Use of 5G in improving port operations at the Port of Livorno

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http://jlab-ports.cnit.it

cnit consorzio nazionale interuniversitario per le telecomunicazioni

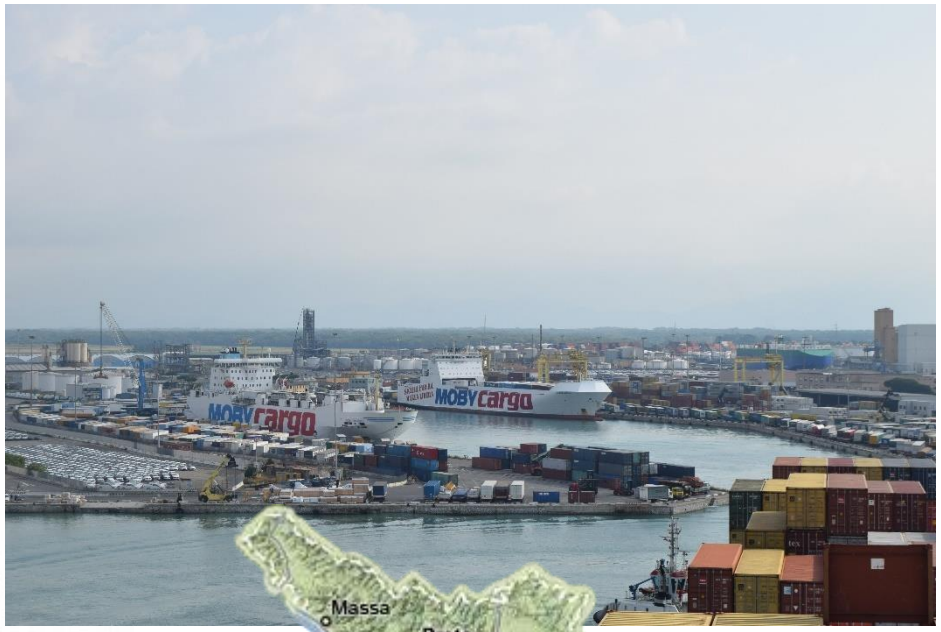
Smart Port Workshop
NetworldEurope & CCSA
Online, Sep 16th 2022

«Port of the Future»

- Sea ports in 2030:
  - LARGe: Lean, Agile, Resilient, Green
    - high capacity and efficiency,
    - highly integrated with inland transport and logistic nodes,
    - capable of sustainable growth without further infrastructure investments.
  - following the European models:
    - for the circular economy;
    - to reduce the environmental footprint (more renewable, less pollutants);
    - to improve the navigability of port channels, operational efficiency, optimize the capacity of docks yards, and flows;
    - transform the port into a local and national innovation hub.

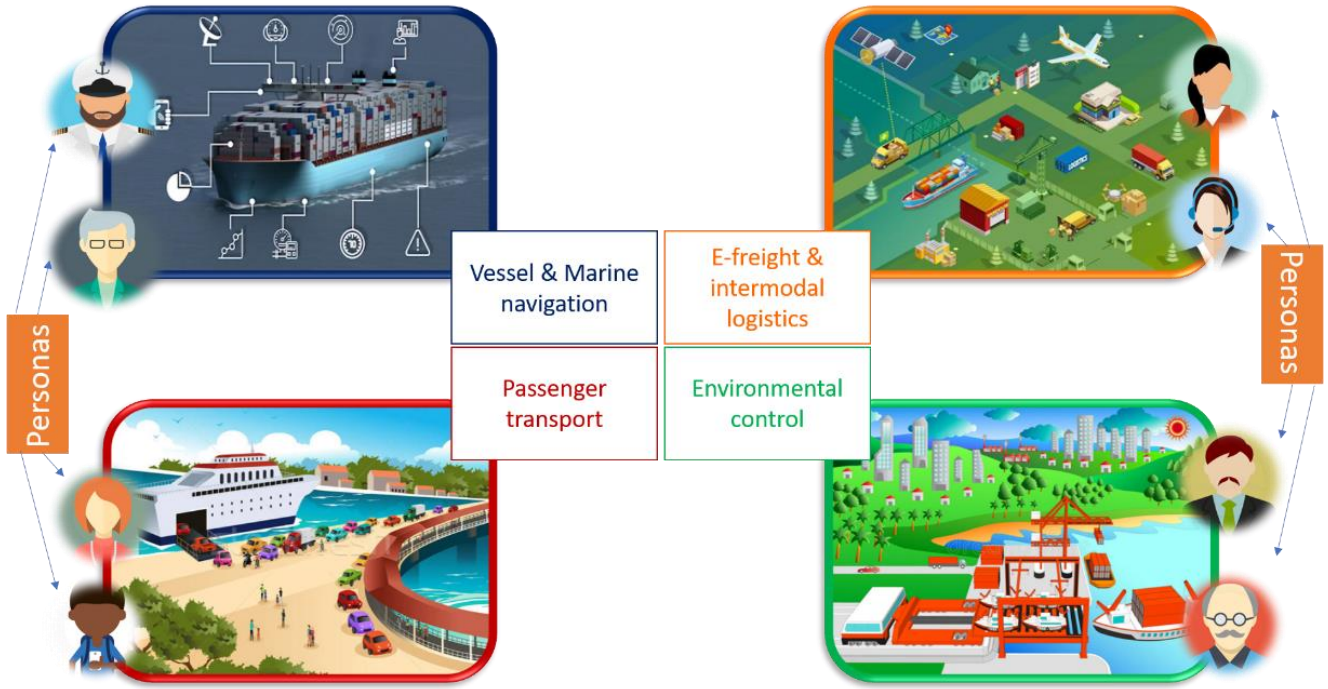
Port of Livorno

- Mid-size historical port:
  - passengers and freight;
  - multipurpose(containers, break/dry/liquid bulk);
  - freight village, car stocking (25,000 cars capacity);
  - along TEN-T SCANMED corridor (core node);
  - door of Tuscany;
  - minor ports (Piombino, Elba) under the same organization.



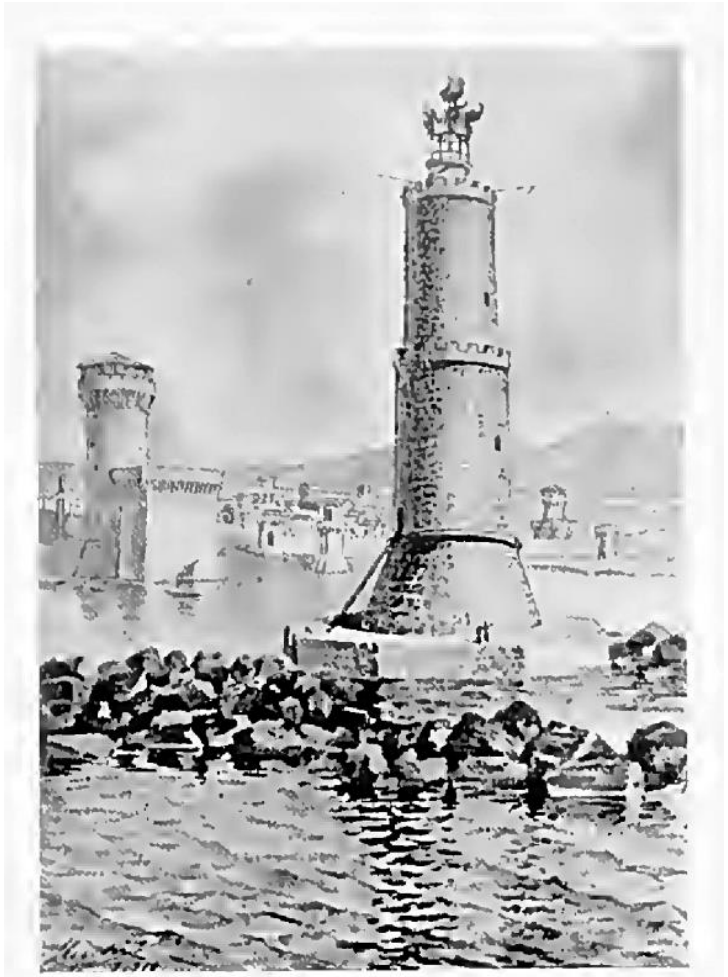
Livorno: Port of the Future

- collect the requirements from the communities and design innovation services;
- follow (and steer) EU standardization for data, networks and services;



- allow the procurement from the digital market of innovation services;
- check the conformance against the requirements (included in tenders).

More videos in: https://jlab-ports.cnit.it/photogallery/



LIVORNO CON LE PRIME MURA PISANE E IL FANALE RIPRISTINATO. (DA ANTICA STAMPA).

Setting the scene

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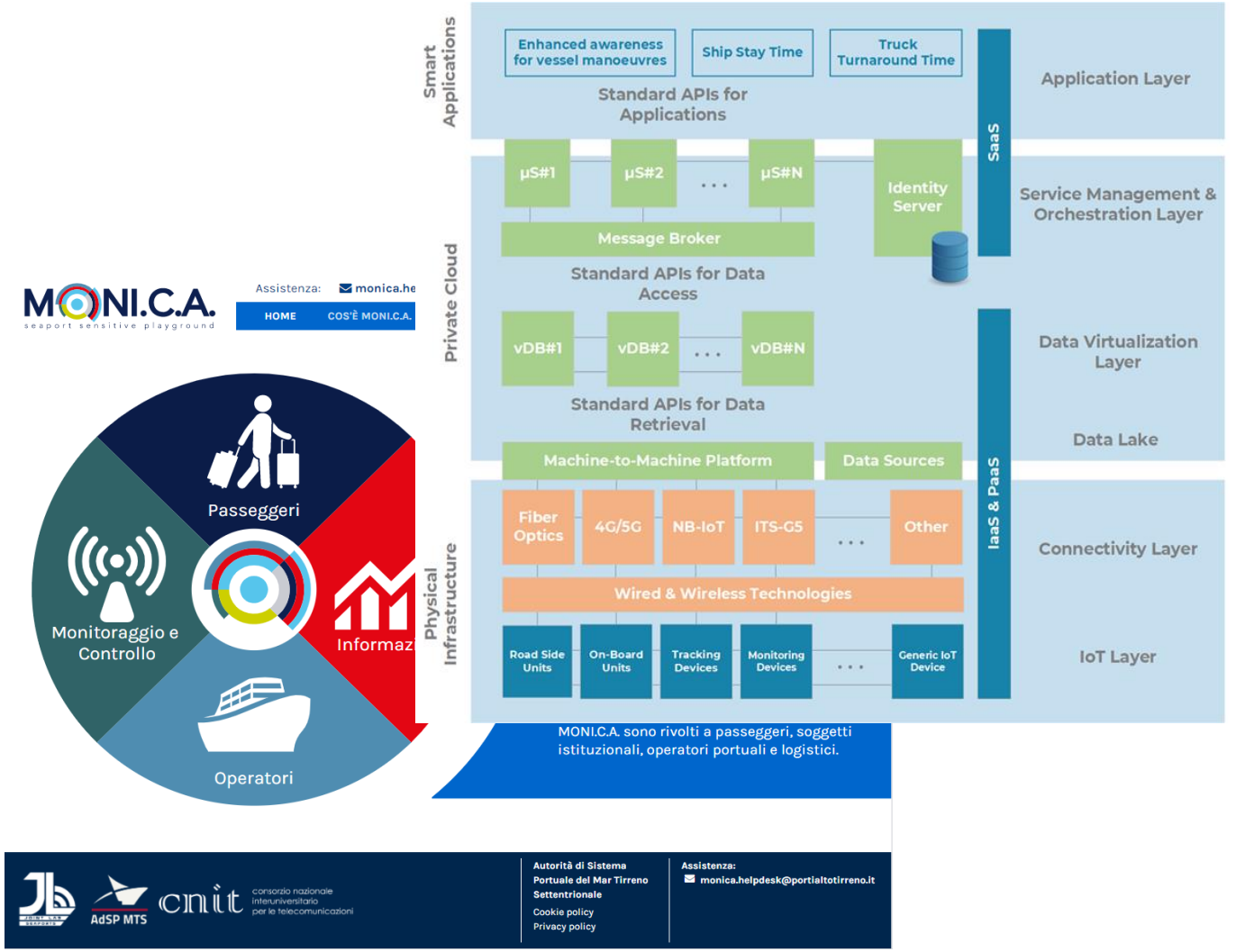
Continuous integration

- Layer separation:
  - Infrastructure, Platform, and Software
- Data Lake (vessels, freight, shippers)
  - Document-based, RDBMS, GIS, and M2M
- Backward compatibility with legacy systems:
  - PCS, distributed IoT
- Cyber-security policies (complying w/ NIST directives)
- Internal Integration Test & Validation



https://www.monicapmslivorno.eu/

MONI.C.A.
seaport sensitive playground

5G Testbed

Ericsson White Paper
GFTL ER 20:003151
June 2020

ERICSSON

5G spectrum for local industrial networks

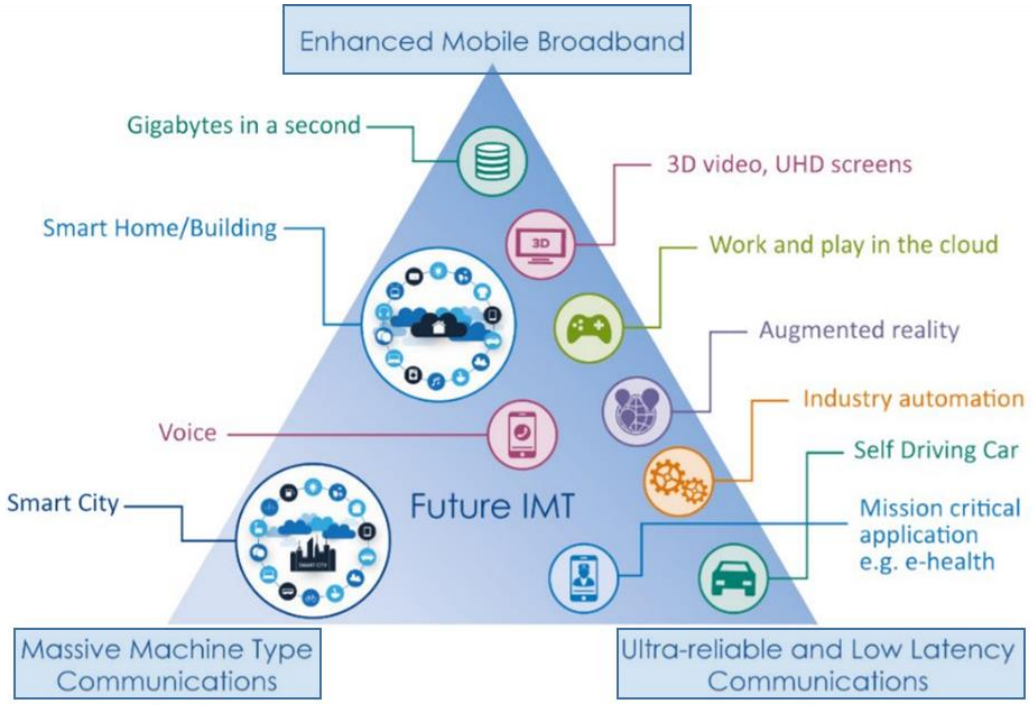
5G Network in Port

ericsson.com Networks Digital Services Managed Services 5G IoT Portfolio Future Technologies

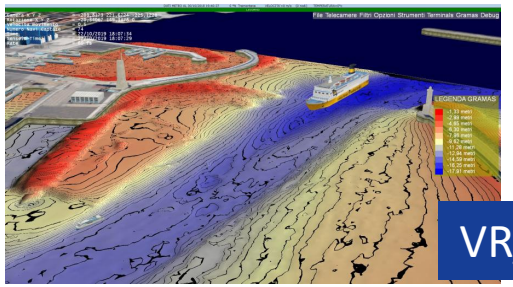
A final example can be found in the potential of the world's 835 c tly active ports [8]. One case study examining the private 5G network trial for the automation of China's Port of Qingdao indicated that a 70-percent labor cost savings could be achieved if 5G automation were to be fully implemented [9]. Our own research engagements in Italy' Port of Livorno uggest much the same, with the potential for significant savings in port and quay operations as well as reduced berthing times for vessels and shortened cargo release times.

Livorno is an international reference for the design of 5G networks in industrial ports.

5G in Ports

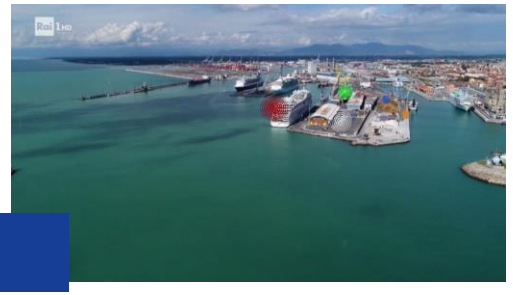


- eBB:
  - Touristic crowds
  - Assistance to people with disabilities
  - Emergency procedures



- UR-LLC (VR/AR - Digital Twin)
  - RT Port View
    - bathymetric data
  - RT Vessel View
  - RT Machinery status
  - RT Assisted docking

- mMTC (massive IoT):
  - Port (landside and sea) massive sensorization
  - Vessel (and cargo) sensorization



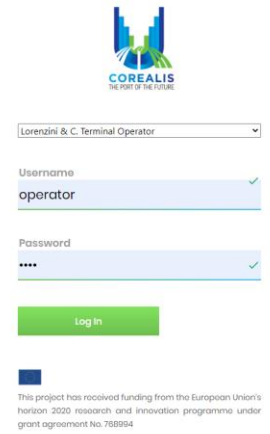
5G PoC: General Cargo

- Use Case:
  - Freight Management for the unloading (from the truck) and loading (onto the ship) phases and handling in the docks.
- 5G RAN and Core;
- Enabled processes:
  - humans, IoT, robotics in the loop;
  - new RT functions for the haulers;
  - integration between ship and port and logistic information systems.

https://www.youtube.com/watch?v=nWrMDoN1z7g

ERICSSON

- Coverage: **250x50 m²**
- Frequency: **3.7GHz**
- E2E Latency: **< 10ms**
- Reability: **> 99%**
- Availability: **99.999%**



Enrironmental Impact of 5G

- Competitiveness & Sustainability can be addressed at the same time:
  - see Livorno work shown at the Global Solutions Forum 2019 (the «Climate Week») at Columbia University in NYC.

-8.2 %
In CO_2 emissions

-2.5 m€
Operational cost reduction

+ 20-25%
Productivity (5G cranes)

AdSP MTS
Autorità di Sistema Portuale del Mar Tirreno Settentrionale

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Fondazione Eni Enrico Mattei

TIM

sustainability

MDPI

Article

Addressing Efficiency and Sustainability in the Port of the Future with 5G: The Experience of the Livorno Port. A Methodological Insight to Measure Innovation Technologies' Benefits on Port Operations

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Abstract: Relying on the international 2030 Agenda and specifically applying sustainable development's triple bottom line to port operations, innovation technologies enabled by 5G transformation have shown to serve as a junction point between the UN Sustainable Development Goals (SDGs) and the port's Key Performance Indicators (KPIs). In order to measure economic, social and financial benefits deriving from 5G networks and digital transformation, a piloted technology model has been shaped with the final aim of designing new models of port management and operational planning, and of implementing sustainable port growth policies. Such an assessment finally represents a crucial means to enhance technological advancements on port competitiveness and efficiency, and to boost sustainability performance by supporting public policies and business decisions, finally leading to the development of the port of the future.

Keywords: 5G; AI; IoT; digitalization; sustainable development; SDG; ports; Livorno

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1. Introduction

Industries are facing a new and unprecedented worldwide challenge to adapt their operational decisions to a more responsible and sustainable framework. Ports are not an exception, since they are fundamental economic ecosystems whose practices significantly impact the surrounding environment and community.

Therefore, it is increasingly important to pursue sustainable development in ports within the economic, social and environmental dimensions of sustainability. This requires to always bear in mind the objective of generating economic, social and financial benefits.

In fact, these economic hubs have to be considered as infrastructure assets that are able to foster economic growth and development as well as to be key gateways to international trade. This means that ports are crucial economic actors when it comes to creating employment, wealth, contribute to increase the national Gross Domestic Product

https://www.mdpi.com/2071-1050/13/21/12146

SUSTAINABLE DEVELOPMENT GOALS

8 DECENT WORK AND ECONOMIC GROWTH

11 SUSTAINABLE CITIES AND COMMUNITIES

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

13 CLIMATE ACTION

Livorno and 5G: feedback to EU regulators

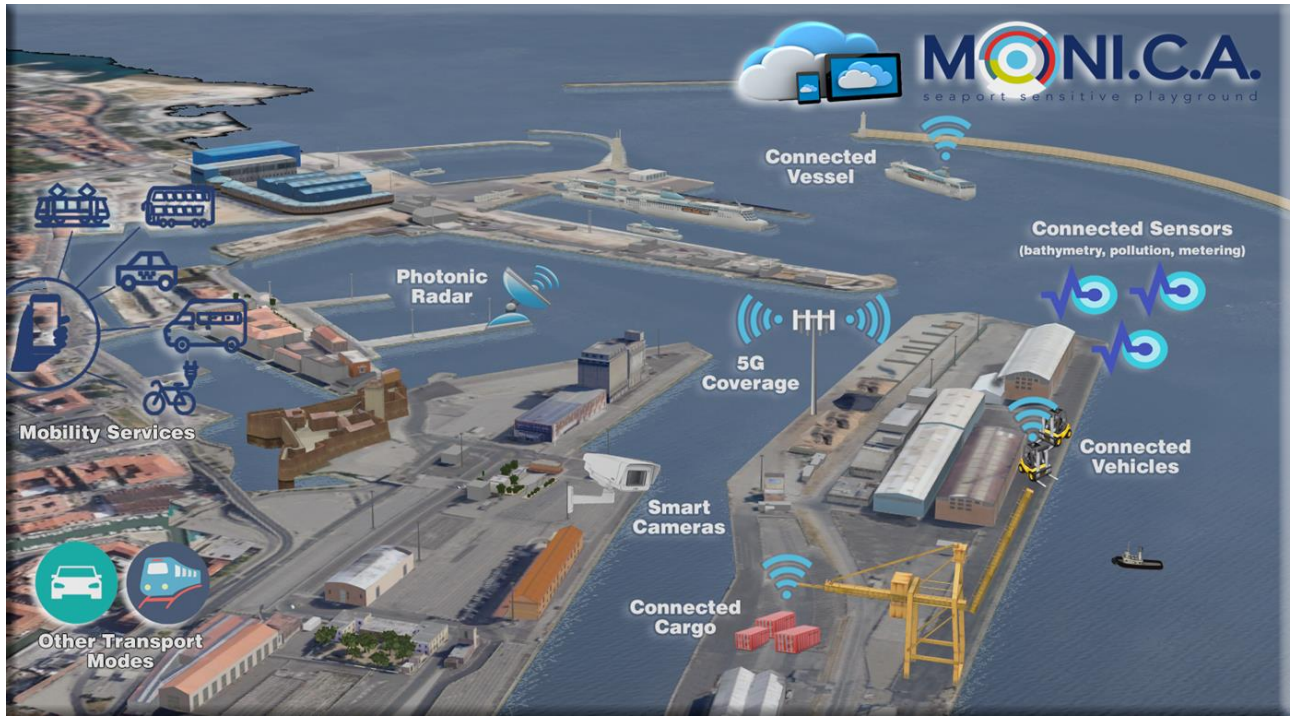
- CNIT is invited to comment on the «BEREC 5G radar» - BOR (20) 223:
  - private networks (NPN) managed by companies
    - ports as large companies in the sector;
  - creation of the global 5G digital market;
    - new players such as terminal operators, logistics operators, ocean carriers
    - a new “public procurement” and “concession” paradigm
- QoS guarantee and integration with satellite communications
  - for the same functionalities in the various world ports
- sustainable growth
  - reduction of the port's carbon footprint

https://www.youtube.com/watch?v=XEt3aAfxYgo&ab_channel=berec.europa.eu (minuto 47:51)

Body of European Regulators for Electronic Communications
BEREC

3/6/2021

BEREC Workshop on 5G: Insights on Innovation,
New Business Models and Value Chains



Looking ahead

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Port of the Future: connectivity

- Connected Ports:
  - complement a fiber optics backbone with private wireless (short and long range) networks;
  - a cyber-secure digital infrastructure.
- A 5G NPN needs to cover the seaways connecting the oadstead to the berths:
  - real-time sharing of high data volumes ;
  - target specification slices can be configured:
    - mMTC, eBB, URLLC.

POC (2017-21) - Livorno

Masterplan (2021-23) - Livorno

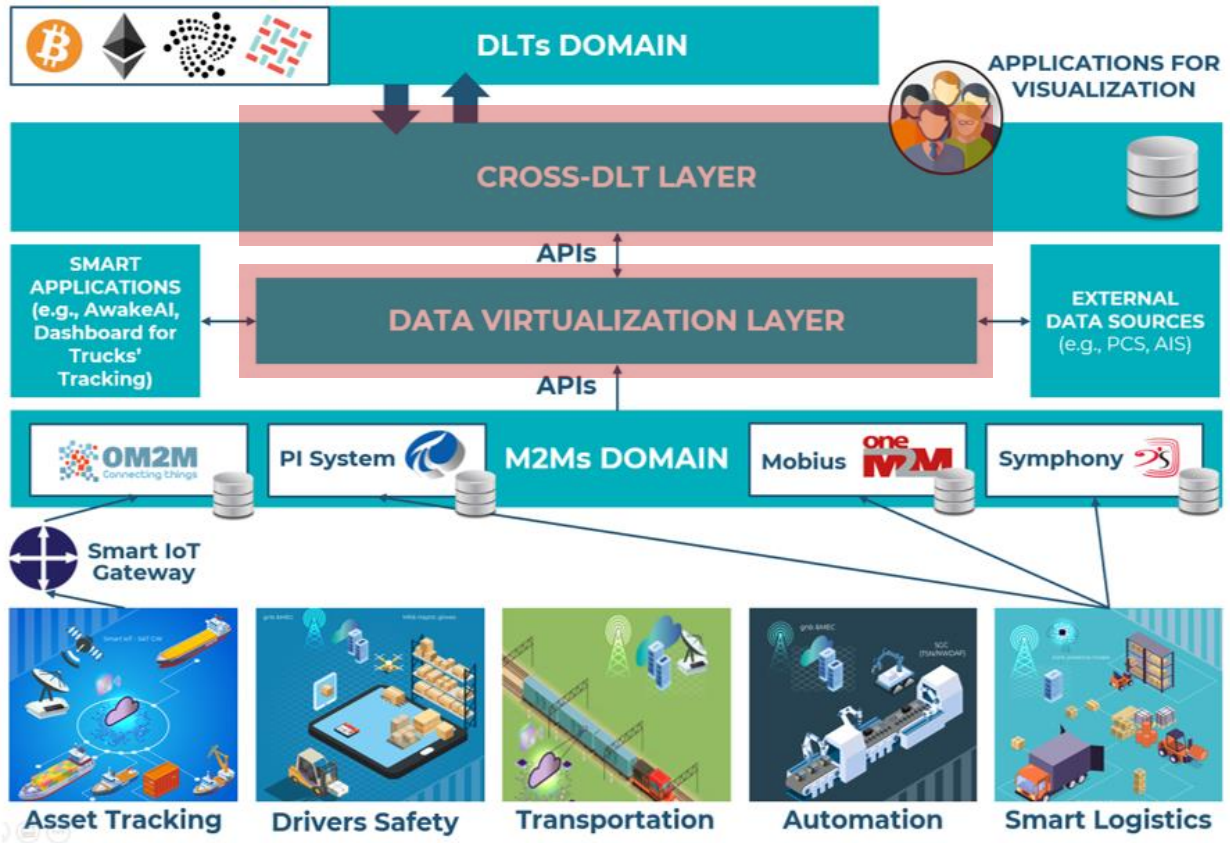
A preliminary design of the 5G NPN is available for Livorno (Q2/21)

Port of the Future: cyber-security and DLTs

DLT-based security:

IOTA DLT in Livorno

- Trustworthy data set:
  - Irrevocability / Immutability / History of transactions (cross-DLT interoperability)
- Privacy issues:
  - manoveurs, communications, processes are sensitive data (Pseudonymization Techniques)

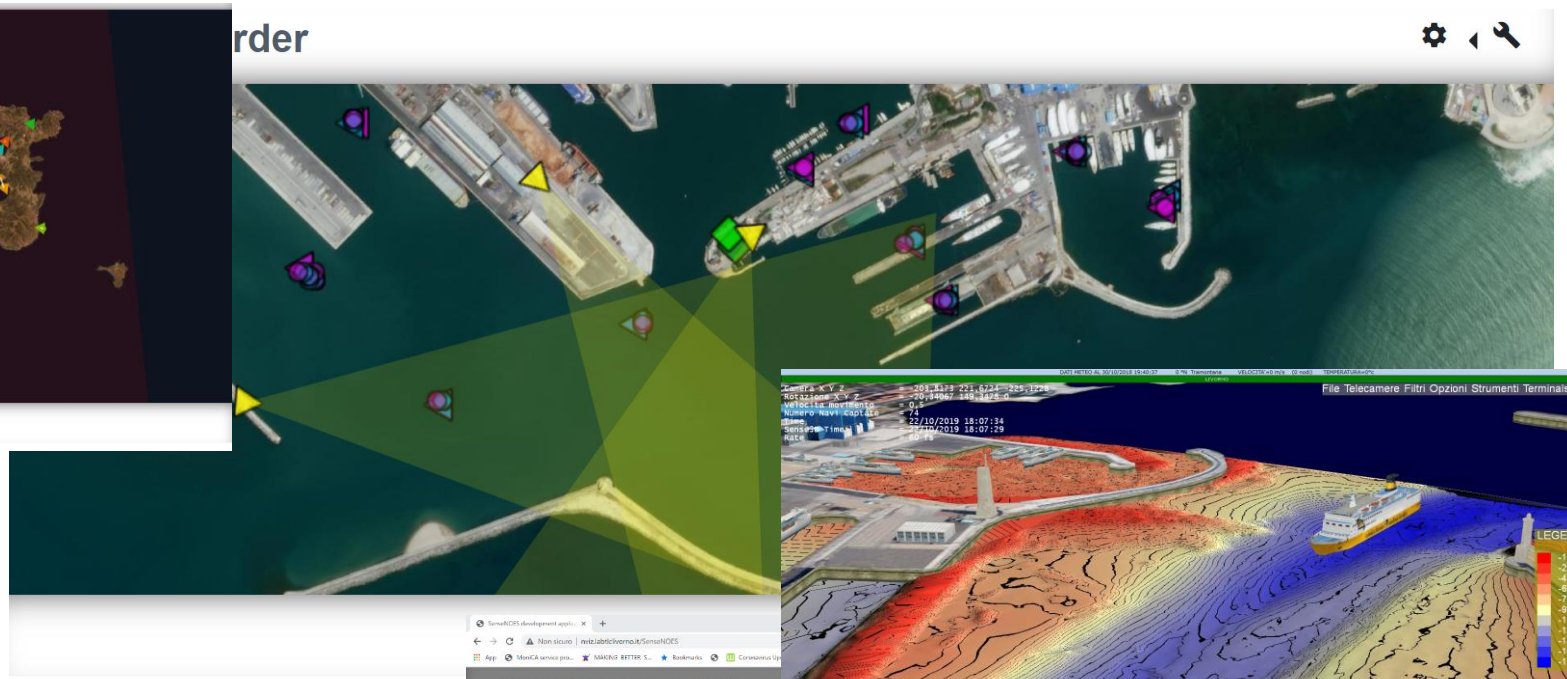


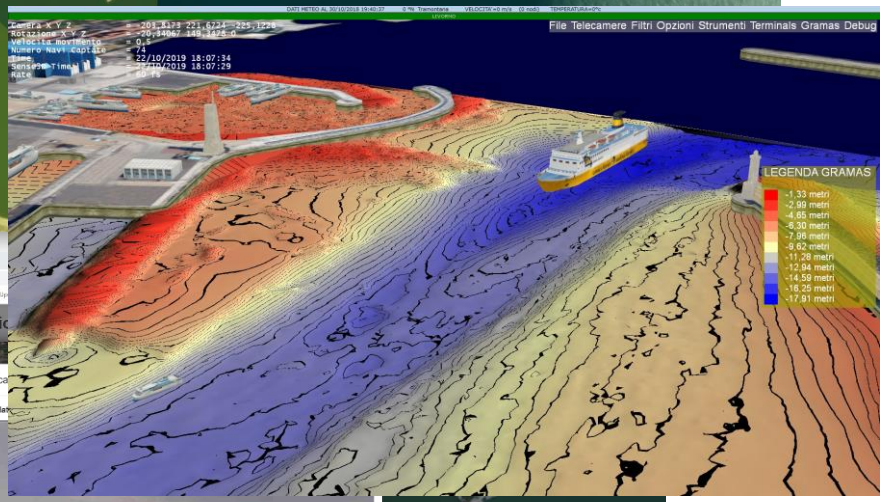
Lack of standardized and open solutions for the interoperability across data silos (e.g., M2M platforms) as well as across different DLT solutions (e.g, HyperLedger Fabric, IOTA, Bitcoin, Ethereum, Tradelens) for secure and shared data management.

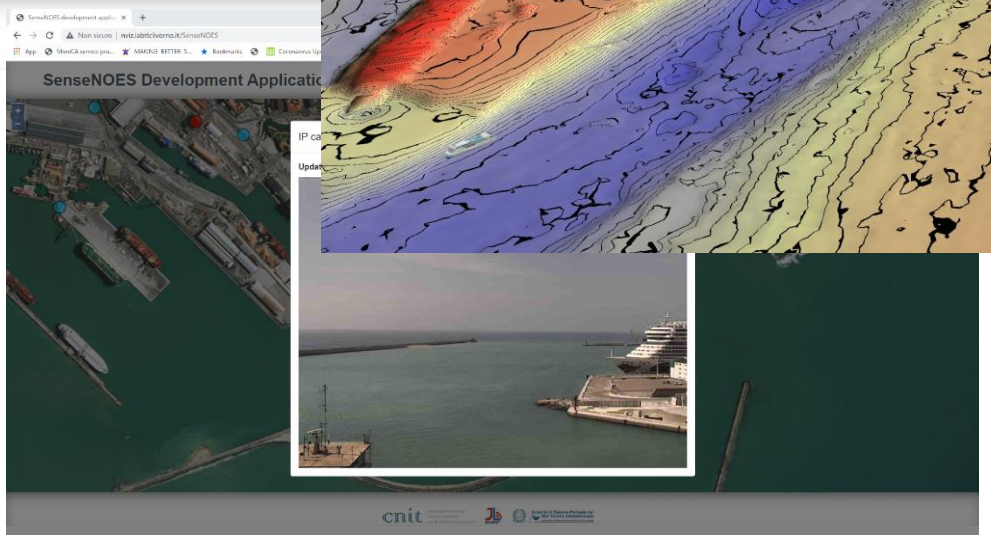
https://ingenious-iot.eu/

Grant Agreement No.: 957216
Call: H2020-ICT-2018-2020
Topic: ICT-56-2020
Type of action: RIA

Port of the Future: Full Control of Port Waters







- AIS monitor;
- Bathymetric charts;
- Active / Passive radar sources;
- Video streams;
- *Improved localization accuracy (via RTK and 5G);*
- Mooring management.

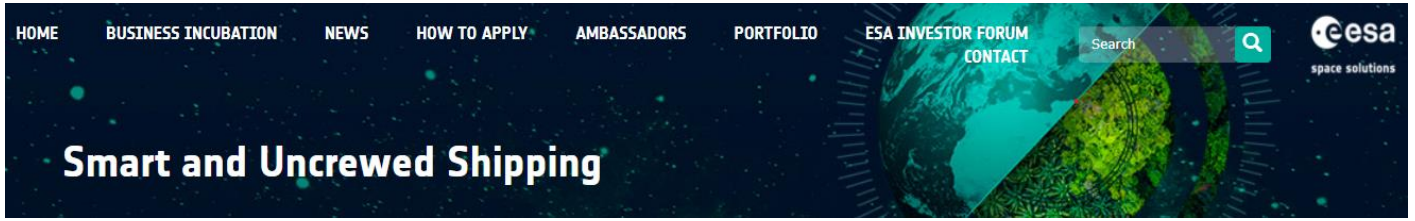
Livorno and 5G: Uncrewed shipping

5G MASS: 2022 - 2024

TIM FLYSIGHT GRIMALDI GROUP CETENA cnit

- Autonomous Ship;
- 5G NPN at Port and enhanced PNT;
- eNavigation Maritime Services;
- long-lasting trials in Livorno under the supervision of

IT Coast Guard



19/5/2021

https://youtu.be/frmcmSOgBnU (minute 46:50)

29/6/2022

https://youtu.be/pZsw8srxp-0

5G MASS: End Users and their expectations

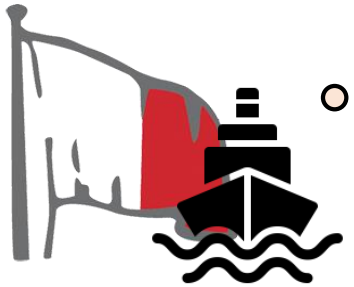
Port Authority

We can exploit a 24/7 port with full digital support to logistics services

I can check the current positioning of the vessel; maneuvering is easier with the port open data and digital systems

I can communicate with the port (remote control center) while approaching

We can early assess the feasibility of MASS in ports



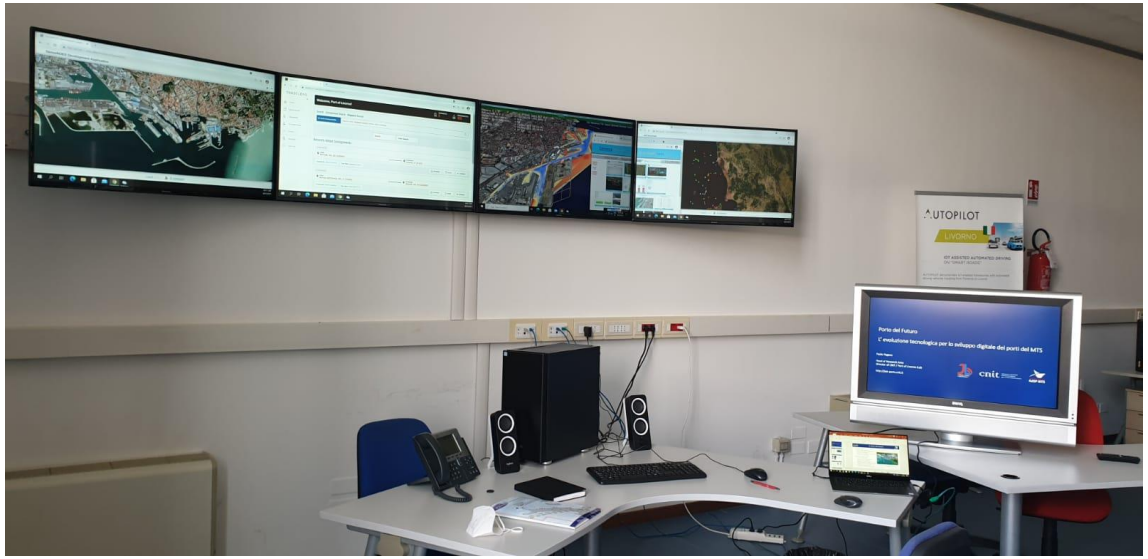
Pilots / Lines

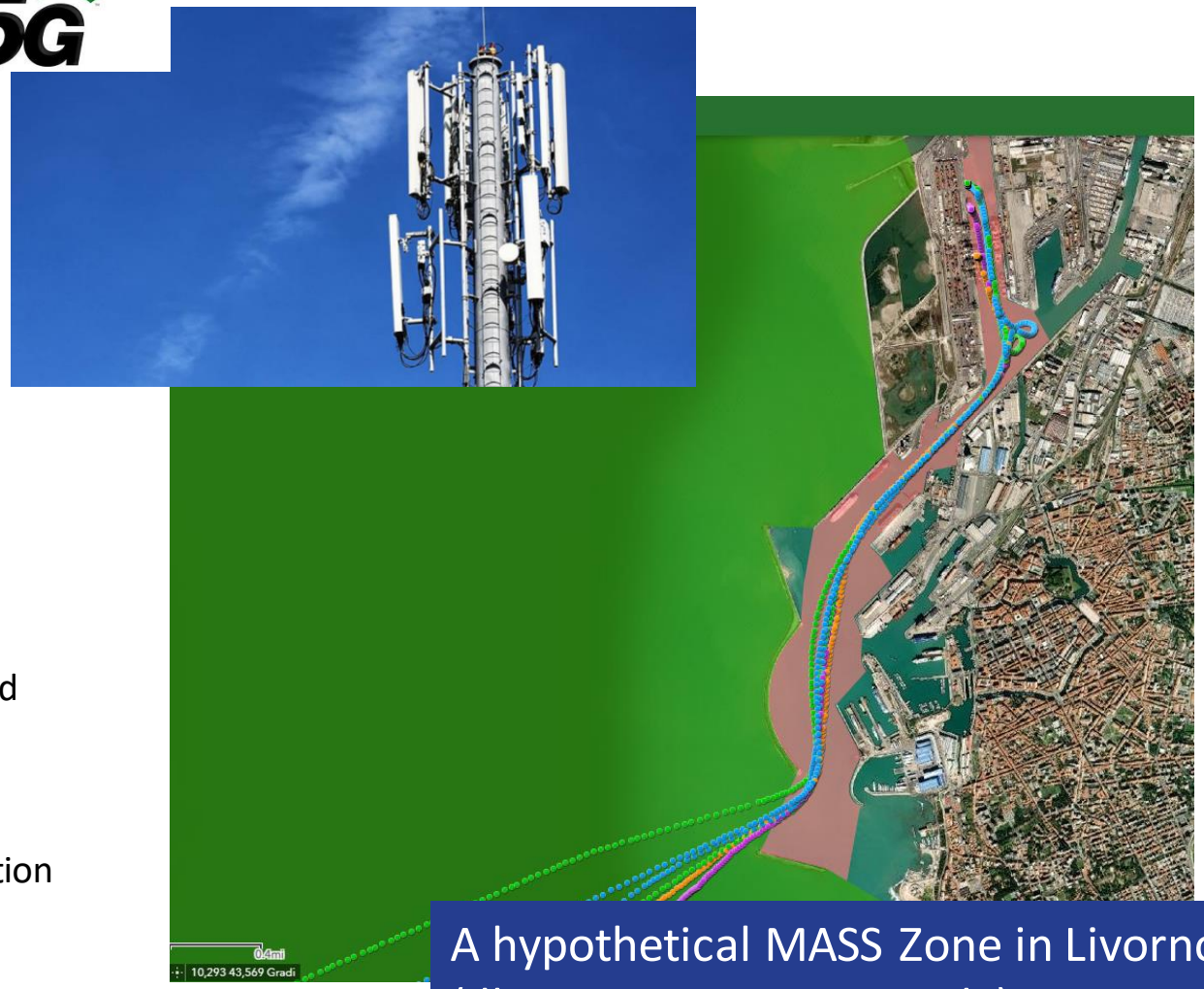
I can access a complete dataset containing real-time meteo-marine observations

We can manage Naval Traffic in a safer and more efficient manner (even in difficult meteo-marine conditions)

Coast Guard

5G MASS expected outcomes (targeting safety)





A hypothetical MASS Zone in Livorno (illustration purposes only)

- Technological development exploiting the ultra-reliable, secure and broadband communication offered by 5G;
- Integration of shipboard, shore, and nomadic equipment (to be handled by active pilots);
- Setting up a (protoype) Shore Command Center, port/vessel twinning;
- Navigation Safety in the port channels, h24 operations, active cooperation with the Coast Guard / Pilots, Situation Awareness during operations.

Thank you!

- Port of Livorno:
  - has enabled a digital infrastructure capable of validating innovative services targeted to port communities;
  - has an unquestionable recognition in the international domain and is considered an international “best practice” for 5G deployments in ports;
  - has proven the positive impact of 5G to sustainable growth;
  - is turning feasibility studies into execution;
  - is looking ahead to new services (tailored to smart and autonomous shipping);
  - ready for replicability in other sea ports.

Courtesy of:

Corpo Piloti del Porto di Livorno