



# 5G-ENABLED SMART PORTS: EXPERIENCES AND PROSPECTS

Institute of Communication & Computer Systems

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WORKSHOP

**5G & GOVTECH**

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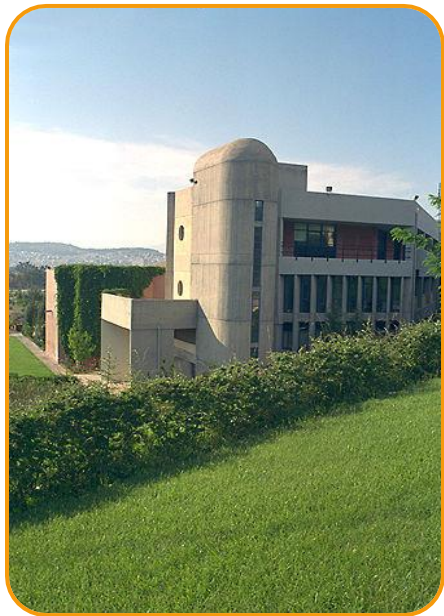
ATHENS, GREECE





# ABOUT US

# ABOUT Us



## ICCS

ICCS is the oldest and largest academic Research Institute in Greece. Being the research branch of the School of Electrical and Computer Engineering of the National Technical University of Athens (NTUA), ICCS conducts interdisciplinary cutting edge research and R&D activities in relevant scientific fields, supports doctoral theses, undertakes innovative & development activities and provides scientific services to private & public bodies in Greece and abroad.



## RESEARCH IMPACT

With a mission to promote basic and applied research, advance digitalisation and boost innovation, ICCS today stands among the top 3 Research Institutions in Greece. It is also ranked among the top 20 European Institutes in terms of research funding in its fields. Committed to the highest standards of academic research, the Institute maintains well organised facilities based in Athens and a reputation as a top-level research institution worldwide.

# ABOUT US



## R&D Projects

At ICCS, we continuously advance our expertise and scientific knowledge through the participation of our research teams in National and European R&D projects in various scientific fields.

4498 +

## Researchers & Scientific Personnel

Excellent research staff lies at the basis of ICCS's success. More than 800 highly qualified researchers, scientists and faculty members are the main pillar of the Center's successful performance.

800+

## Innovation

ICCS actively supports the creation of startups and participates in successful spinoffs such as 'The first Greek Energy Competence Center'.

06

## Scholarships & Excellence

With an aim to promote scientific excellence, ICCS every year provides scholarships to Phd students and supports a number of Educational activities.

1650

# ABOUT Us



**150** People  
**58 / 110** Ongoing/Finished Projects  
**191** Partners  
**6G SNS IA** Full Research Member  
**digiGOV innoHUB**  
**π(N)E(T)** EMERGING NETWORKS & APPLICATIONS



National Technical University of Athens

Institute of Communication & Computer Systems

## Research areas

Cooperative Connected & Automated Mobility

Smart Mobility Applied Systems

Intelligent Networks & Services

Logistics & Maritime

Industry 5.0 & Smart Manufacturing

Health Technologies

Earth Observation & Environmental Monitoring

Crisis Management & Secure Societies

Circular Economy & Tracing

XR Culture & Society



# SMART PORTS



# WHAT IS A SMART PORT?

*“A smart port equips the workforce with relevant skills and **technology** to solve the unique internal and external challenges of the organisation, and to facilitate the efficient movement of goods, delivery of services and smooth flow of information.”*

*Wikipedia, [https://en.wikipedia.org/wiki/Smart\\_port](https://en.wikipedia.org/wiki/Smart_port)*

*“...a connected port that protects the environment and mobilizes **innovative technologies** for business process and information flow management.”*

*Rajabi, A., et al., “Towards smart port: An application of AIS data,” In IEEE HPCC/SmartCity/DSS, 2018*

*“... a modern and technologically advanced port that leverages **innovative technologies** and data-driven solutions to enhance its operational efficiency, safety, and sustainability.”*

*PORT Technology International, <https://www.porttechnology.org/>*

*“...a **connected, automated port** designed to meet stakeholder demand.”*

*Molavi, A., et al., “A framework for building a smart port and smart port index. International Journal of Sustainable Transportation, 14(9), 686–700, 2020*

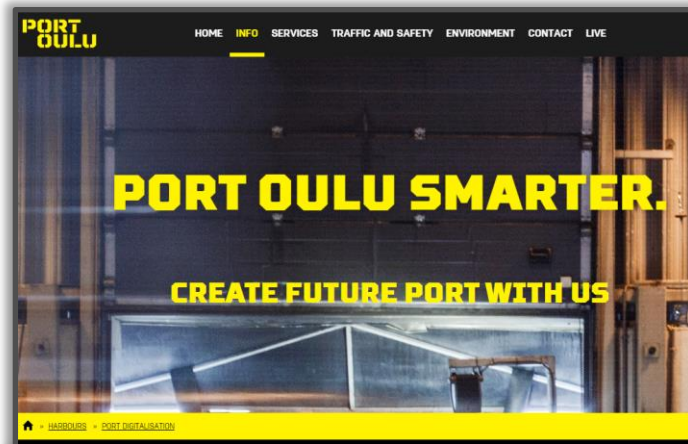
# SMART PORT EXAMPLES



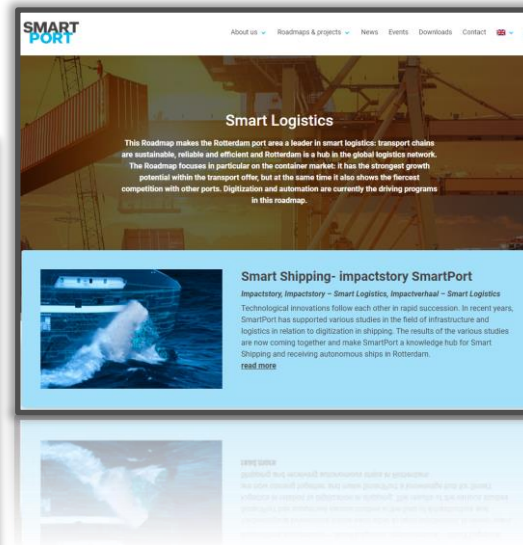
## Smart Sound Plymouth (UK)



## Port Oulu (FI)



## Smart Port Rotterdam (NL)

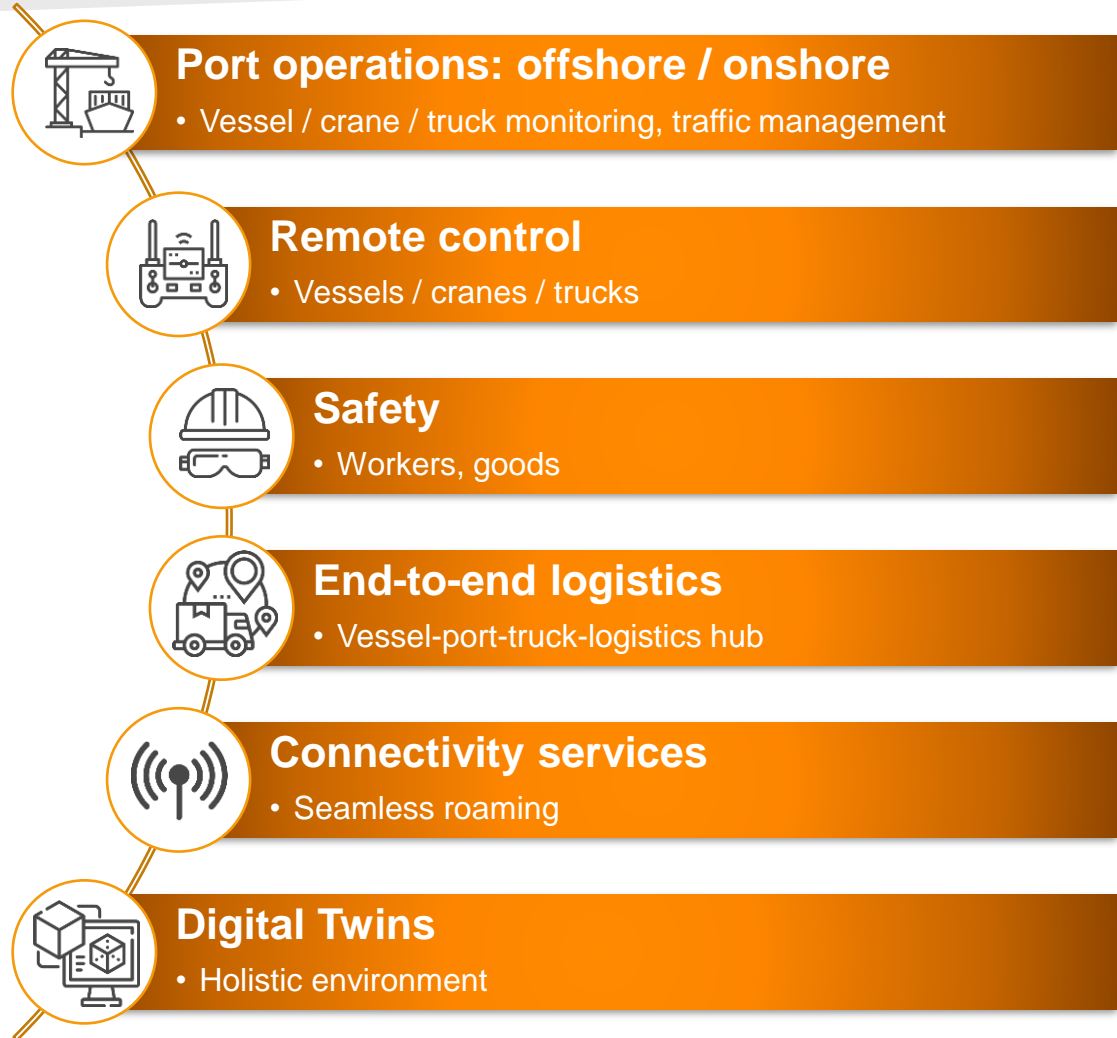


## Port of Hamburg (DE)





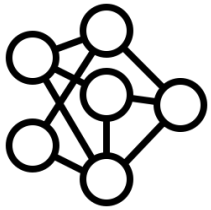
# SMART PORT APPLICATIONS



Source: Nexus Integra

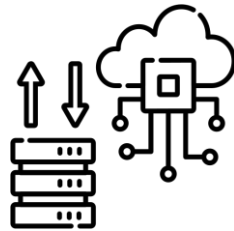


# ENABLING TECHNOLOGIES



## Connectivity

- 5G System
- Satellite/NTN



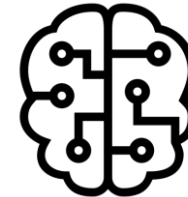
## Cloud / Edge Computing

- Cloud native technologies
- Variable HW incl. AI support



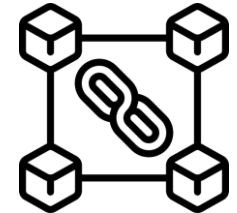
## IoT Technology

- Sensing/actuation
- Embedded computing



## AI / ML

- Video analytics,...
- MLOps



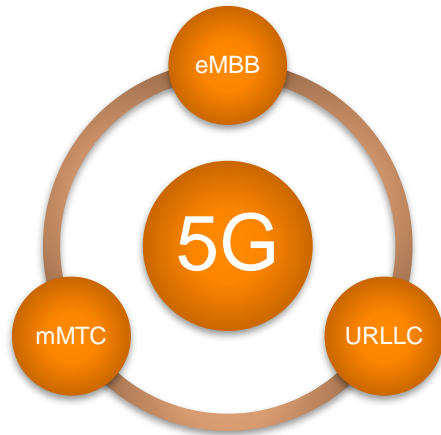
## Blockchain

- Smart contracts

# THE ROLE OF 5G



enhanced Mobile BroadBand

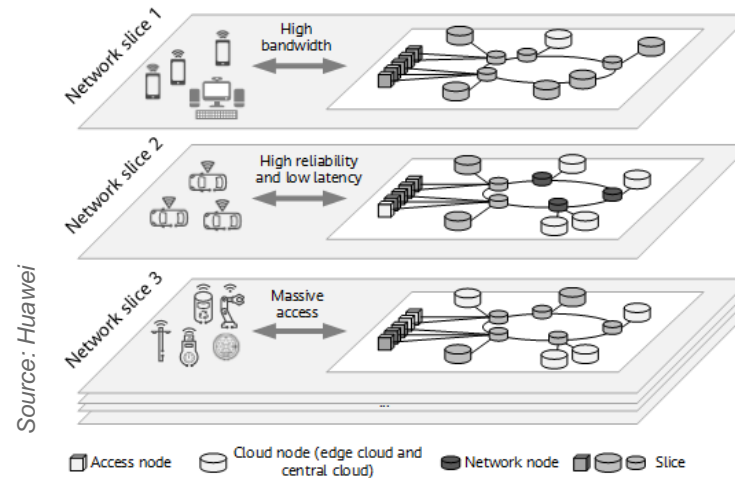


massive Machine Type Communications

Ultra Reliable Low-Latency Communications

## Enhanced performance

- Data rates (eMBB)
- Latency & reliability (URLLC)
- Device density (mMTC)

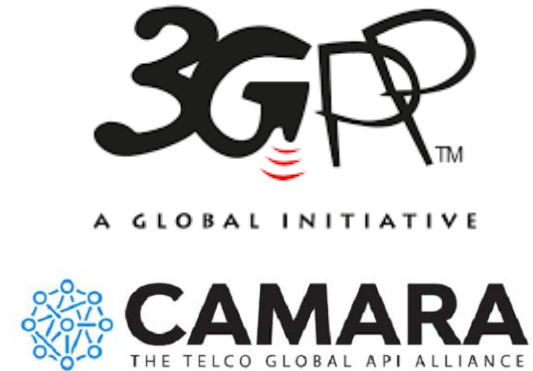


## Service differentiation

- Network Slicing
- Cloud Native

## Vertical – Network Interaction

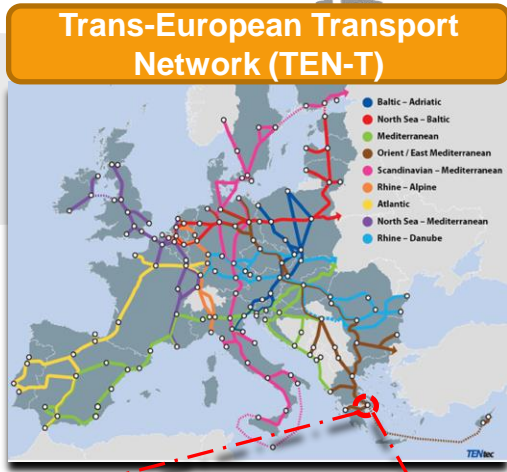
- Network Exposure Function (NEF)
  - Application Function (AF)
- CAMARA GSMA/LF








# OUR EXPERIENCE

# THE 5GLOGINNOV ATHENS LIVING LAB



Partners		Role
	Institute of communication and computer systems (ICCS)	Living Lab Coordinator (5G-IoT, NFV-MANO, AI/ML)
	Vodafone (Innovus)	Mobile Network Operator
	Piraeus Container Terminal (PCT)	Living Lab



## 5G & AI-enabled Use Cases

-  Surveillance and monitoring
-  Container seal detection
-  Collision warning

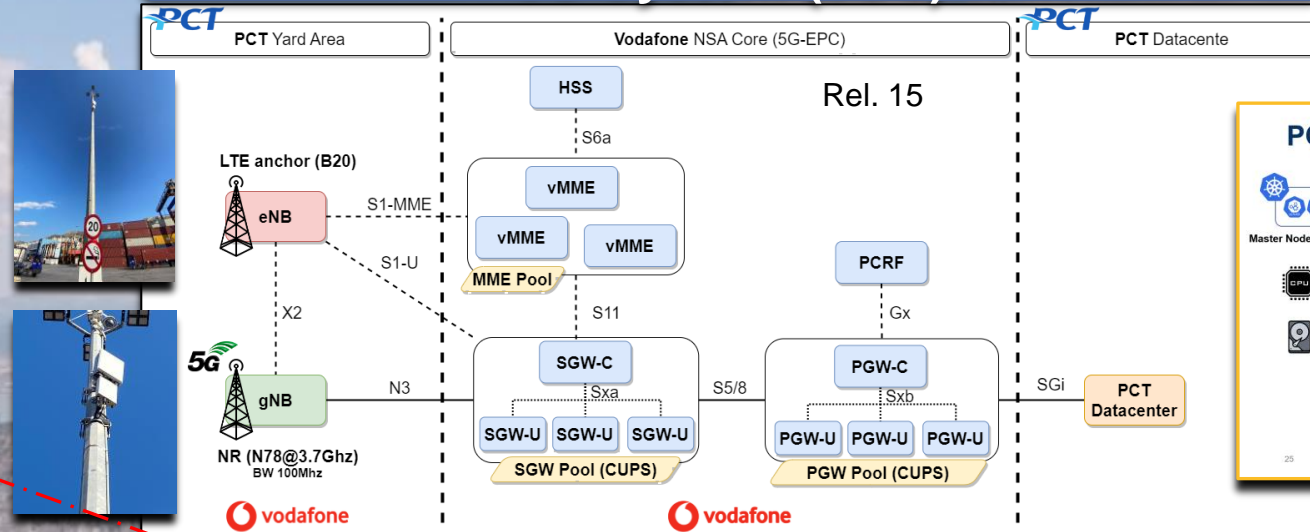
# PRIVATE 5G NETWORK AND 5G-IoT PLATFORM

Far-edge

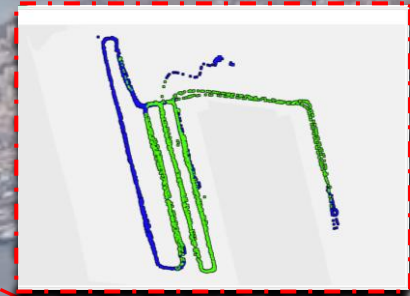


5G-IoT Nodes

5G System (5GS)



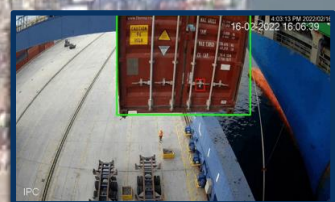
Cloud



Trials Area



Truck



Quay Side Crane

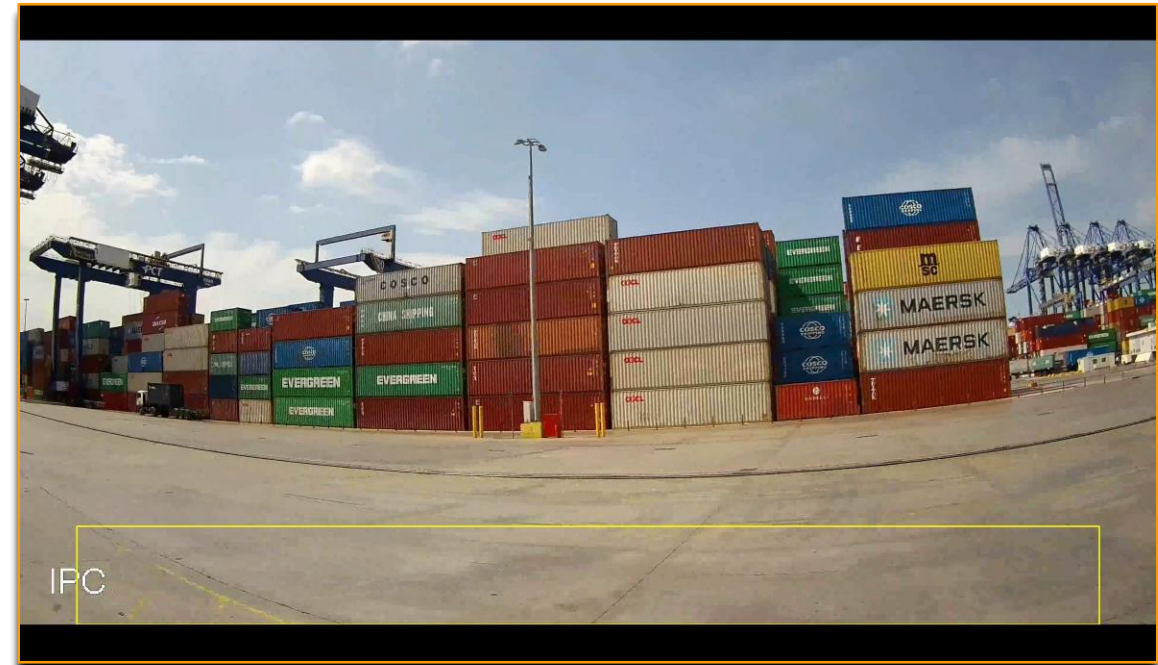
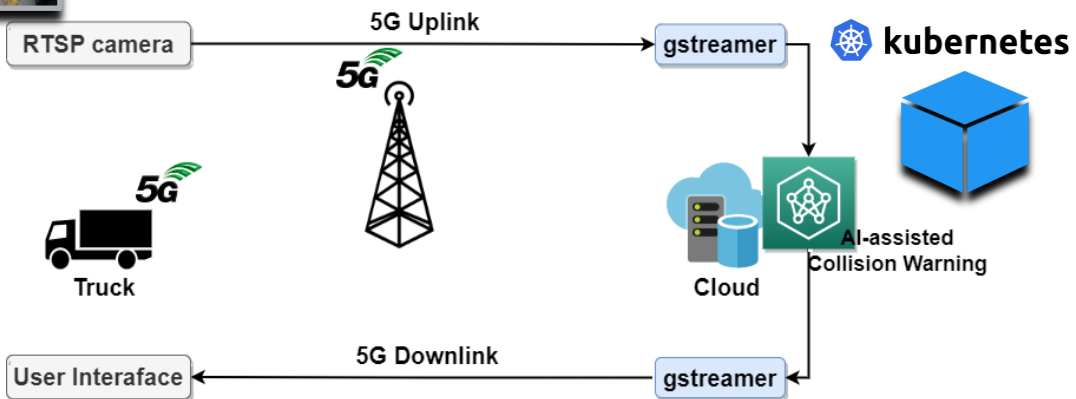


Port Infrastructure

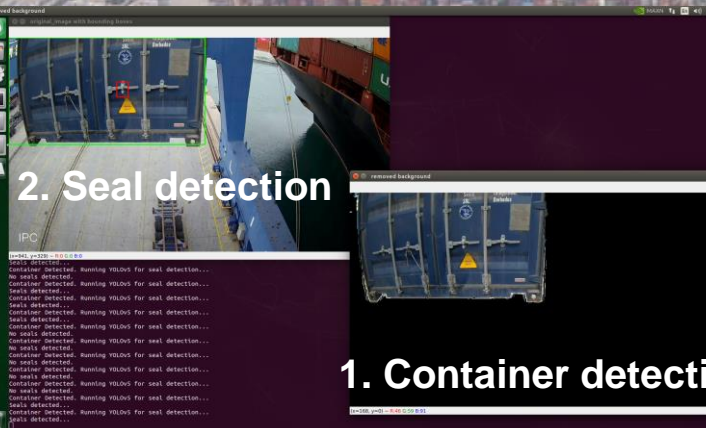
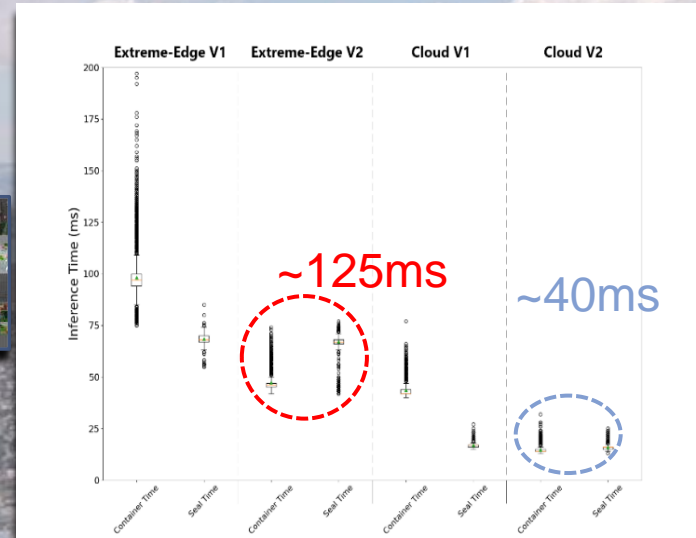
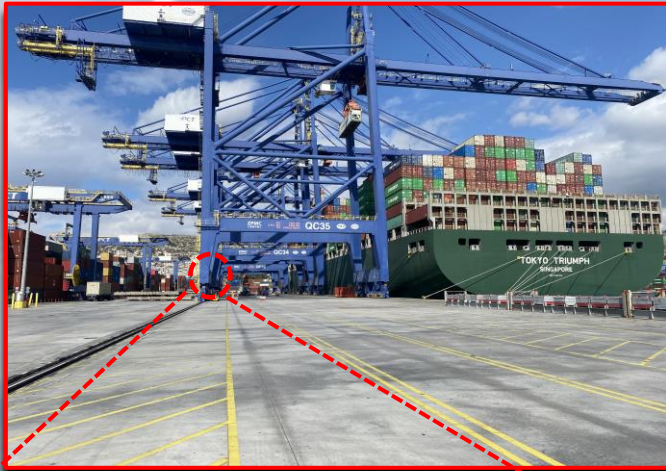
AI-enabling HW (GPUs)



# COLLISION WARNING



# CONTAINER SEAL DETECTION



Training Set: 50K -> 500K images  
Validation: 30 hours

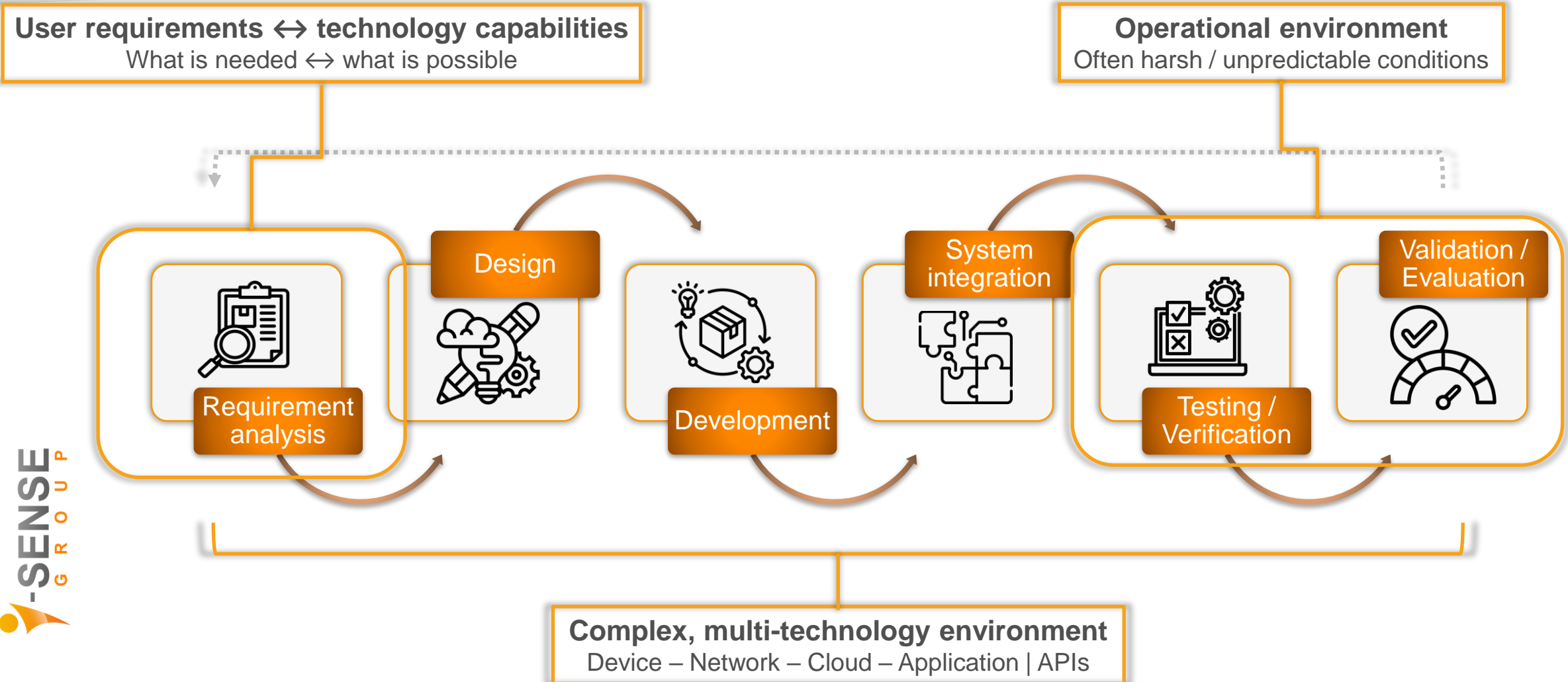


5GLOGINNOV





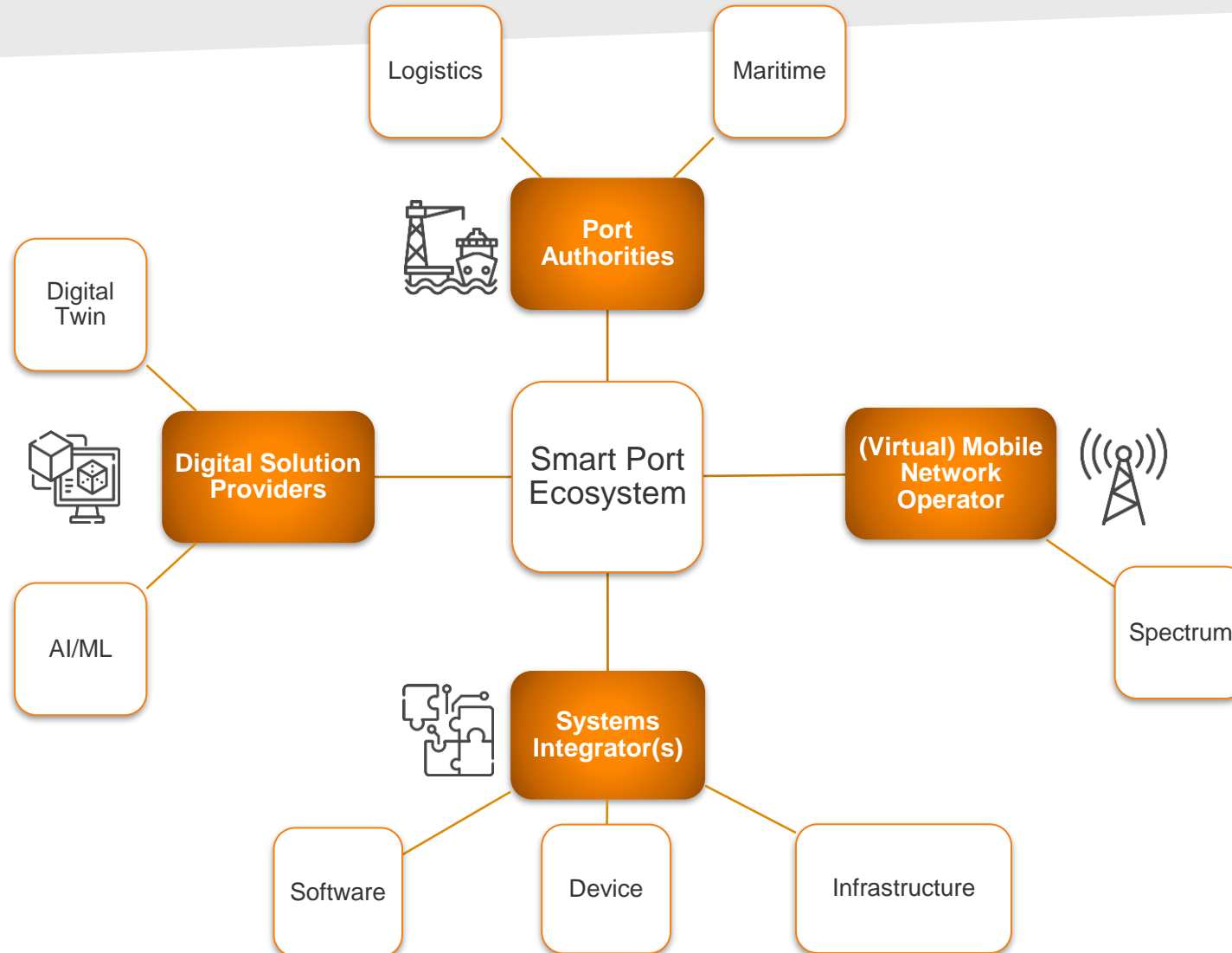
# LESSONS LEARNED





# TOWARDS TESTBEDS / SANDBOXES

# BUILDING THE ECOSYSTEM ...



# ...AND TAKING THE FIRST STEPS



**Collaboration environment**  
co-creation processes

-  Capturing operational needs
-  Grasping novel technology capabilities
-  Bridging technology domains
-  Extensive experimentation



- Address market needs
- Provide end-to-end solutions
- Ensure maturity / robustness



# THANK YOU!

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