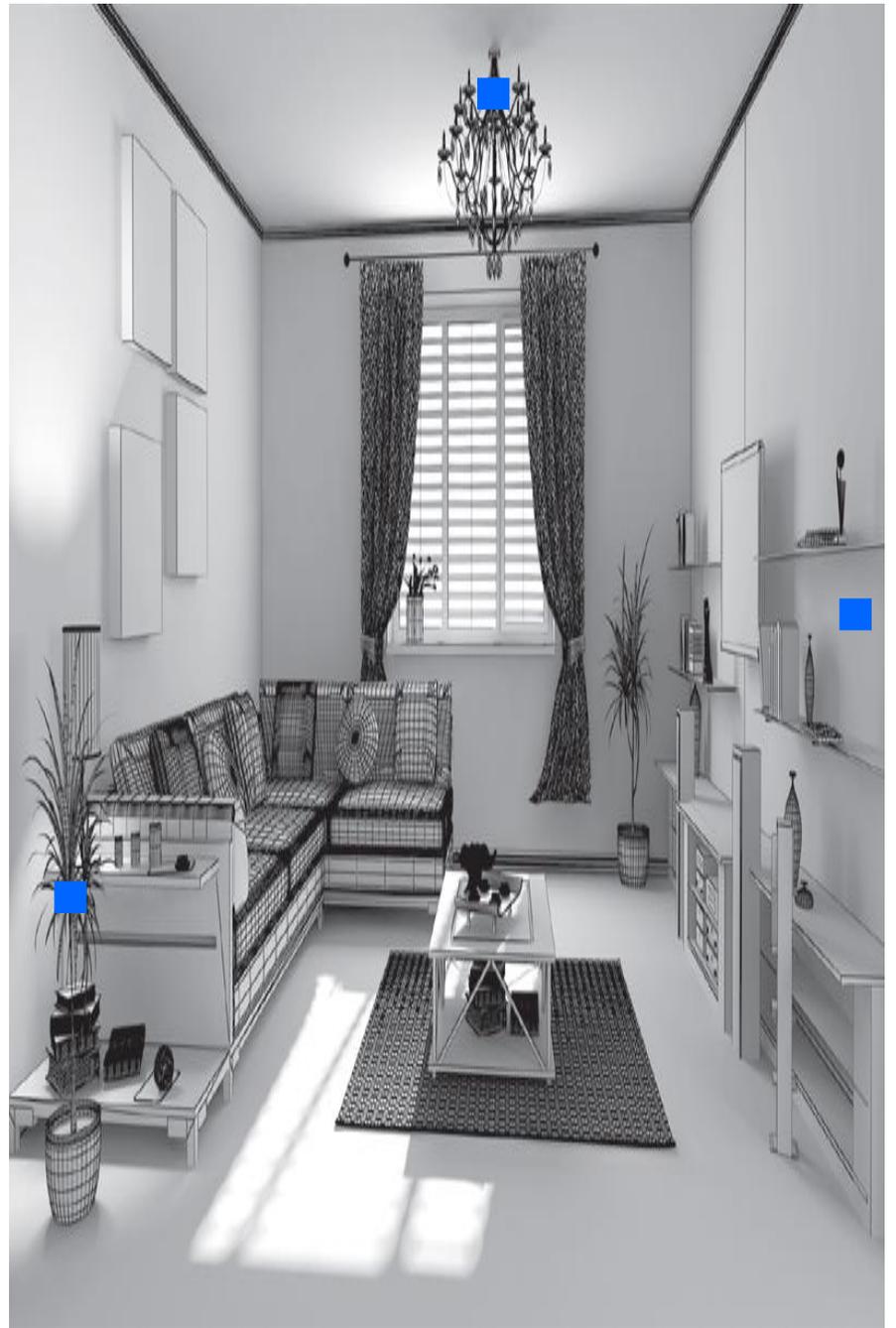
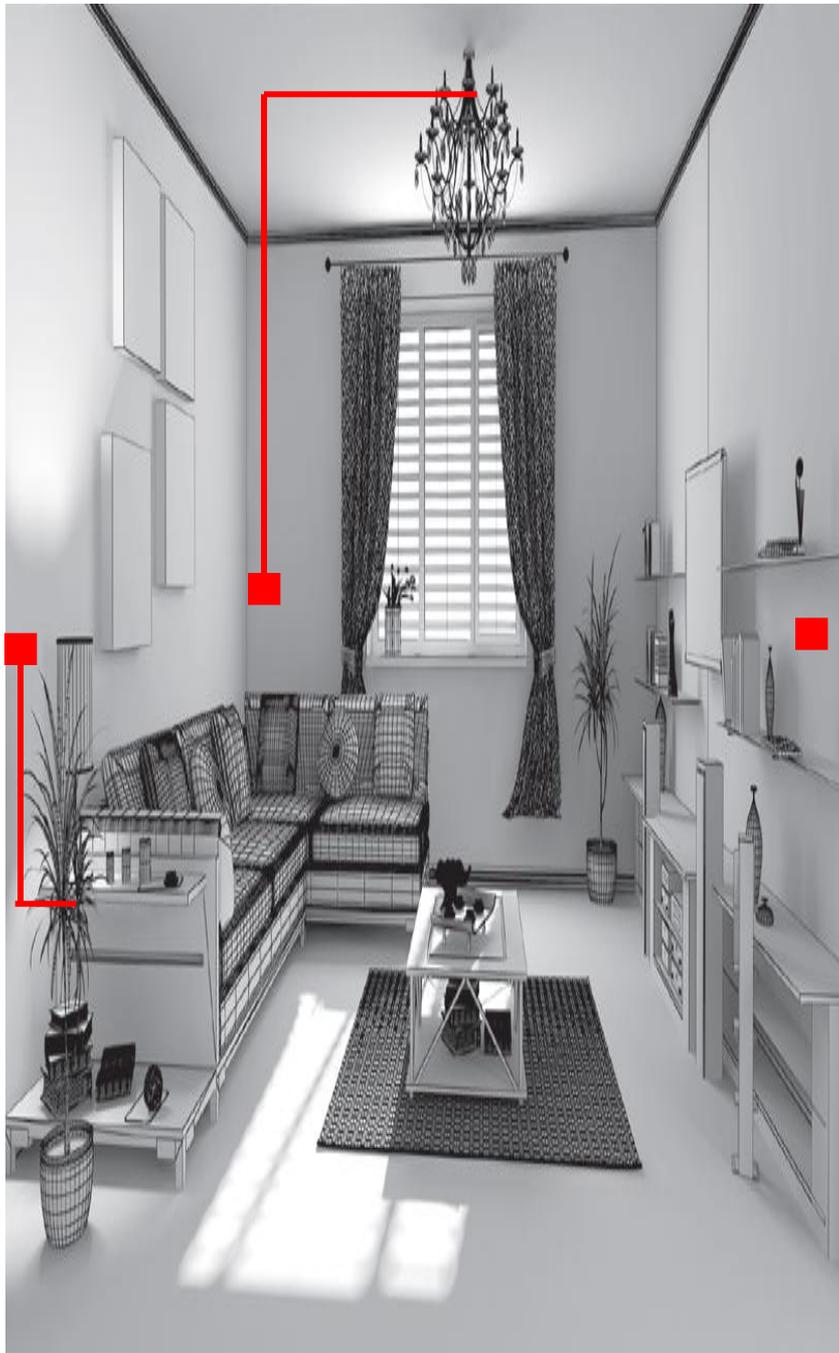


(MonteCarlo Simulation + MES Analysis + ANN + MPSoC)

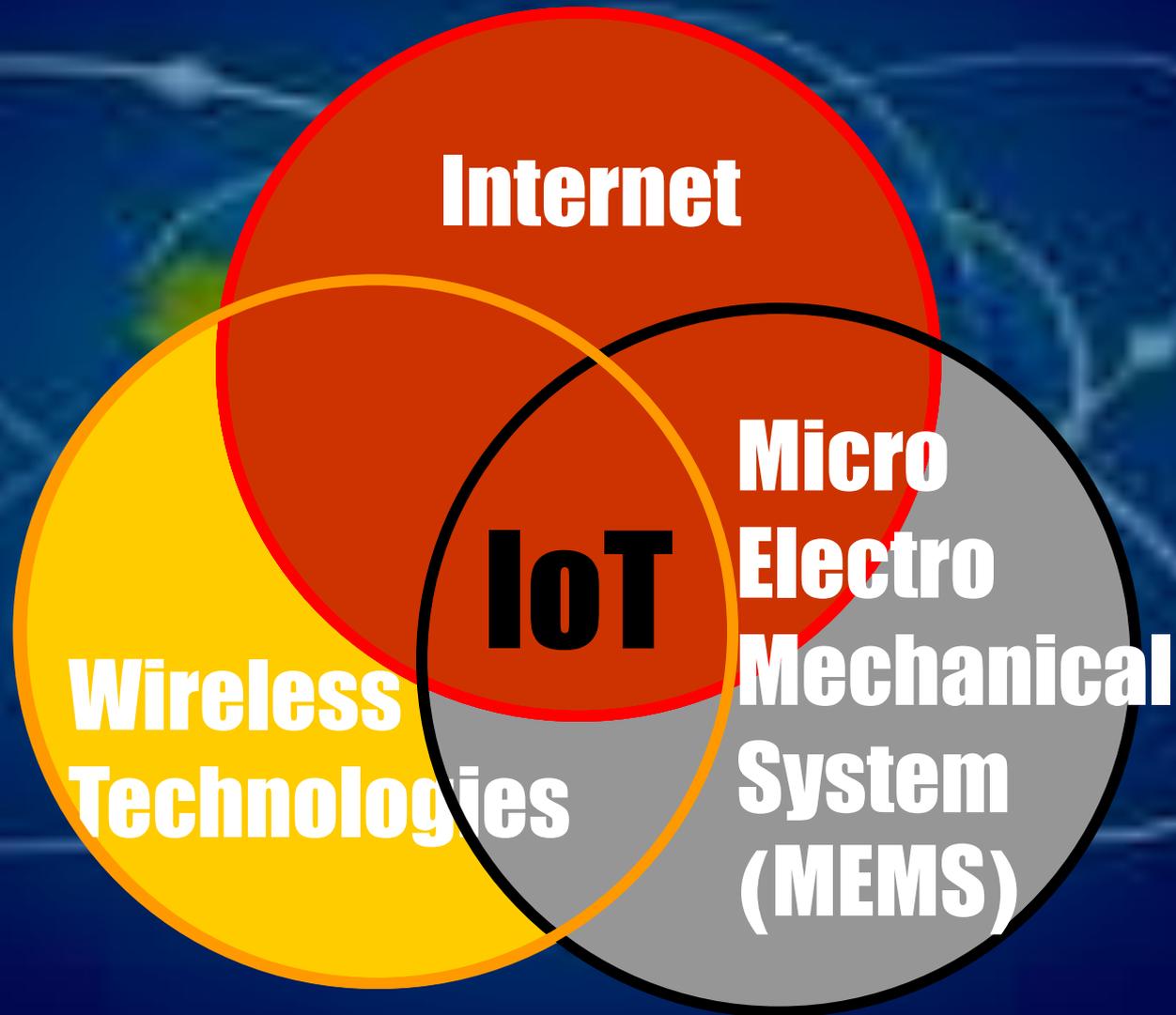


# **6. IoT Technology**

**1.7 trillion \$ in 2020**



# Internet of Everything



**M2M Data & Communication.**



**Internet/Cloud**

**IP  
Backbone(s)**

**UMTS/3G  
GPS + RTK**

**Satellite Network**

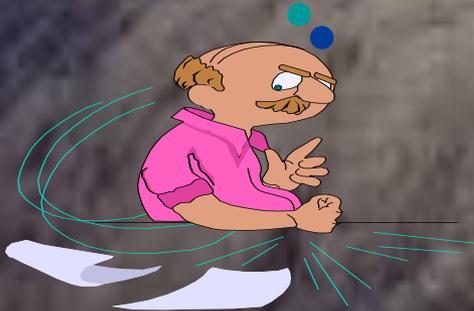
**WLAN**



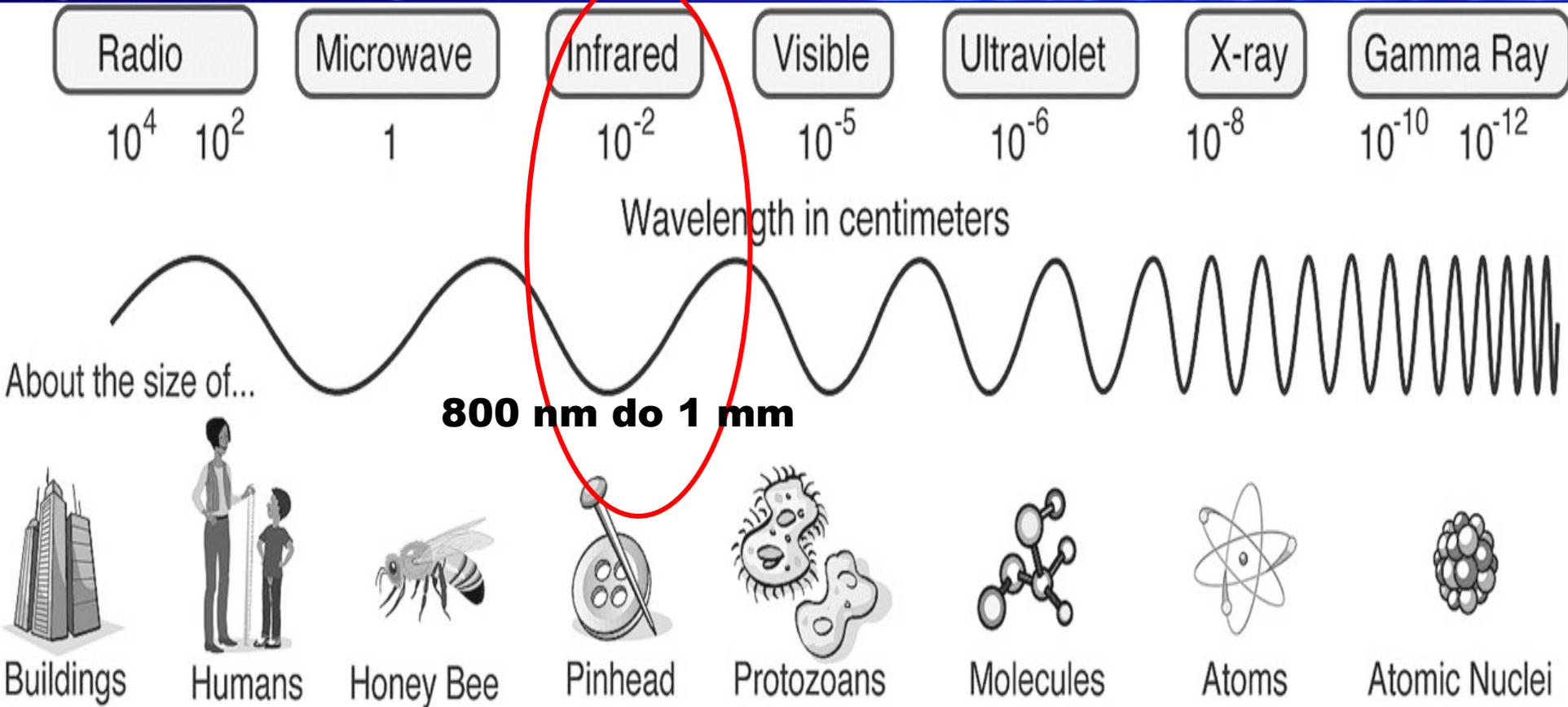
# 7. Application

A bright, curved light streak, possibly a meteor or rocket trail, arches across a dark sky. The streak starts near the bottom right and curves upwards and to the left. The background is a dark, gradient sky.

# Remote Sensing for Pavement Management



# Electromagnetic Spectrum



$$E = h\nu$$

frequency of radiation, sometimes written as  $f$  giving expression  $E = hf$ .

Quantum energy of a photon.

$h$  = Planck's constant =  $6.626 \times 10^{-34}$  Joule-sec =  $4.136 \times 10^{-15}$  eV·s

Planck eq.

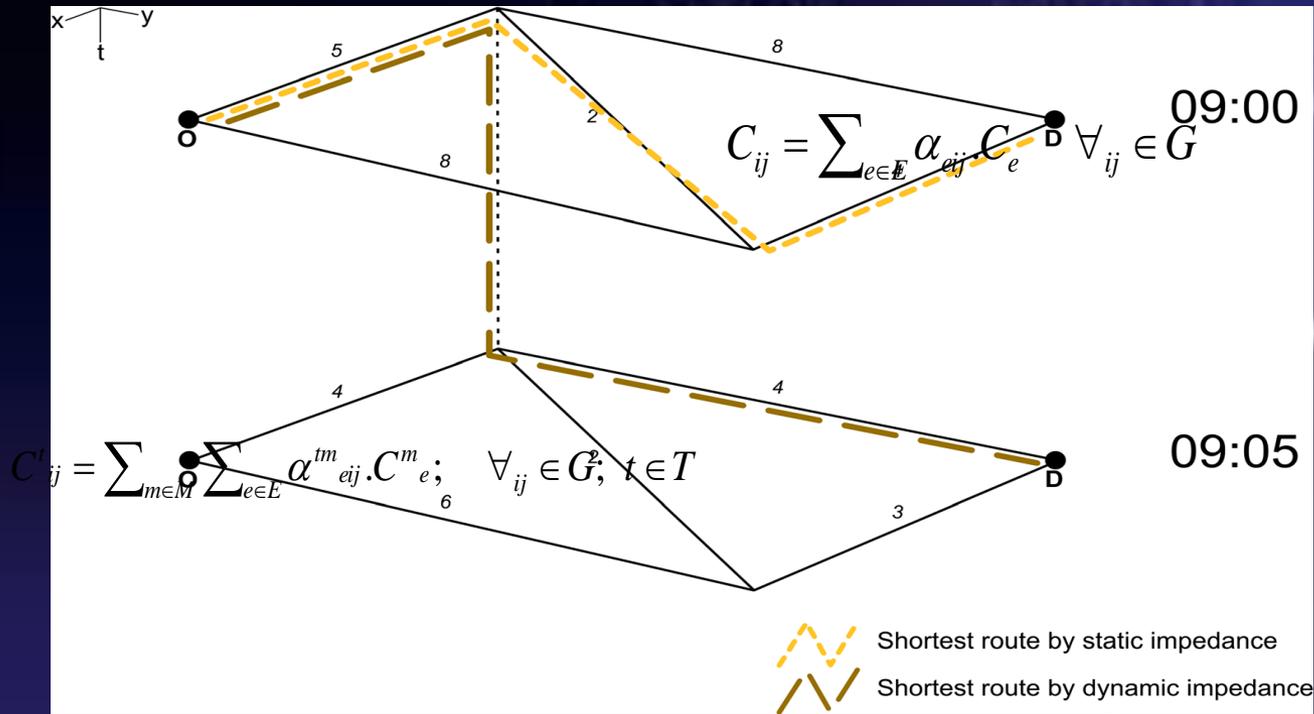


# Dynamic accessibility

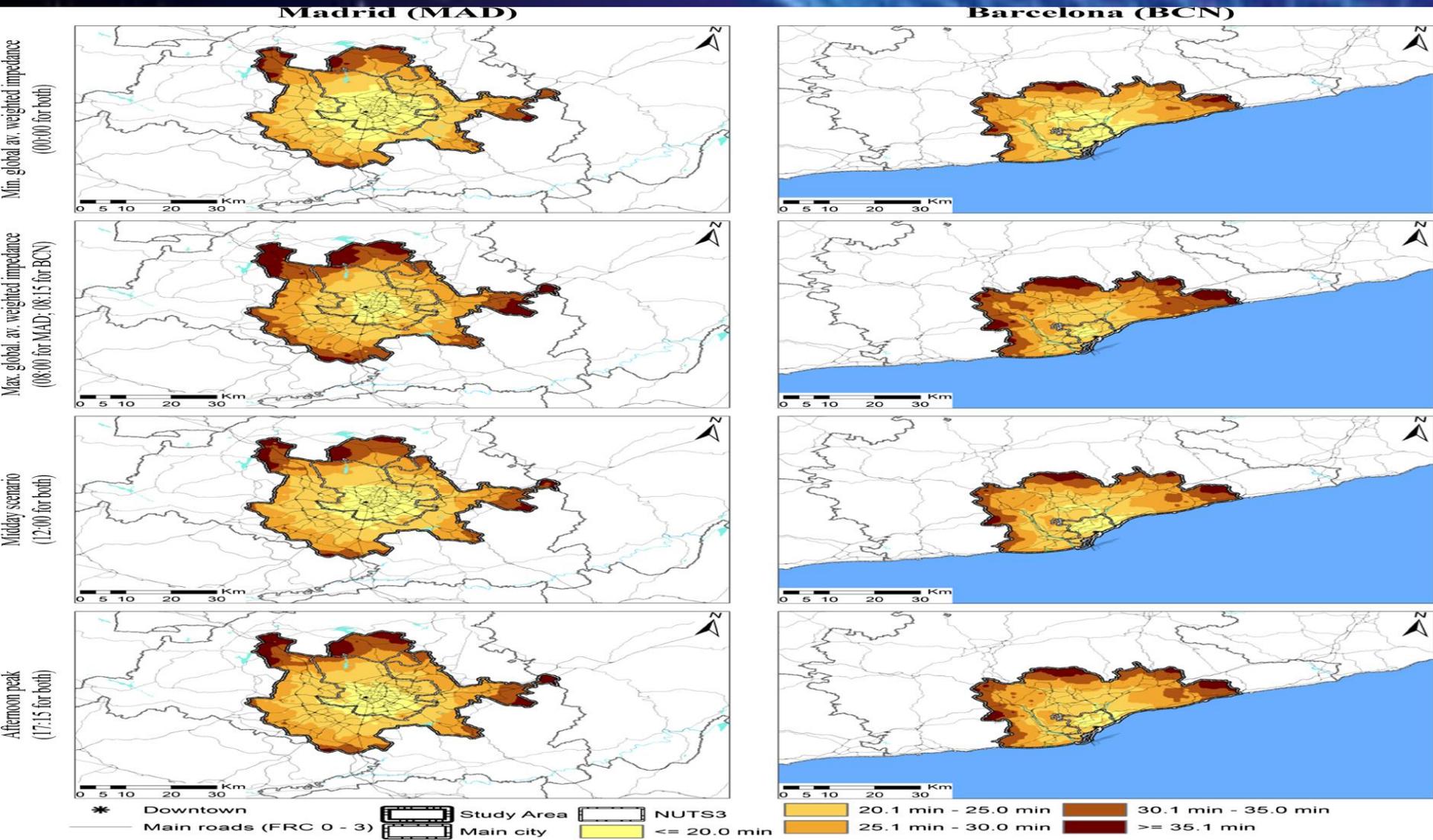


$$C_{ij} = \sum_{e \in E} \alpha_{ej} \cdot C_e \quad \forall_{ij} \in G$$

# Example of the differences between the shortest route estimated by static methods and by dynamic methods



# Dynamic effects on static maps



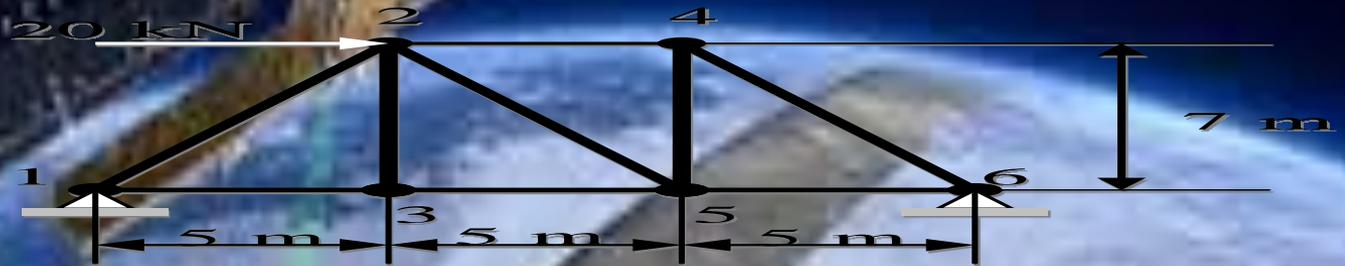
# Intelligent bridge





# Real-Time Security

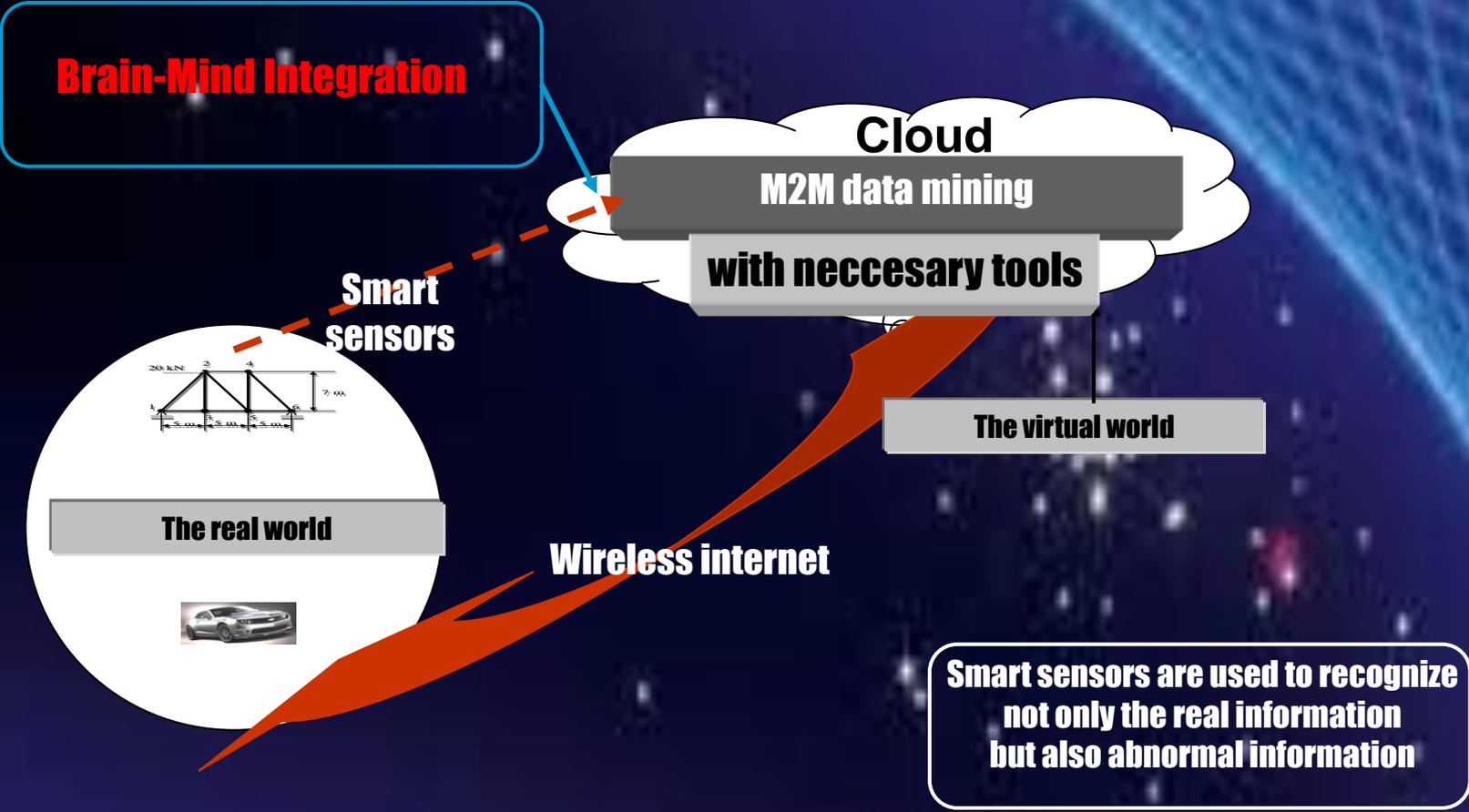
„IoT” Technology



# The bridge-car Talking



# The bridge-car Talking (Real-Time Security)



# Wyniki końcowe

1. Jest to badanie w kierunku interdyscyplinarnym wykorzystując tempo:

- Matematyki
- Informatyki
- Geodezji
- Sensor & Micromechatroniki
- Budownictwa Drogowego
- IoT & ICT Technologii
- Innych Technologii

# The Internet of Thing and the Brain of Thing

Chi Tran



Universal Journal  
of  
Computers & Technology

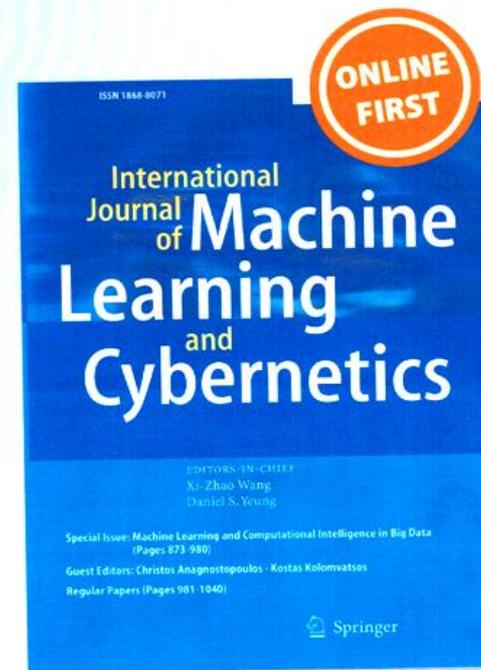
*Structural-damage detection with big data  
using parallel computing based on MPSoC*

**Chi Tran**

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*Cognitive information processing*

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