5G-HEART WEBINAR SMART AQUACULTURE WITH THE USE OF 5G

5G-HEART.EU

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5G HEALTH AQUACULTURE AND TRANSPORT VALIDATION TRIALS

07/05/2021

Outline

- Aquaculture today
- Need for 5G
- 5G HEART Aquaculture use cases
- AQUAWINGS platform
- Sealab Aquaculture platform
- Cooperation of infrastructures/platforms
- Benefits from 5G
- Future work

Aquaculture today

Market overview, Objectives and Challenges faced by the Aquaculture sector

World Aquaculture

- Aquaculture is one of the fastest growing food producing sectors
  - Contributes to global food supply & economic growth
  - The share of seafood products supplied by aquaculture grew from 16% in 1990 to 54% in 2018 (FAO)
  - Global production is 212M tonnes in 2018 v 90M tonnes from capture fisheries
  - Value is estimated at €219 billion (FAO)

World Aquaculture

FAO identifies aquaculture as a leaner and much more sustainable, environmentally-friendly method of producing food for the world's rapidly increasing population.

It is an enormously efficient method of producing highly nutritious food that contains high quantities of proteins and ingredients that are key to human health.

Meat products cannot compete, because the food conversion ratio (FCR) of aquaculture products is much lower than traditional animal farming on land.

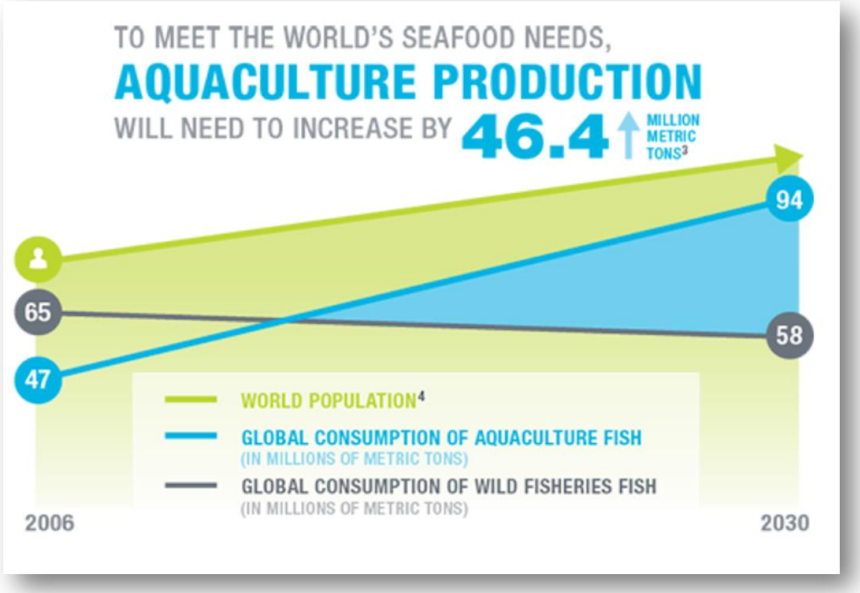
8,7 Kg for 1Kg Beef

5,9 Kg for 1Kg pork

1,9 Kg for 1Kg Poultry

1,2 Kg for 1Kg fish

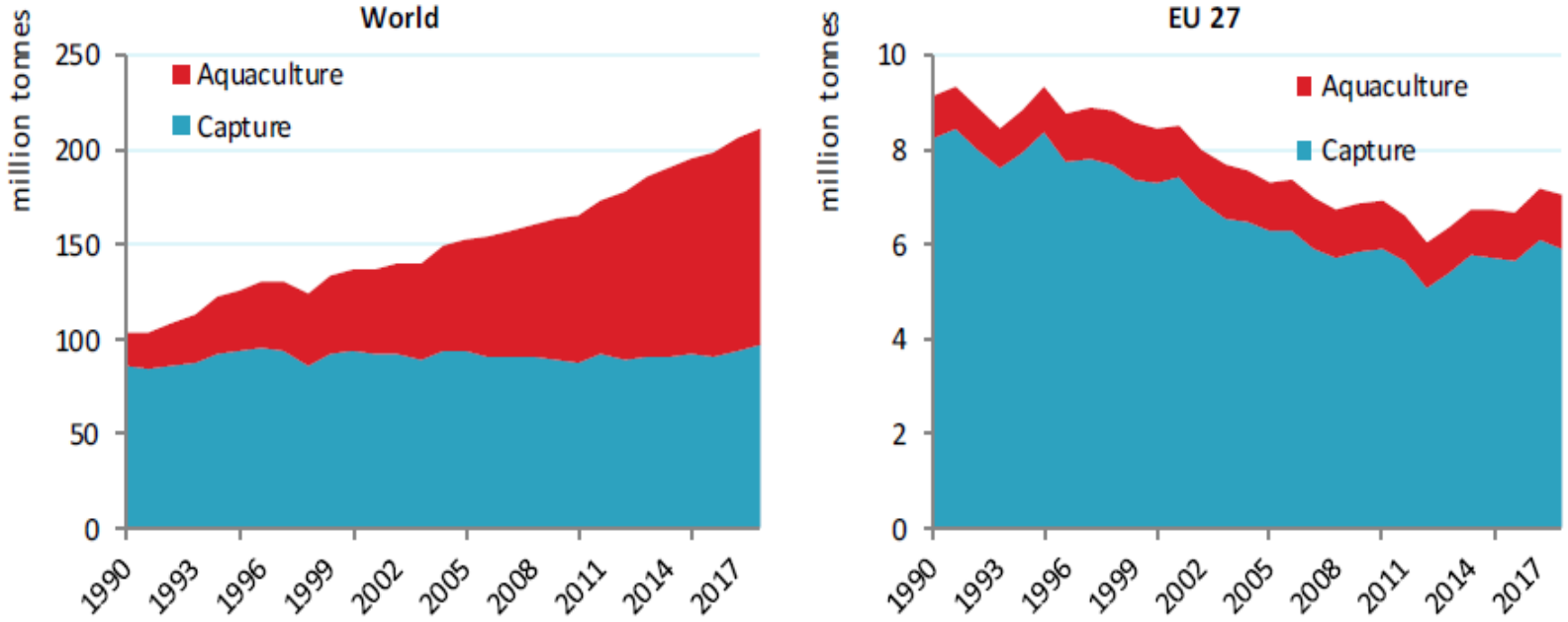
Aquaculture Today: Growing demand of fish



Source: World Bank. 2013. Fish to 2030

- With our global population projected to reach more than 8.5 billion by 2030, aquaculture production will need to more than double from today's level in order to satisfy the growing demand for seafood

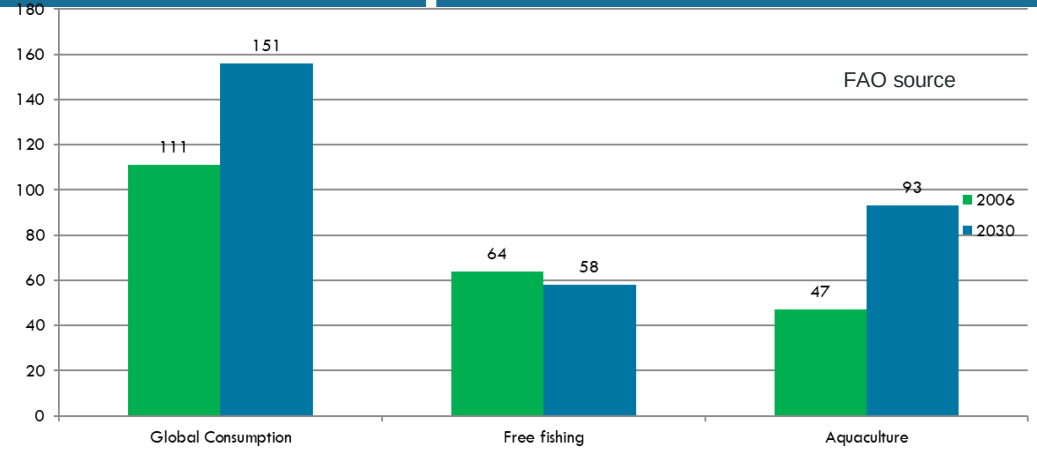
World Aquaculture

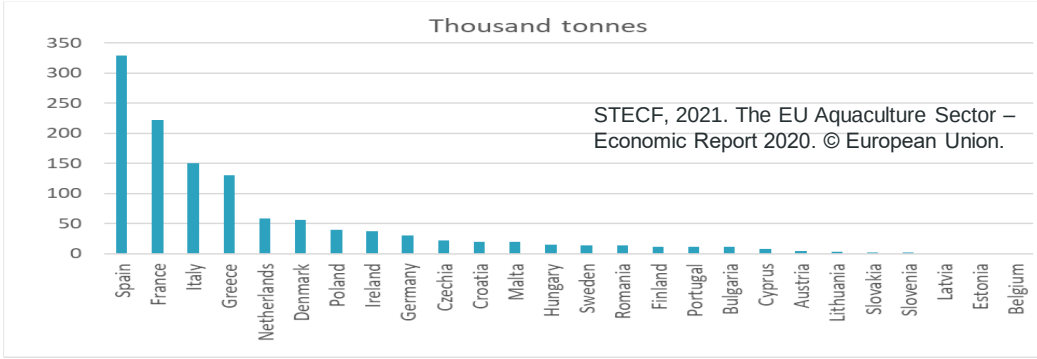


World and EU-27 seafood production (aquaculture and capture fisheries) 1990-2018

STECF, 2021. The EU Aquaculture Sector – Economic Report 2020. © European Union.

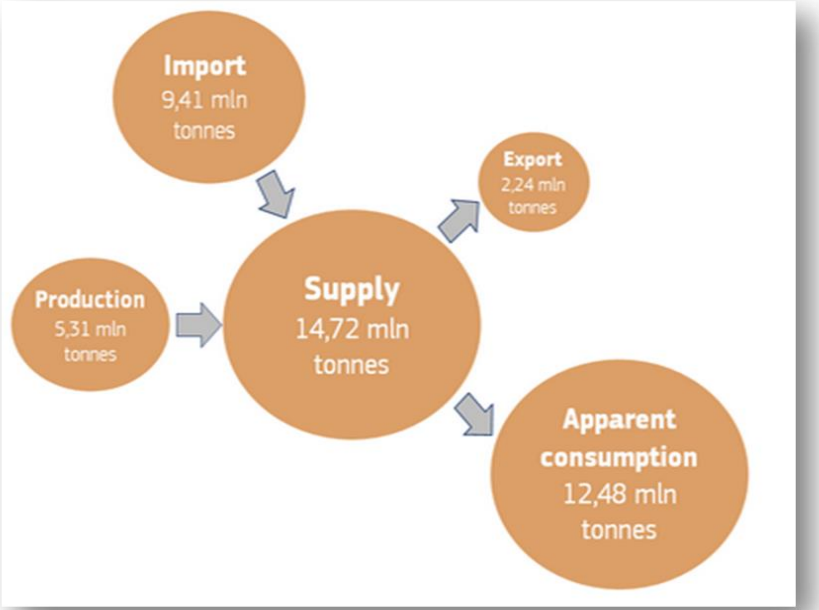
Aquaculture Today: Growing demand of fish
EU-27 Aquaculture Production





- Global aquaculture production is dominated by China (58%) with the EU producing only 1%
- EU production has remained stable over the last decade at 1.2M tonnes, worth €4.1 billion in 2018
- The largest producers within the EU are Spain (27%; 330,000 tonnes), France (18%; 220,000 tonnes), Italy (12%; 150,000 tonnes) and Greece (11%; 135,000 tonnes)
- Norway produces *ca.* 1.45M tonnes; the UK *ca.* 220,000 tonnes

Aquaculture Today: European Market Overview



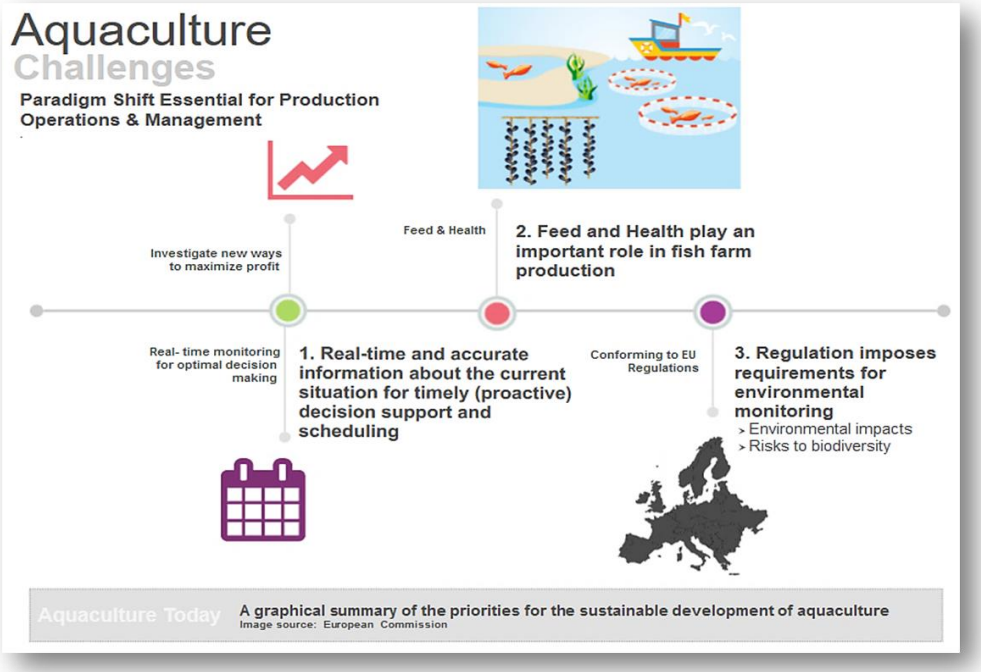
Source: EUMOFA: European market observatory for fisheries and aquaculture products

- The Europe aquaculture market is accounted to **US$ 10,345.4 Mn** in 2018 and is expected to grow at a CAGR of 5.3% during the forecast period 2019 - 2027, to account to **US$ 16,311.8 Mn by 2027**.
- The EU is the **sixth largest producer** in fishery and aquaculture products, covering in 2018 around 3% of global production (5,5% for catches and 1,2% for aquaculture).
- The internal demand of seafood in the EU is mostly met **through imports, as they cover around 60% of the total supply.**
- 15% of EU supply is exported.

Aquaculture today: Goals and objectives

- Productivity increase
- Reduction of production costs
- Improvement of economic performance
- Facility security
- Reduction of the environmental footprint

Aquaculture Today: Challenges and linked parameters



Key parameters for achieving the goals

- Productive Parameters
- Environmental Parameters
- Parameter Interaction

Key Production Indicators

- F.C.R (Feeding Conversion Rate)
- Rate of survival
- S.G.R (Standard Growth Rate)

Main Environmental Parameters

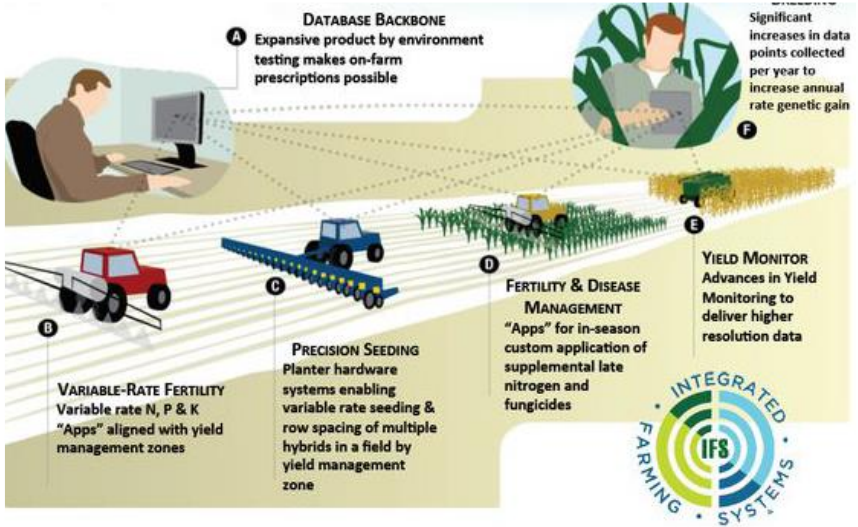
- Dissolved Oxygen
- Temperature
- Currents

Objectives:

- Improvement of the F.C.R (Feeding Conversion Rate)
- Reduction of production costs
- Environmental footprint reduction

Agriculture/Aquaculture 4.0

Agriculture 4.0 (or Aquaculture 4.0) encompasses new trends facing the industry including a focus on **precision aquaculture, the Internet-of-Things (IoT), artificial intelligence (AI) and the use of big data to drive efficiency and improve performance (economic and environmental).**



Industry 4.0 in agriculture: focus on IoT aspects. European Commission 2017.

Need for 5G

The role of 5G in bringing added value to aquaculture

Aquaculture Use Cases : Need for 5G

- The capacity of the 4G-network is too low to support the amount of data needed to be transferred from the high bit rate cameras of a fish farm.
- The low latency needed to have from components like underwater drones can be supported by 5G infrastructures.
- Edge and cloud-based computing which are enablers of the 5G networks will support in a better way the Aquaculture verticals
- The high number of sensors needed to operate in an aquaculture setting can be more efficiently operated by 5G
- The artificial algorithms and the necessity to process and manipulate real time data analytics will be accomplished from edge computing and 5G which offers low latency in data processing

Aquaculture 4.0: 5G Technologies

- A key driver of Aquaculture 4.0 will be **greater connectivity**

- Legacy networks (3G/4G) are suitable for many basic requirements, but are **limited** by connectivity, latency and energy consumption

5G can provide ubiquitous cover for all on-farm **requirements**

- ✓ **Internet** needs for personnel,
- ✓ **Data transfer** from monitoring stations and sensors
- ✓ **High resolution** video/image transfer
- ✓ Supporting **intelligent management systems** offering autonomous monitoring and control of the farm
- ✓ **Low** latency
- ✓ Energy efficiency

5G HEART Aquaculture use cases

Greek and Norwegian site

Key Production Indicators

Goals and objectives:

- Productivity increase,
- Reduction of production costs,
- Improvement of economic performance,
- Facility security,
- Reduction of the environmental footprint from the production process

Objectives:

- Improvement of the F.C.R (Feeding Conversion Rate)
- Reduction of production costs
- Environmental footprint reduction

Aquaculture

Main Environmental Parameters

- **Dissolved Oxygen**
- **Temperature**
- **Currents**

Necessary equipment:

- **Under Water Camera** (Inspection of living conditions and fish behavior, Monitoring the response of fish during feeding, Estimation of fish biomass, Fish mortality inspection)
- **Sensors** (Recording of monitored parameters, Recording the speed and direction of submarine currents)
- **Security Camera** (Night monitoring of the facility with the capability of thermal imaging)
- **Under water Drone** (Inspection of the unit anchorages, Inspection of the nets)

Aquaculture use cases (WINGS-Sealab)

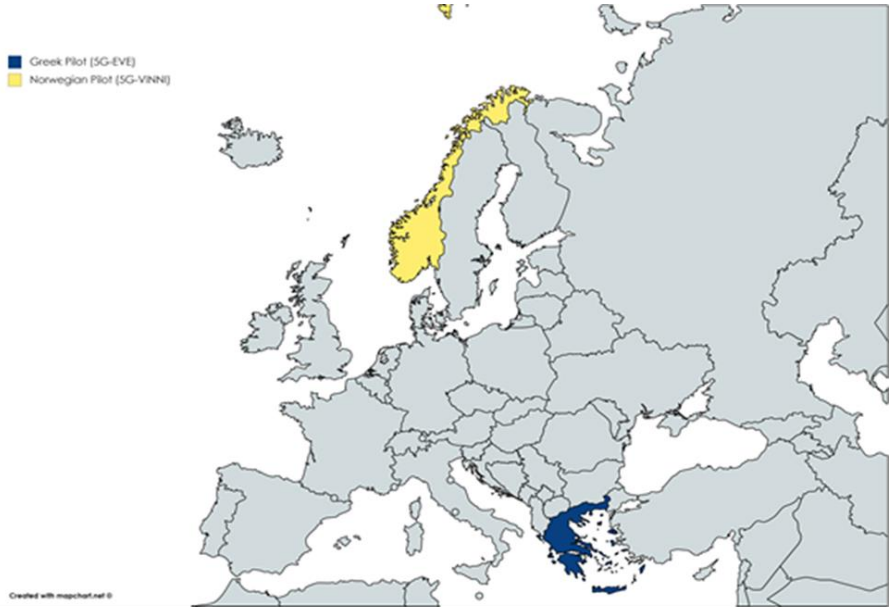


Figure: Aquaculture vertical cartography

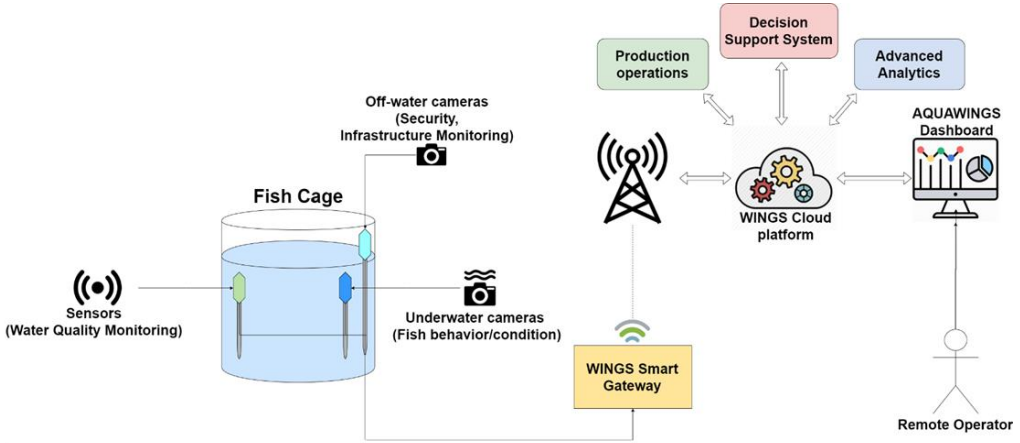
- The use case for the aquaculture vertical will take up to deploy two pilots on two different environments showcasing the applicability of the solution developed in different locations.
- The Greek pilot is deployed in Megara, Attica near Athens where the Greek node of 5G-EVE is located.
- The second pilot is deployed in Norway and will use the Norwegian node of 5G-VINNI to access the network.

Aquaculture Use Case in Greece

SKIRONIS Aquaculture farm in Megara

- Skironis Aquaculture SA is an aquaculture farm established by license and operates a fish-farming unit, on floating facilities of fifty thousand (50000) m3 in the area of "Kato Aloni", Megara Bay, Megara, Western Attica
- The farm comprises of **3 sites**, with annual production capability of 1500 tonnes. The first site has an area of 20000 m3 with 15 cages, the second site has an area of 10000 m3 with 12 cages, the third site has an area of 20000 m3 with 10 cages.

Aquaculture Use Case in Greece



AQUAWINGS: Smart Aquaculture solution architecture

Underwater Cameras

- Inspection of living conditions and fish behaviour
- Monitoring the response of fish during feeding
- Estimation of fish biomass
- Fish mortality inspection

Underwater Sensors

- Recording of monitored parameters
- Recording the speed and direction of submarine currents

Security Camera

- Night monitoring of the facility with the capability of thermal imaging

Underwater Drone

- Inspection of the unit anchorages
- Inspection of the nets

Aquaculture Use Case in Norway

Panorama overview of the Norwegian fish farm

- The Norwegian use case is located at a fish farm in Rørvik, on the west-coast of Norway. The farm consists of 8 cages where Atlantic Salmon is produced.
- For the 5G-HEART project each cage will be equipped with HD-underwater cameras with underwater lights to monitor the fish live and to use Artificial Intelligence (AI) like pellet detection to control feeding of the fish.
- Other included installations: topside cameras and environmental sensor on each cage.

Aquaculture Use Case in Norway

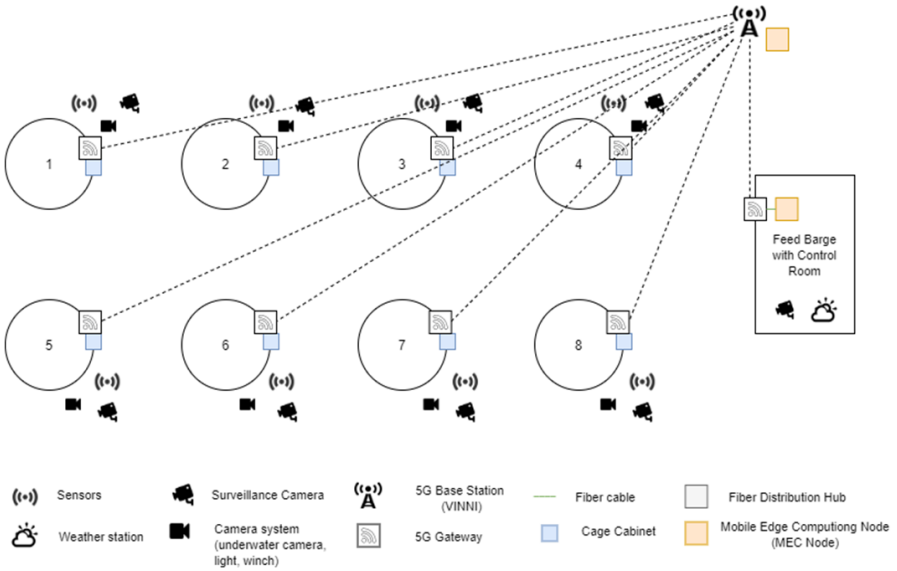


Illustration of the Norwegian pilot site with the planned installed equipment in the final phase

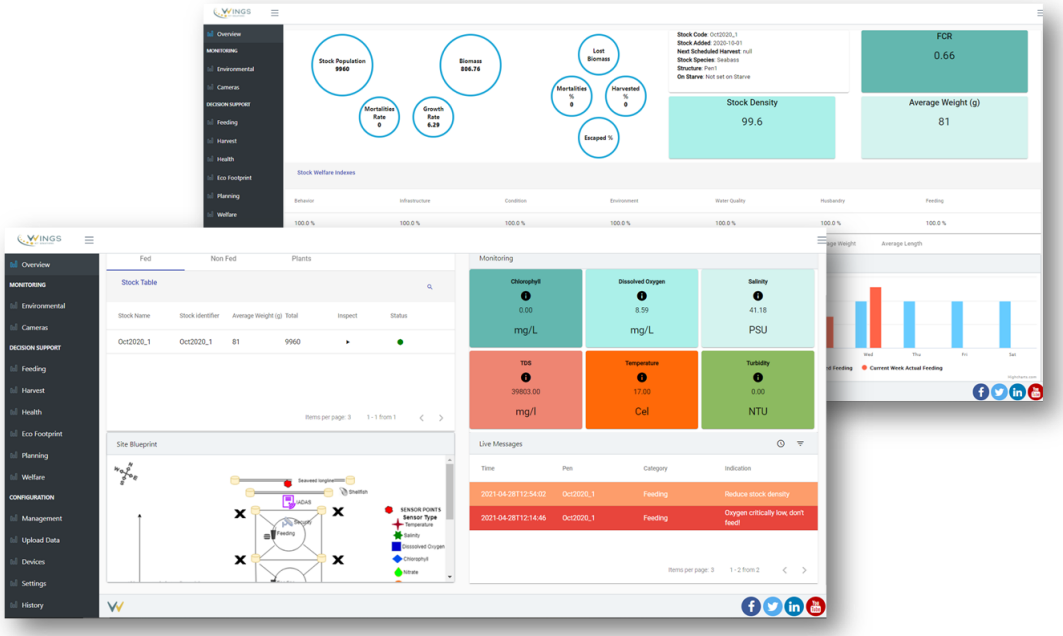
Scenarios that will be carried out on the Norwegian test site:

- A1S1: Sensory Data Monitoring
- A1S2: Camera Data Monitoring
- A1S4: Edge and Cloud-based computing
- A1S5: Wireless communication on site

AQUAWINGS platform

The role of AQUAWINGS platform in the optimization of aquaculture production

AQUAWINGS solution: Description and role



AQUAWINGS Dashboard

AQUAWINGS is a holistic solution that delivers enhanced monitoring and management of farm operations and production planning. The platform delivers the necessary innovations for sustainable fish farms:

- **Disease** diagnosis
- Fish **behaviour** analysis
- **Intelligent** feeding
- Water Quality **Analytics**

AQUAWINGS solution: Description and role

Advanced monitoring and insights

Based on user objectives and multiple sensing devices and cameras, AQUAWINGS is able to effectively monitor various production and environmental parameters responsible for the farm's productivity and sustainability.

- Predictive analytics such as:
- Fish behaviour monitoring
- Disease diagnosis
- Biomass estimation &forecasting
- Water quality analytics

Decision Support System

A powerful Decision Support System, empowering farmers with early warnings/alerts, and with suggestions for:

- Optimal Feeding
- Optimal Harvesting & Seeding
- Disease Prevention and Mitigation
- Planning

Farm Performance and Assessment

AQUAWINGS provides records of farm performance by keeping farm and stock information such as:

- Average weight biomass
- Feed Conversion Ratio (FCR),
- Fish volume
- Stocking density

AQUAWINGS features contribution to 5G HEART

Unlimited sensing

Parameters: Temperature, pH, Salinity, Current, Dissolved oxygen, Turbidity, Chlorophyll, Nitrate, Ammonium, Meteorological Data

Multiple connections: Multiple sensors in each cage, sensors in central or border points of the site

High quality video

Analytics: Biomass calculation, behaviour monitoring, disease diagnosis, feed pellets detection

Data rate: Video footage from multiple cages at the same time

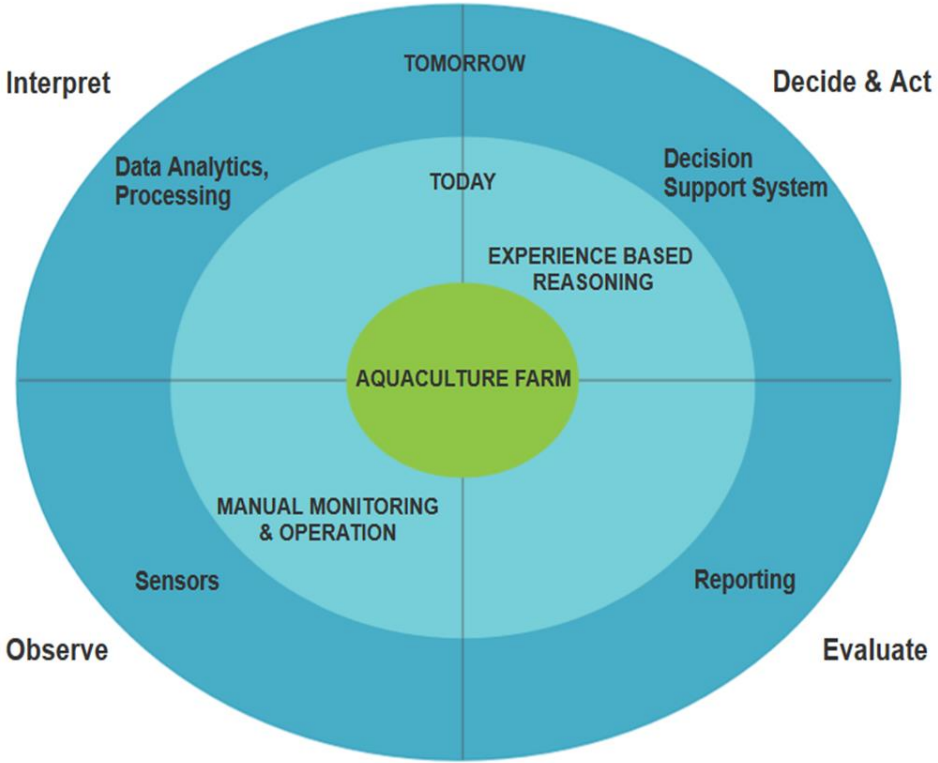
Real-time monitoring and actuation

Measurements: Real-time measurement of water quality

Optical observations: Real-time biomass calculation, early alerts

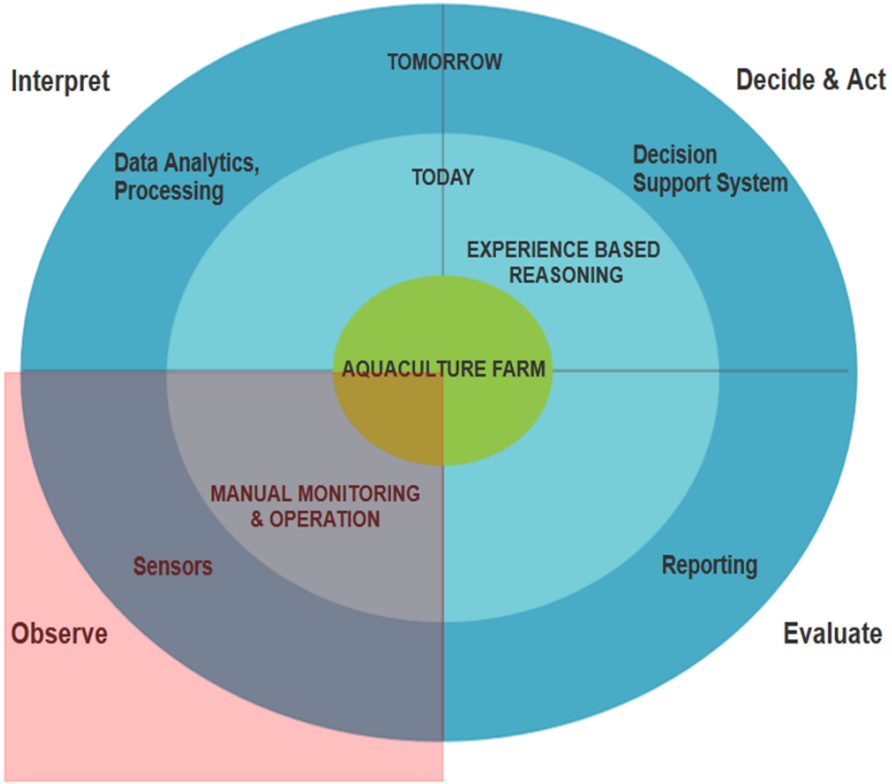
Remote actuation: Feeders, lights, camera positions, parameter regulators, UAV/drone operation

AQUAWINGS Smart Aquaculture Solution



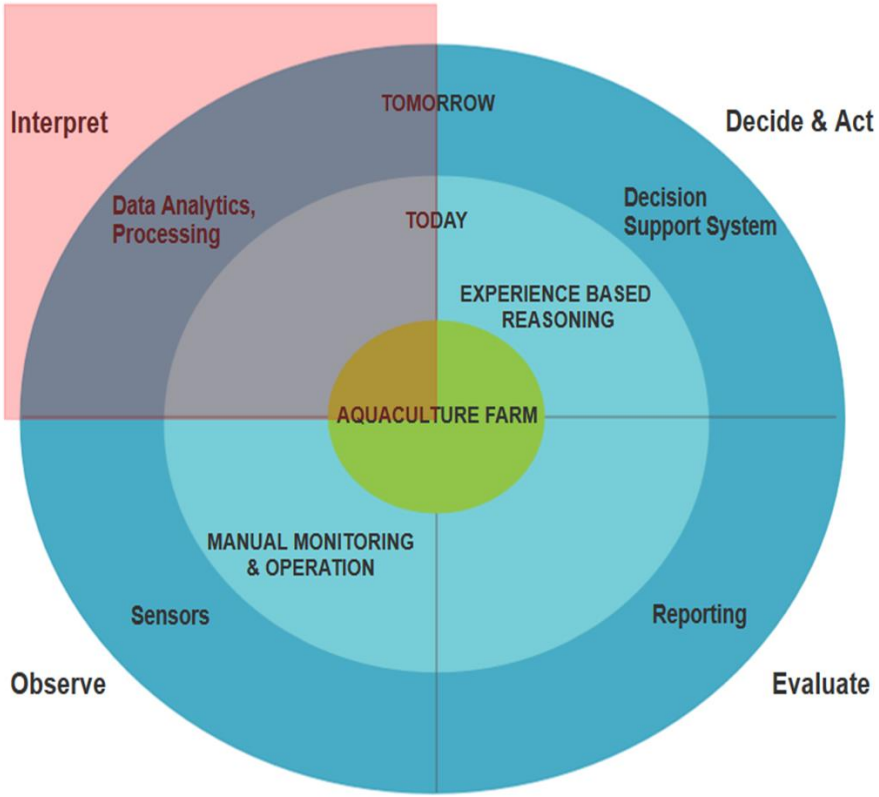
- **Observe**
  - Heterogeneous Data Collection / Management
- **Interpret**
  - Data Analytics / Accurate Predictions
- **Decide & Act**
  - Decisions Support / Scheduling
- **Evaluate**
  - 360° Reporting

AQUAWINGS Smart Aquaculture Solution: Observe



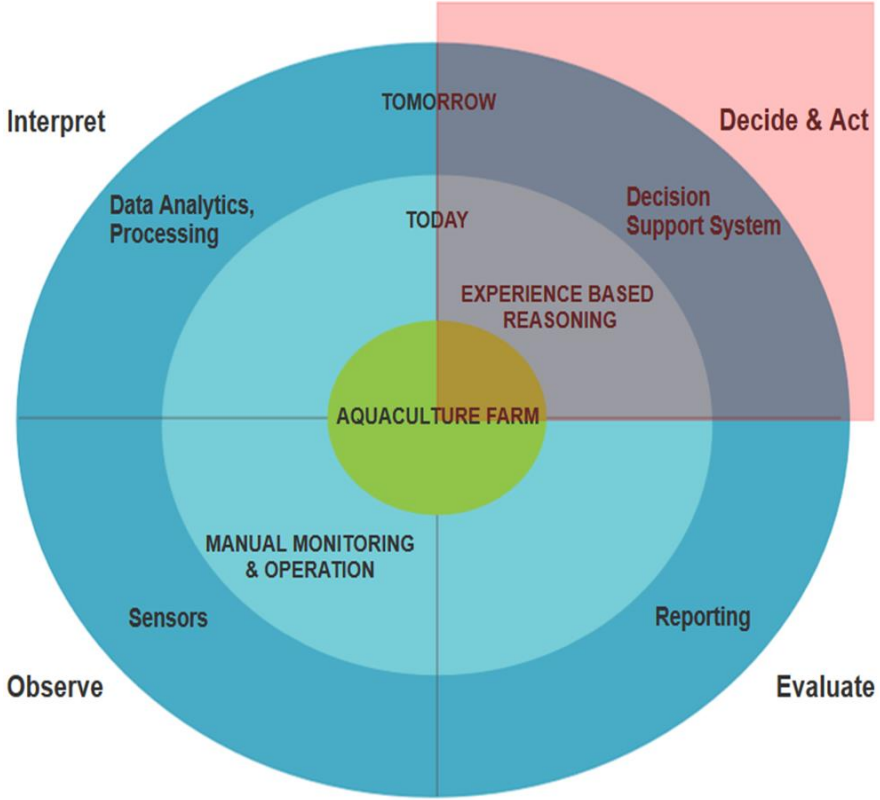
- **Production Overview**
  - Average weight, biomass, FCR, fish number, seaweed length
- **Multi-sensing**
  - Temperature
  - Dissolved Oxygen
  - Current
  - Conductivity
  - Meteorological data
  - pH
  - Salinity
  - Turbidity
  - Chlorophyll
  - Nitrate
  - Ammonium
- **Advanced Monitoring**
  - Cameras
  - Satellite Data

AQUAWINGS Smart Aquaculture Solution: Interpret



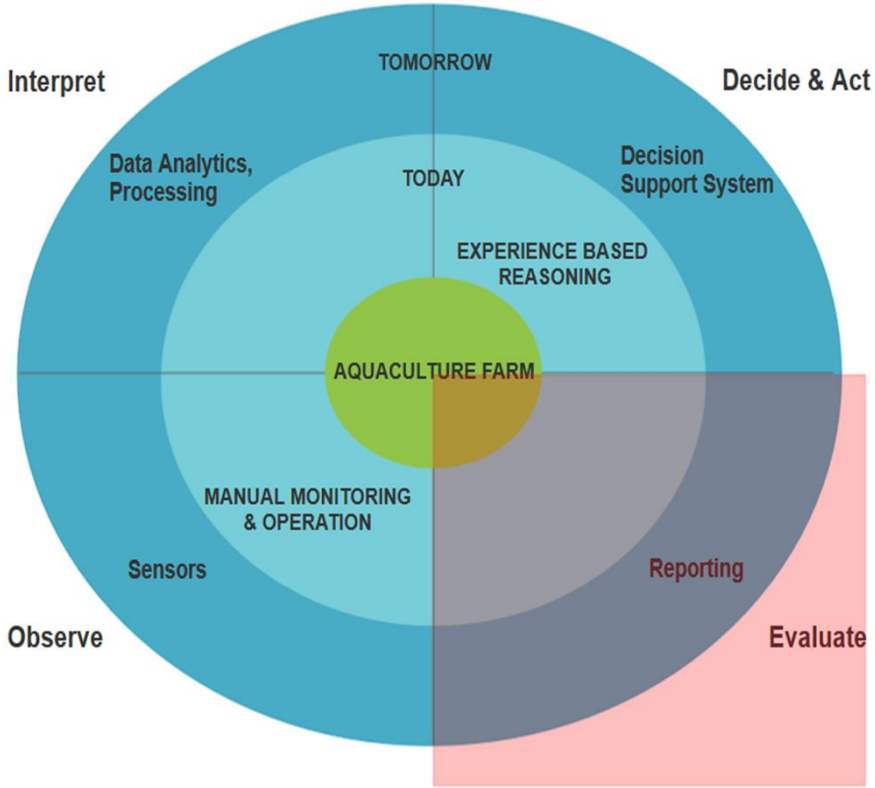
- Advanced Analytics
- Data Management
- Complex Event Processing
- Predictive Analytics
- Image Processing

AQUAWINGS Smart Aquaculture Solution : Decide & Act



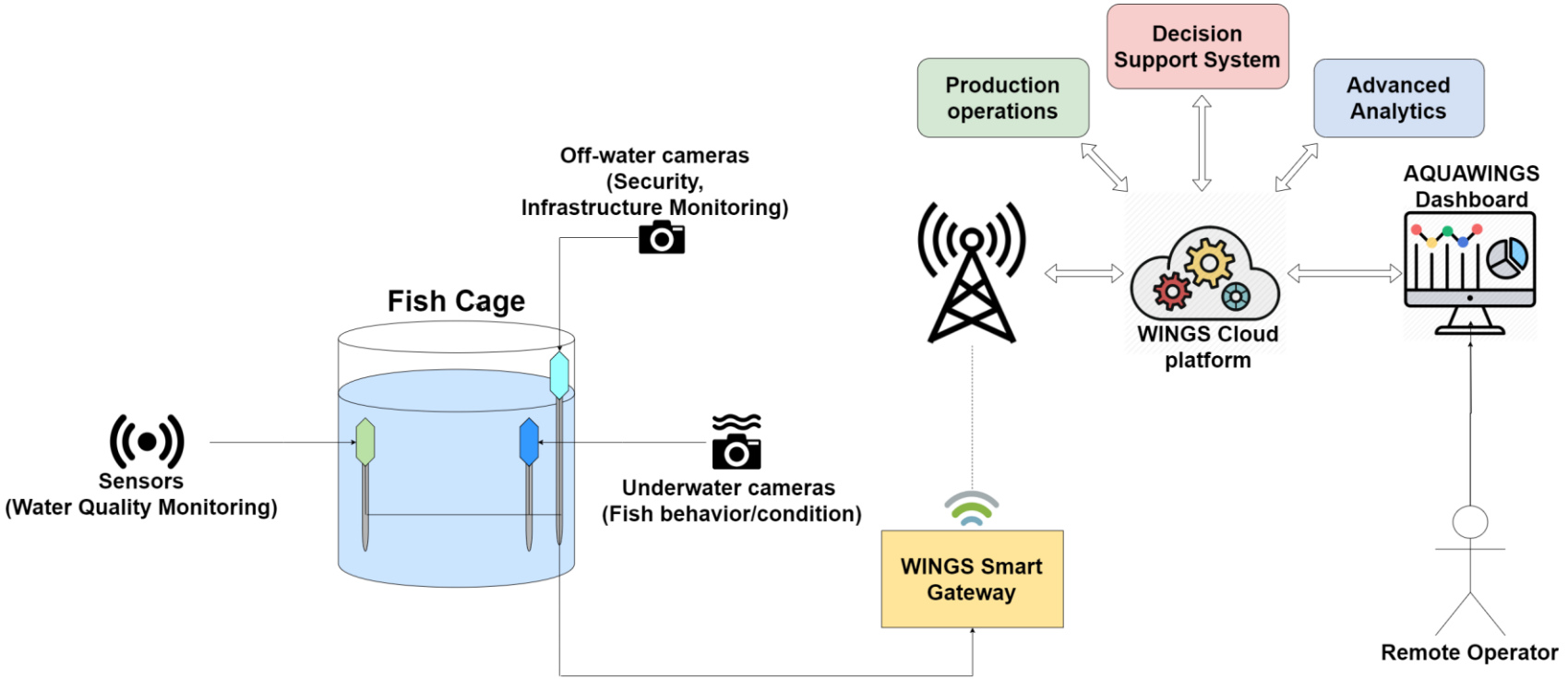
- **Decision Support System:**
  - Optimal Feeding management for FCR minimisation
  - Optimal Harvesting time
  - Optimal Seeding time
  - Disease Prevention & Mitigation
  - Planning
  - Stock Welfare: Overall health status of the farm
  - Environmental Footprint

AQUAWINGS Smart Aquaculture Solution : Evaluate

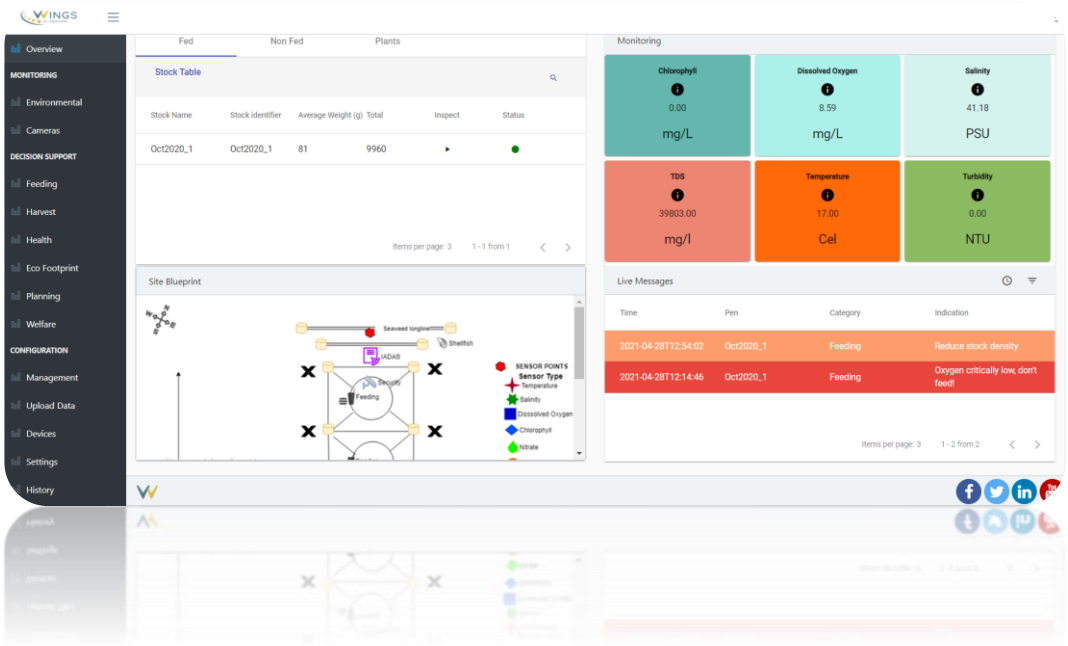


- **Reporting**
  - Effective tracking of Production
    - Average weight
    - Biomass,
    - Feed Conversion Ratio (FCR)
    - Fish volume
    - Stocking density
  - Environmental reporting

AQUAWINGS Architecture

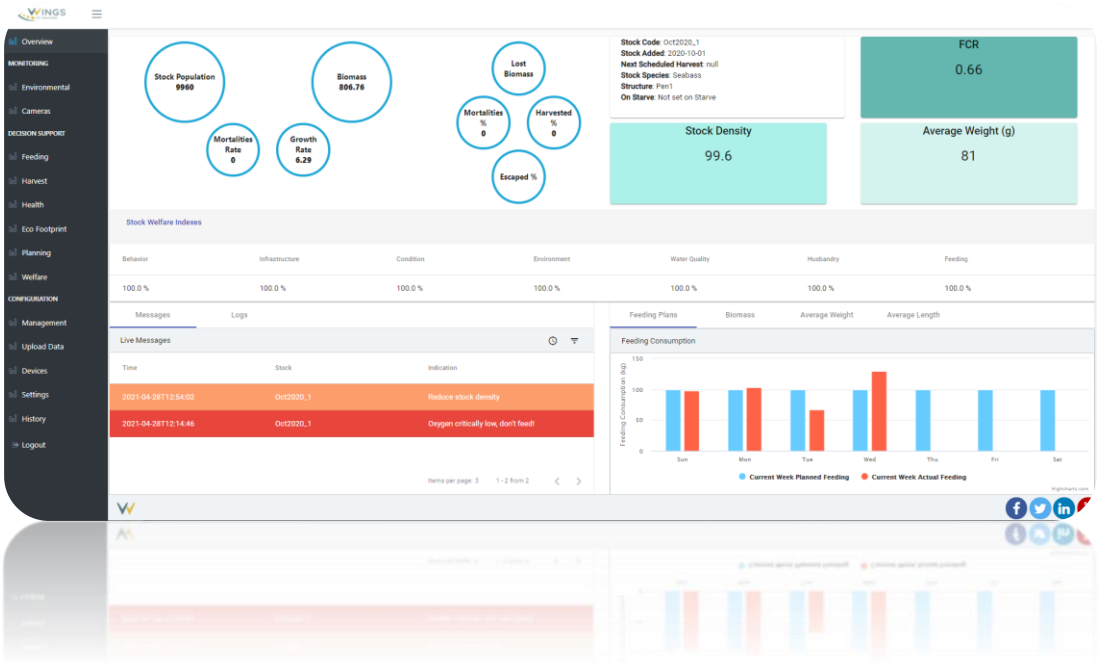


AQUAWINGS Dashboard: Production Overview



- **Fish number, Average weight, Biomass, Stock Density, FCR and Stock Welfare Index (SWI)**
- **Keep track of:**
  - Harvests
  - Average Weight of fish per cage
  - Mortalities
  - FCR
  - Monitor and Manage
  - Feeding Efficiency
  - Stock Welfare
  - Live Messages (alerts, recommendations)

AQUAWINGS Dashboard: Real Time Monitoring

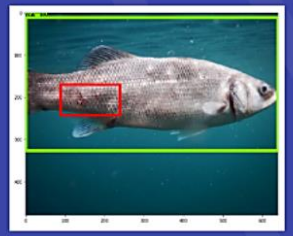


- **Welfare Status of fish per pen:**
  - Behaviour
  - Condition
  - Environment
  - Water Quality
  - Husbandry
  - Feeding
- **Parameters Monitoring:**
  - Input from various sensors
  - Water Quality is a significant contributor to fish welfare

AQUAWINGS: Advanced Features

AQUAWINGS Advanced Features

DISEASE DIAGNOSIS



- Fish detection
- Disease scars identification
- Image-based condition estimation

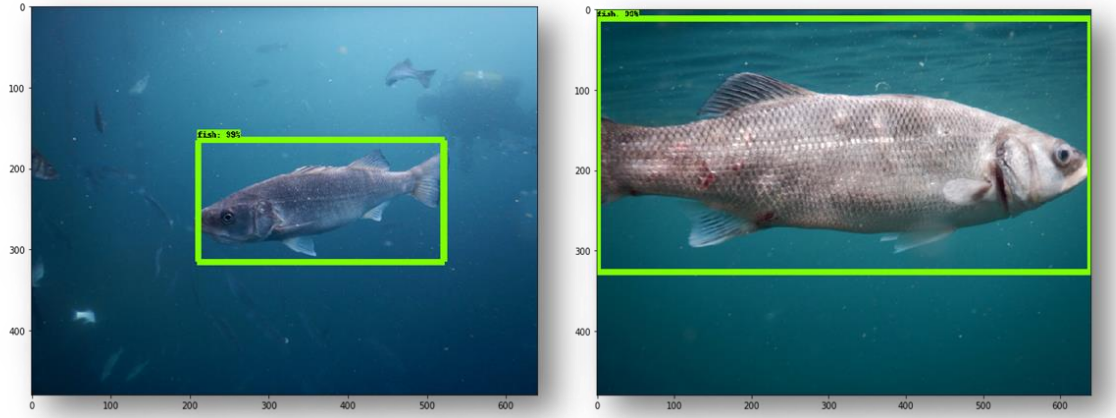
BEHAVIOR ANALYSIS

- Image recognition
- Identification of behavior traits
- Speed, direction, patterns

WATER QUALITY ANALYTICS

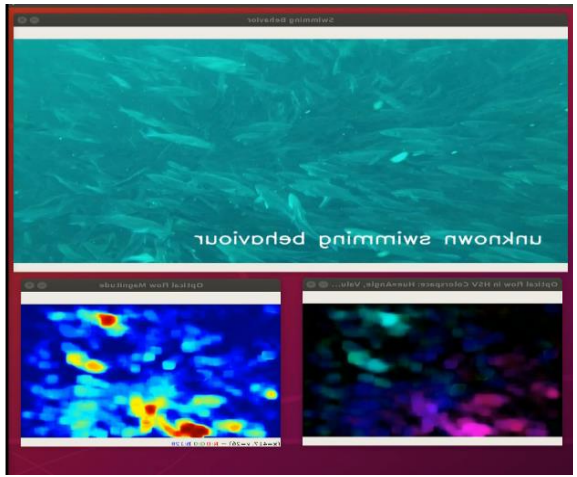
- Statistical analysis of sensor data time-series
- Histograms, outliers, event predictions

AQUAWINGS Dashboard: Real Time Monitoring



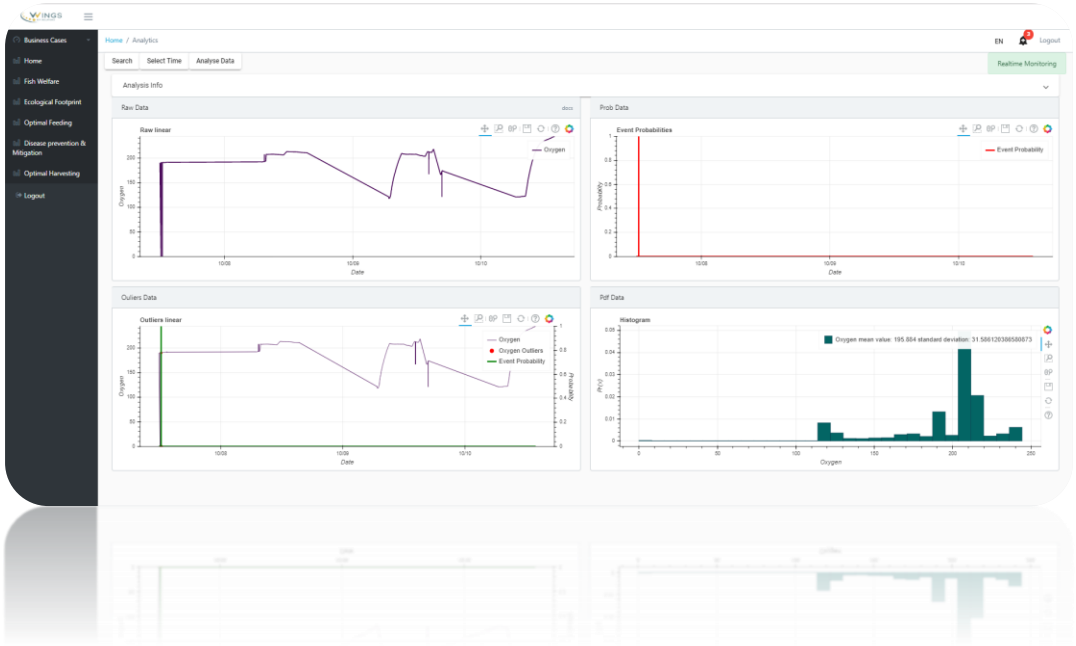
- **AQUAWINGS Disease Diagnosis** captures any visible disease scar spotted on the fish and sends corresponding alerts
- **How it works:**
  - Camera detects fish individually
  - Disease scars are identified
  - Condition of fish is estimated based on image

AQUAWINGS Advanced Features: Behaviour Analysis



- **Behaviour Analysis** identifies through image processing the behaviour traits of fish based on their speed, direction and swimming patterns
- **Behaviour Analysis enhances significantly:**
  - Optimal Feeding
  - Stock Welfare

AQUAWINGS Advanced Features: Water Quality Analytics



- **Water Quality Analytics for the identification of quality problems in the water**
- **This feature performs:**
  - Water quality evaluation based on multi-parameter analysis
  - High accuracy predictions of parameter values to ensure normal operation conditions
  - Notification of users in case of an event
  - Constant adaptation to background changes

AQUAWINGS integration with Video streaming for aquaculture facility surveillance

- **Monitoring of fish farm and detection of physical intrusions**

  - ✓ Video streaming with 360°/4K cameras
  - ✓ Also potentially video analytics at edge (object detection)

- **Network requirements**

  - ✓ High bandwidth for demanding high definition
  - ✓ Low latency for real-time streaming
  - ✓ eMBB is needed for high bandwidth capabilities URLLC low latency for real time streaming

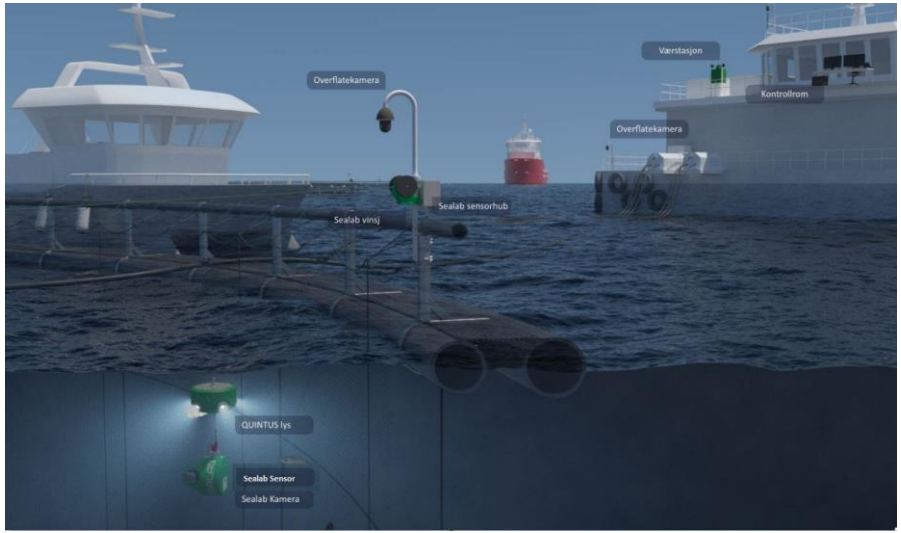
AQUAWINGS Advanced Features: Water Quality Analytics

WINGS Smart Gateway

- **Smart Gateway is a device that collects data from sensors and transmits them to AQUAWINGS platform:**
  - Various sensors are connected to the Smart Gateway
  - Data transferred over wireless networks (4G, NB-IoT, GPRS, LoRa)
  - Device Management
  - Smart Operation with local intelligence:
  - Alerts, adapting measurement/transmission profiles, data filtering

Sealab Aquaculture platform

Aquaculture use case in Norway

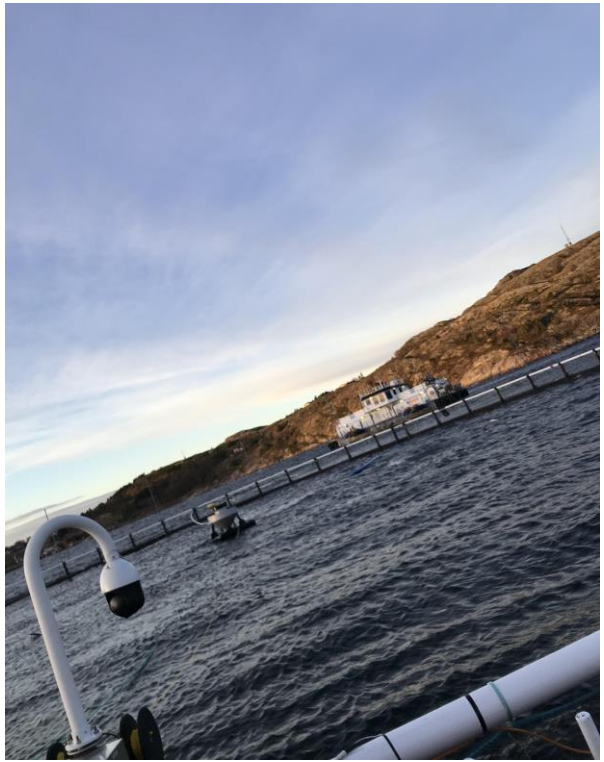


Location: Gjerdinga, Rørvik
Producing Atlantic Salmon in 8 cages

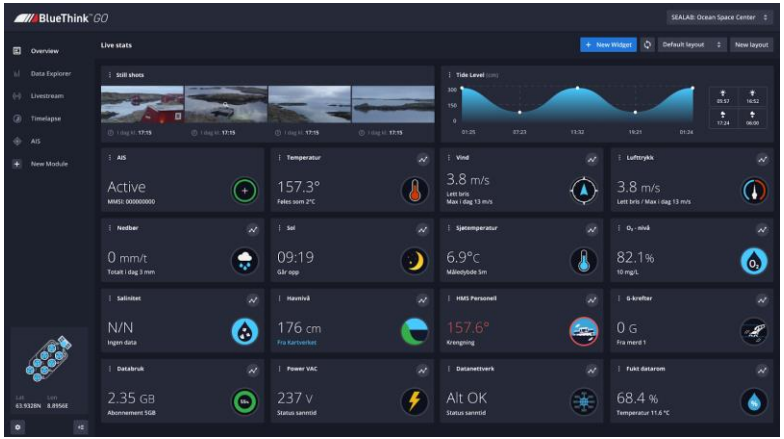
On each cage the following equipment is installed:
- Underwater camera
- Surveillance camera
- Environmental sensors
- Underwater light
- Smart winch
- Cabinet

On the feeding barge the following equipment is installed:
- Control room with screens for monitoring and controlling
- Surveillance camera
- Weather station
- BlueThink GO - Platform for remote monitoring

A1S1 - Sensory Data Monitoring

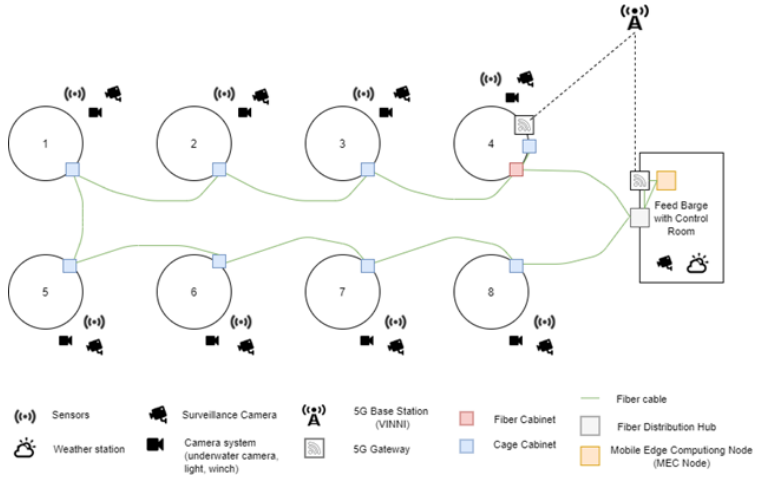


- **Remote monitoring of physical conditions at site**
- In-water sensors measuring sea temperature, oxygen- and salinity levels
- Above water sensors measuring winds, temperature, rainfall etc.



A1S2 - Camera Data Monitoring

- **Live stream – transfer and storage of image/video data**
- Access to real time image and video data from the site for remote operations of the fish farm.
- Storing image/video data for documentation and further processing.
- Latency, bandwidth and throughput will be tested in this scenario.



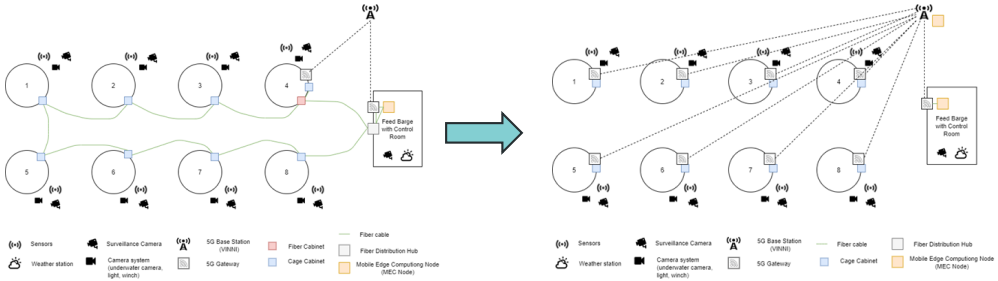
A1S4 - Edge and Cloud-based computing

- Due to the evolution of high speed, high resolution cameras and real time image/data processing algorithms, users need a data network infrastructure that supports the payloads of such functionalities.
- Real time pellet detection will be run, providing decision support during feeding.
- The tests will focus on bandwidth, throughput and latency.

- **Why pellet detection?**
  Optimize the feeding, lower the feed waste and pollution of the sea bed, and then contribute to a more sustainable production and lower environmental footprint. An optimal feeding regime will also be economically beneficial for the fish farming company.

A1S5 - Wireless communication on site

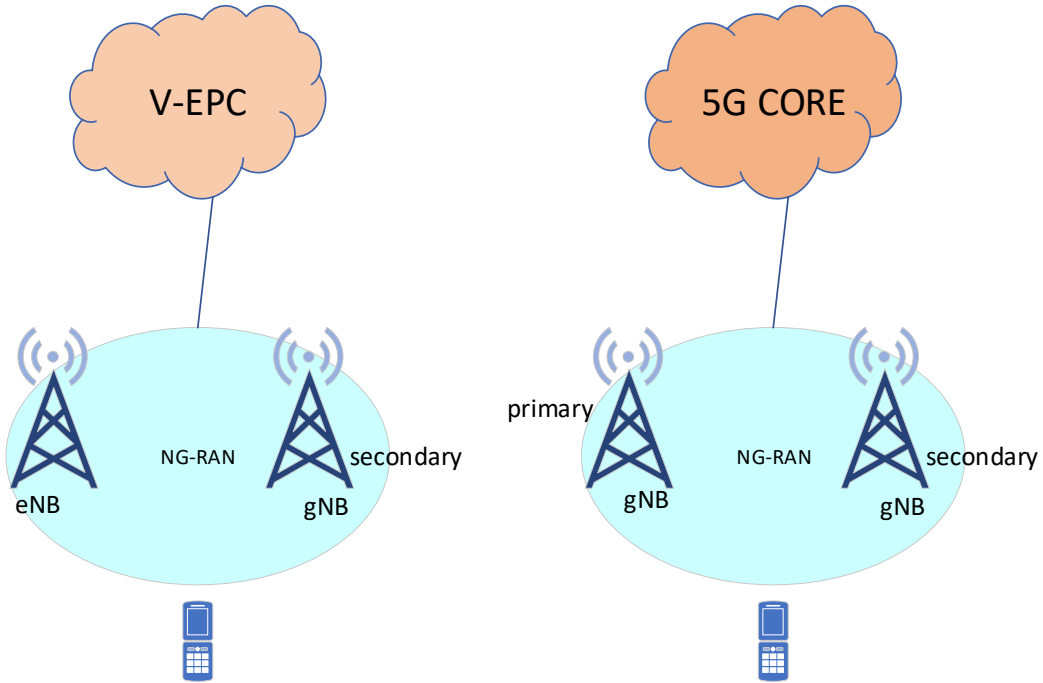
- **Remove the challenge with cabled network on the site**
- Today, cable networks are being used to transfer data. Cables are susceptible to damage and breakage.
- By using the 5G-network to operate the cameras, farmers can trust the system to be more stable, which is critical for several daily operations, like feeding .



Cooperation of infrastructures/platforms

5G-EVE, 5G-Heart / 5G-VINNI, 5G-HEART

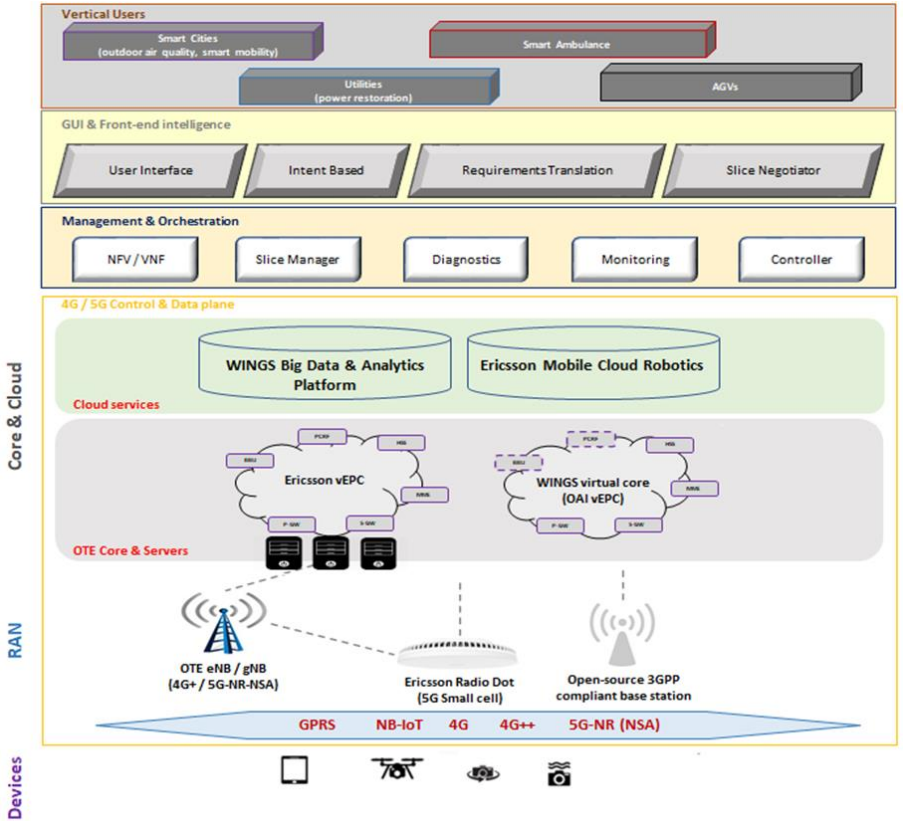
5G-EVE – Greek pilot: NSA architecture



NSA architecture:

- LTE core
- eNB and gNB
- combine several advantages of 5G with the reuse of the existing hardware of 4G
- SA architecture:
- next generation core
- completely independent of the LTE core network

Network high level architecture



1. User Equipment

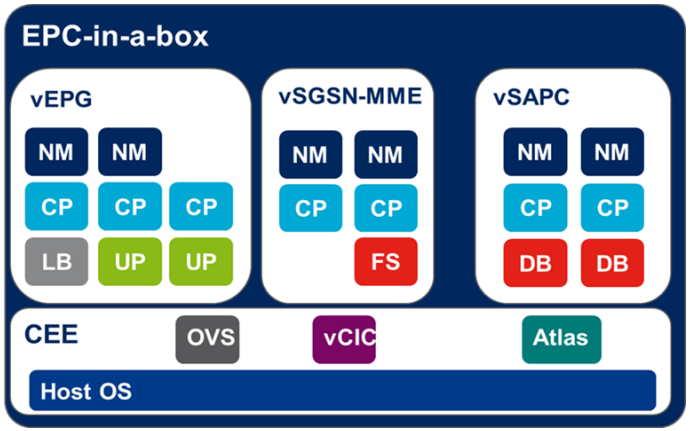
- 5G SIM cards
- 4G SIM cards

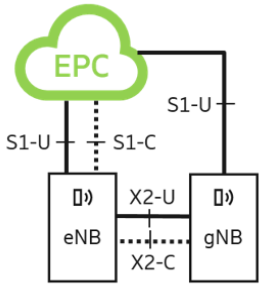
2. Radio Access Network

3. Core Network

- vEPC
- Cloud infrastructure

Core and RAN

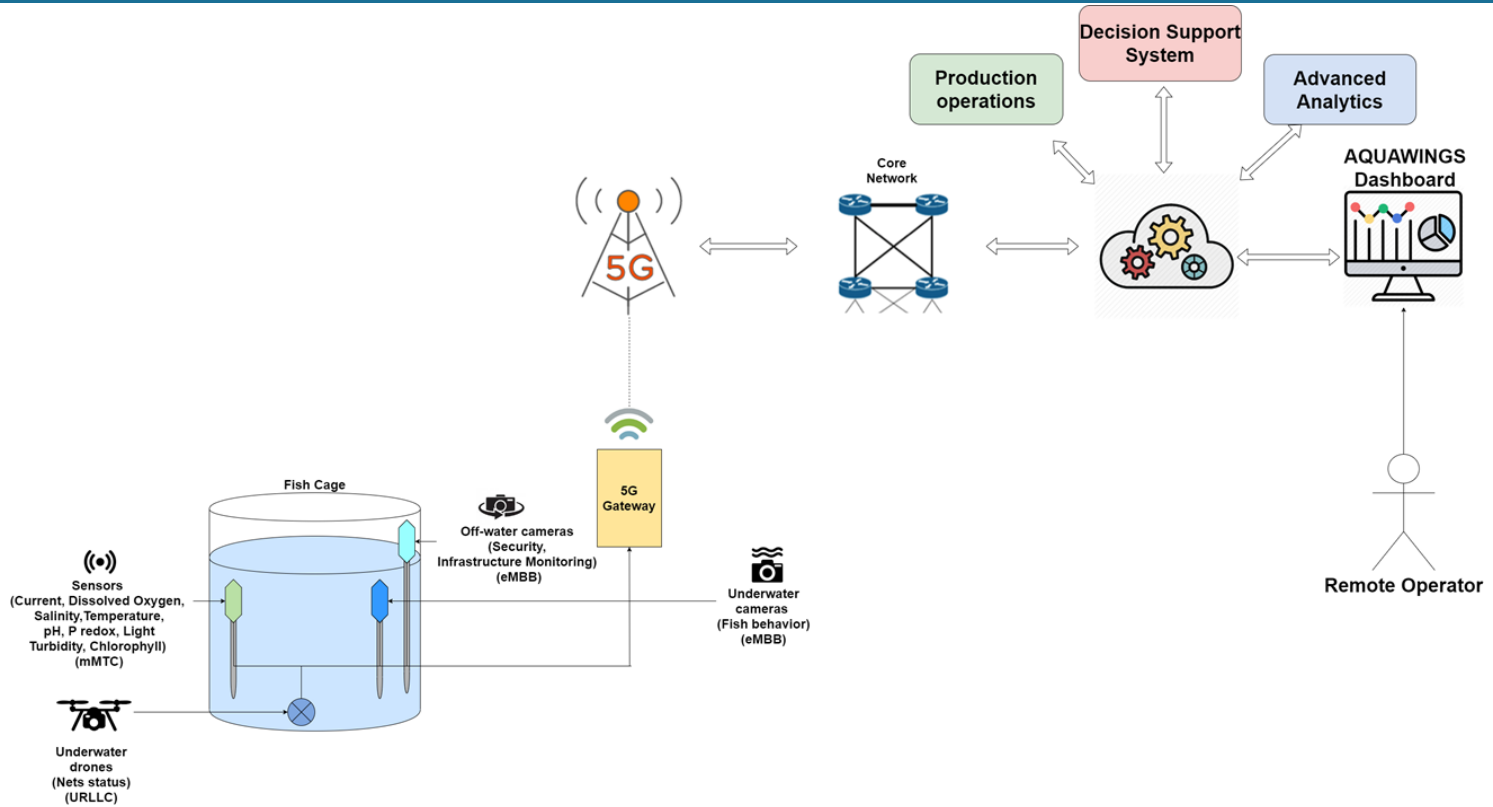




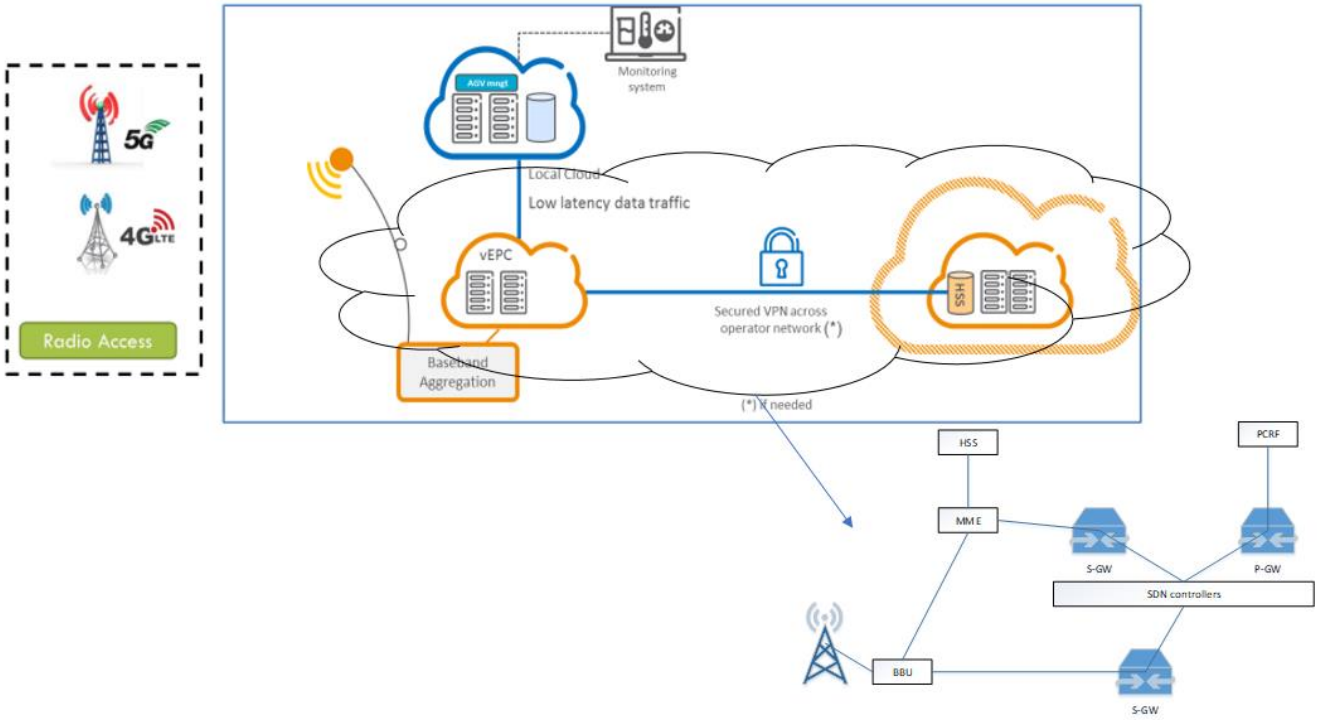
OPTION 3x

- Mobility Management Entity – MME (Software functionality of proposed SGSN-MME):
  - user authentication
  - verifies whether the UE is authorised to use the network
- Serving/Packet Data Network Gateway – S/PGW (Software functionality of proposed EPG):
  - S-GW: packets routing to and from the gNB
  - P-GW filters user traffic in order to ensure the QoS.
- Service-Aware Policy Controller (SAPC):
  - policy control and charging rules
  - optimized utilization of network resources.
- RAN:
  - radio unit
  - Software to support LTE (up to 3GPP Rel-14) and 5G (3GPP Rel-15 and upwards)

Greek site physical infrastructure



Greek Site - overall status



GR Aquaculture Site network Monitoring Components (1/6)

ACTA KPI probes will monitor the network traffic at the Skironis gateway and at 4 other locations, namely at the OTE premises at the City of Megara, the OTE LABs in the OTE-Academy location, the Ericsson EPC and the WINGS Cloud platform, as shown in Fig. 1. This will provide segmentation of the network monitored, besides the end-to-end monitoring, for better identification of the quality in the segments.

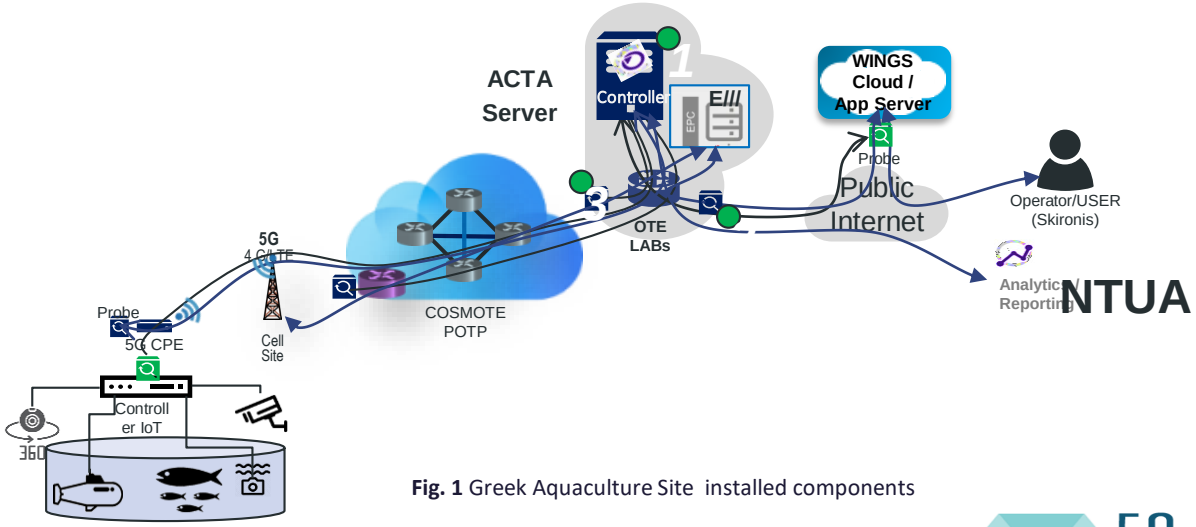


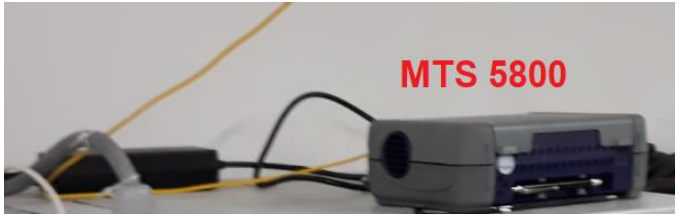
Fig. 1 Greek Aquaculture Site installed components

GR Aquaculture Site network Monitoring Components (2/4)

In the context of 5G-HEART, different probe alternatives, both hardware (shown by blue in Fig.1) and software (green) are being or planned to be installed on the 5G-EVE infrastructure and the 5G-HEART network expansion:

- Hardware probe VIAVI-MT-S5800 (with 10 Gbps Optical Interface) capable also of traffic generation
- Smart SFPs (that will be placed in the main Control Plane Switch and Data Plane L2/L3 Switch)
- MicroPC with L4 (and L3) Testing S/W (open source and proprietary)
- Hardware NSC/ONX portable probe by VIAVI
- Software TWAMP implementation (reflectors and clients) running at UEs and some of the above probes

Network KPIs of particular importance will be throughput (esp. uplink) and latency for video transmission.



ACTA KMVaP:KPI Measurement and Validation Platform (3/6)

To achieve E2E measurement of KPI values, the various probes will have to communicate with a central controller software, for configuration, management and data-measurement acquisition and storage purposes.

The ACTA KMVaP (KPI Measurement and Validation Platform) shown in Fig. 2, is the central management system for the multitude of probes that are installed in the network and are responsible for collecting data from measurements of network KPIs.

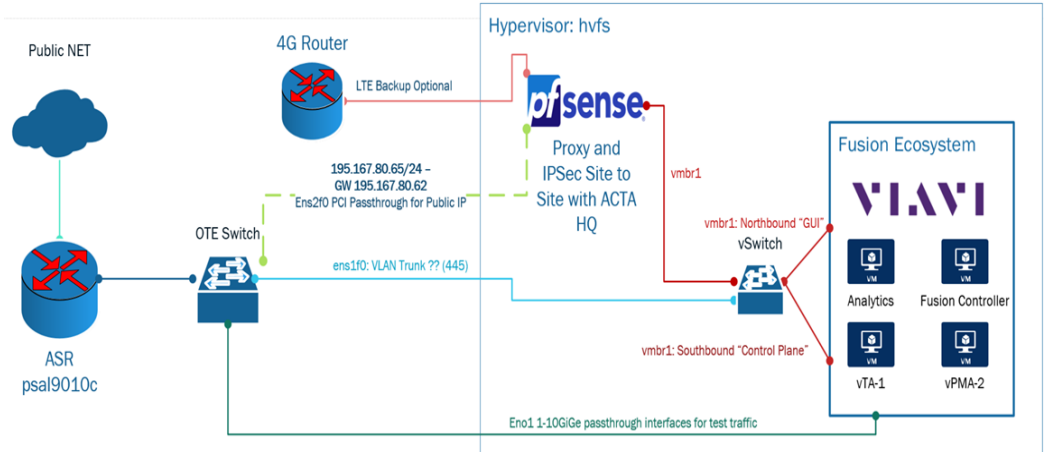


Fig. 2 ACTA's KMVaP ecosystem for KPI measurement and validation

ACTA KMVaP Installation (4/6)

ACTA's KMVaP is installed in OTE-group R&D Laboratories and interconnected with Psalidi OTE's LAB infrastructure and through this also to the 5G-EVE and 5G-HEART infrastructures. In Fig. 3, some actual installations of probes, depicted in Fig.1, are shown with corresponding numbers.

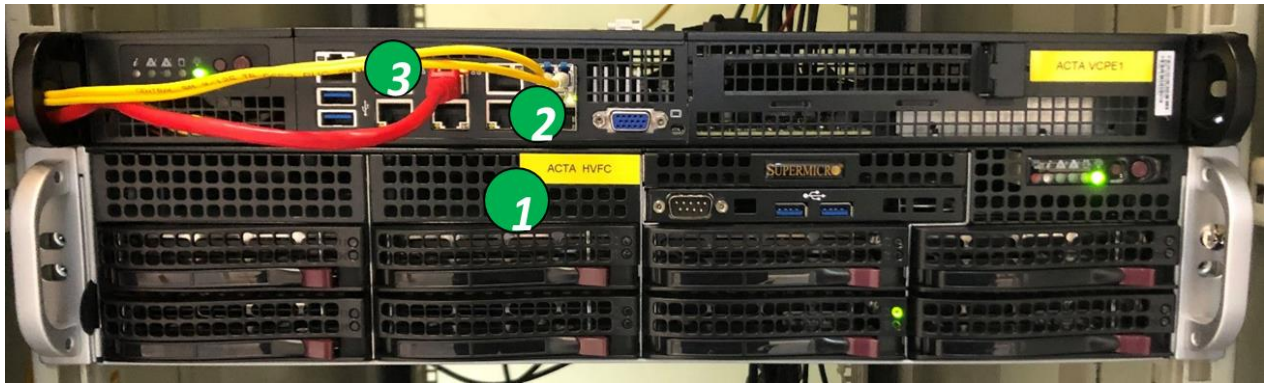


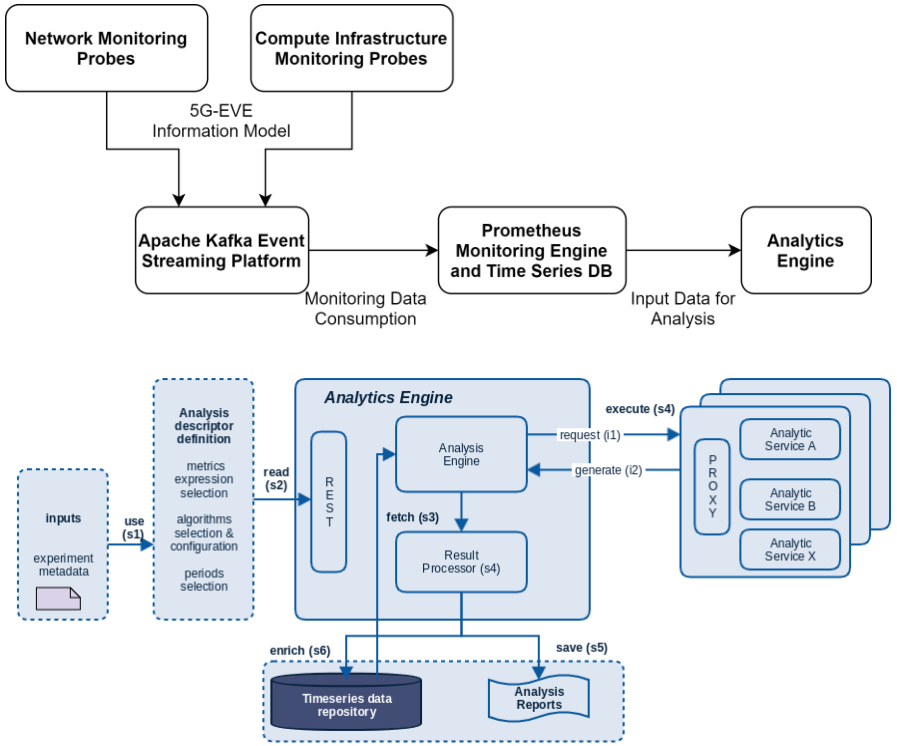
Fig. 3 ACTA's KMVaP actual installation

GR Aquaculture Site network Monitoring Components Analytics Engine(5/6)

Support the execution of different type of analysis and the extraction of insights with regards to 5G KPIs.

Objectives:

- Extract insights upon the results of the pilot's scenario execution.
- Identify capacity limits and extract resource consumption trends.
- Identify unknown or not well-examined relationships among monitoring metrics.
- Consider both network and compute resources usage metrics.
- Introduce automation in orchestration mechanisms.



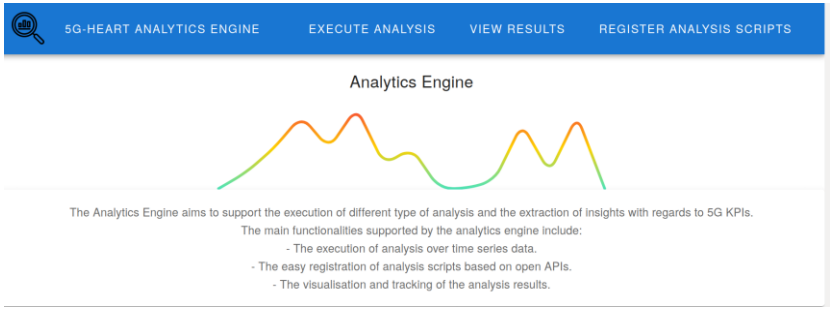
GR Aquaculture Site network Monitoring Components Analytics Engine (6/6)

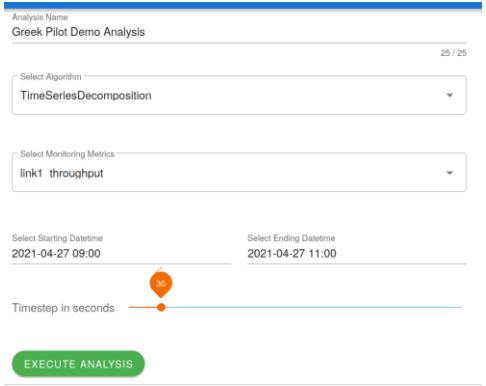
The main functionalities include:

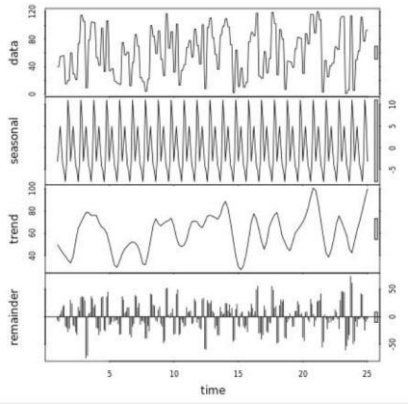
- Execution of analysis over time series data.
- Consumption of data provided by the 5G-HEART monitoring infrastructure.
- Easy easy registration of analysis scripts (in R and Python) based on open APIs. Support a pool of algorithms.
- Visualisation and tracking of the analysis results.

Main set of algorithms:

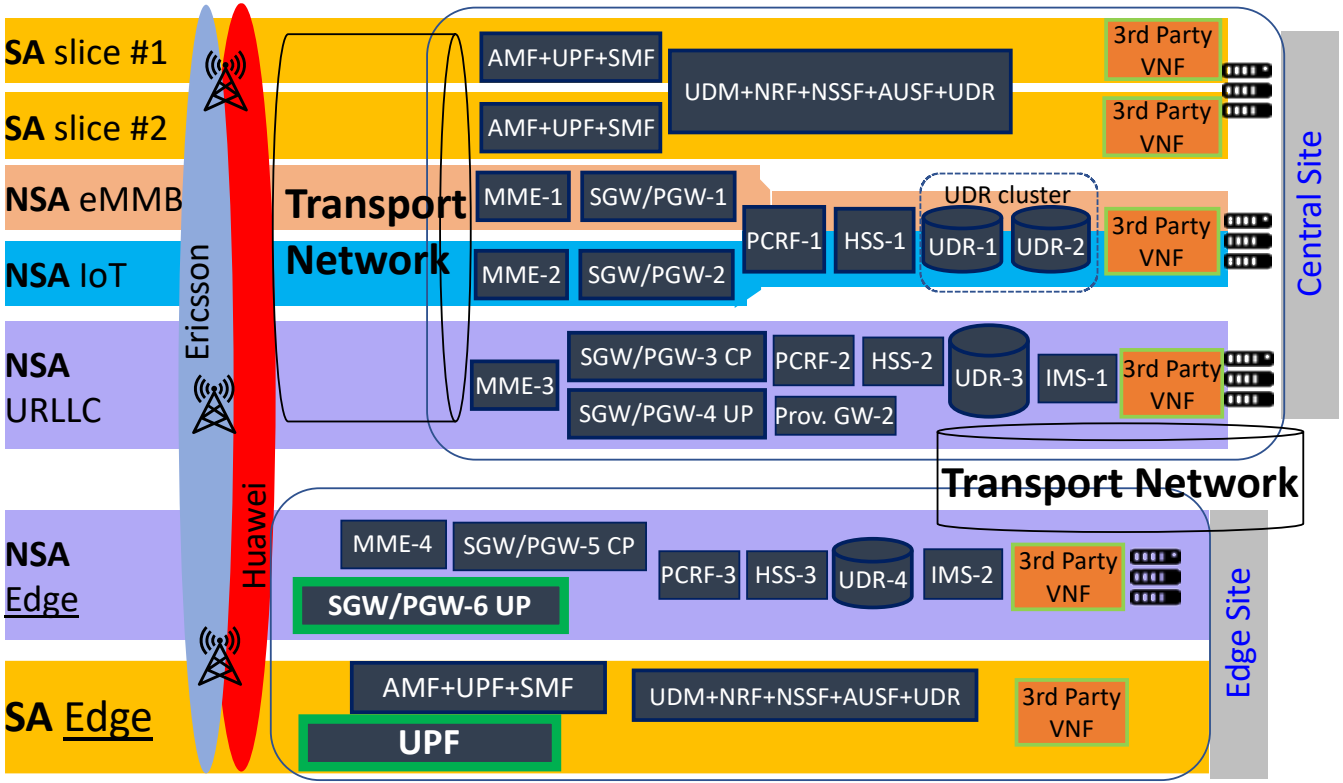
- (Multiple) Linear Regression
- Correlograms
- Time Series Decomposition and Forecasting
- Clustering



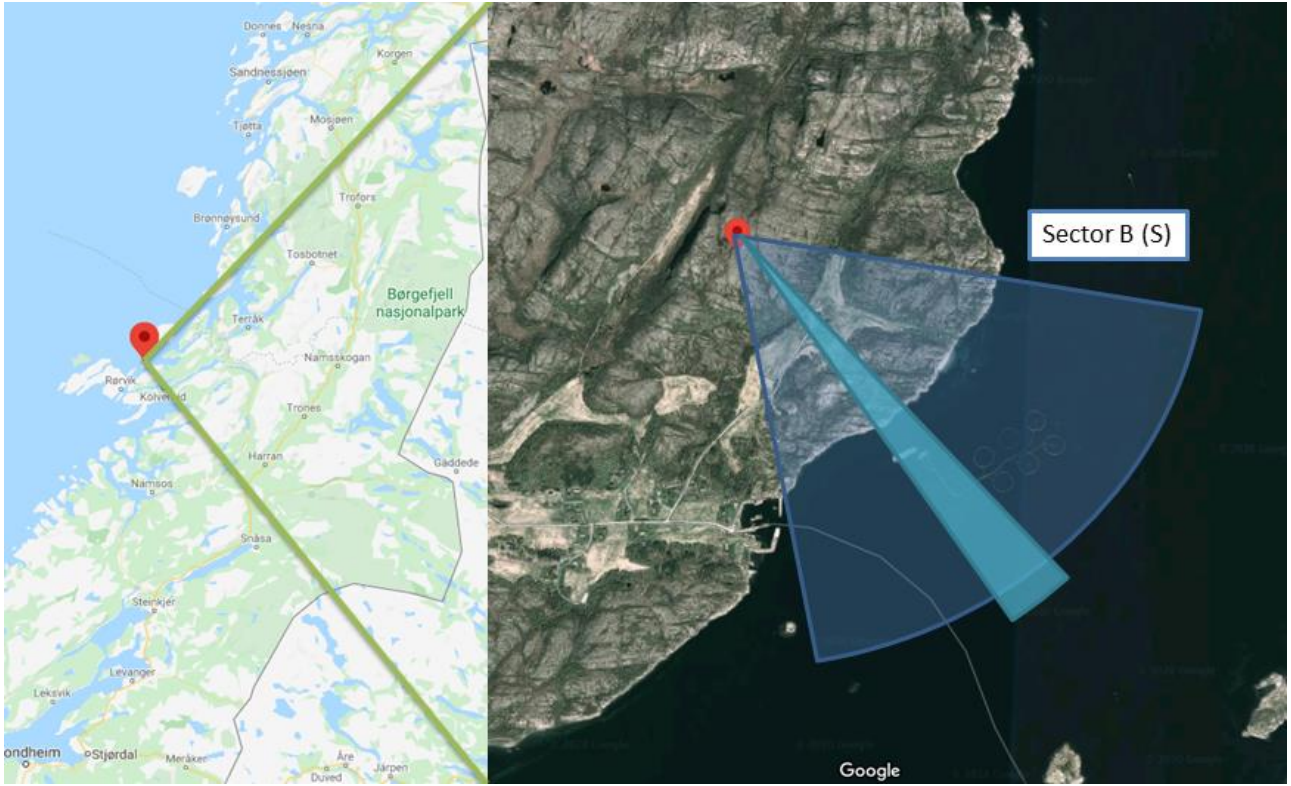




5G VINNI – Norwegian site: 5G-VINNI NORWAY - Architecture



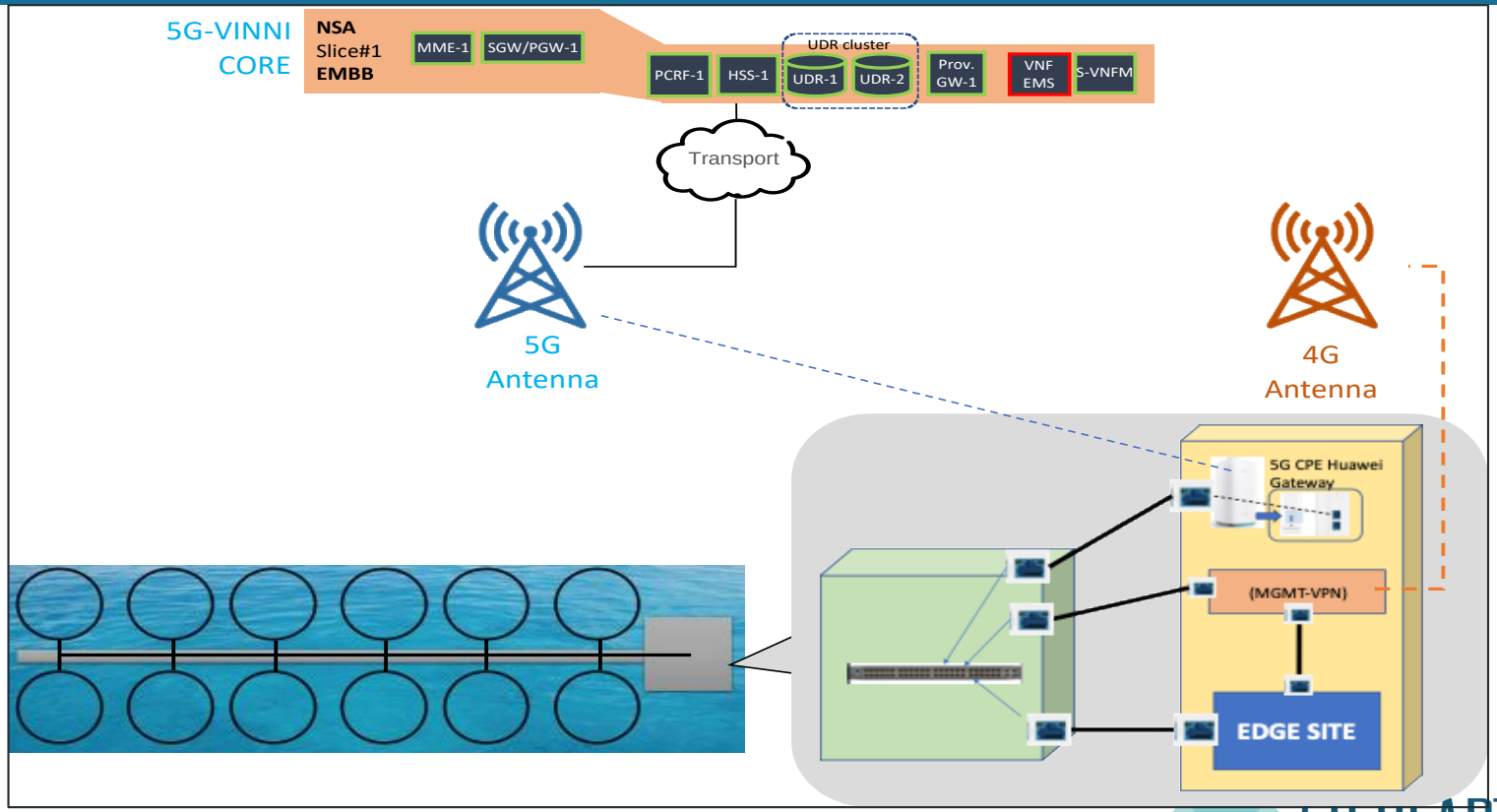
Geographical Location



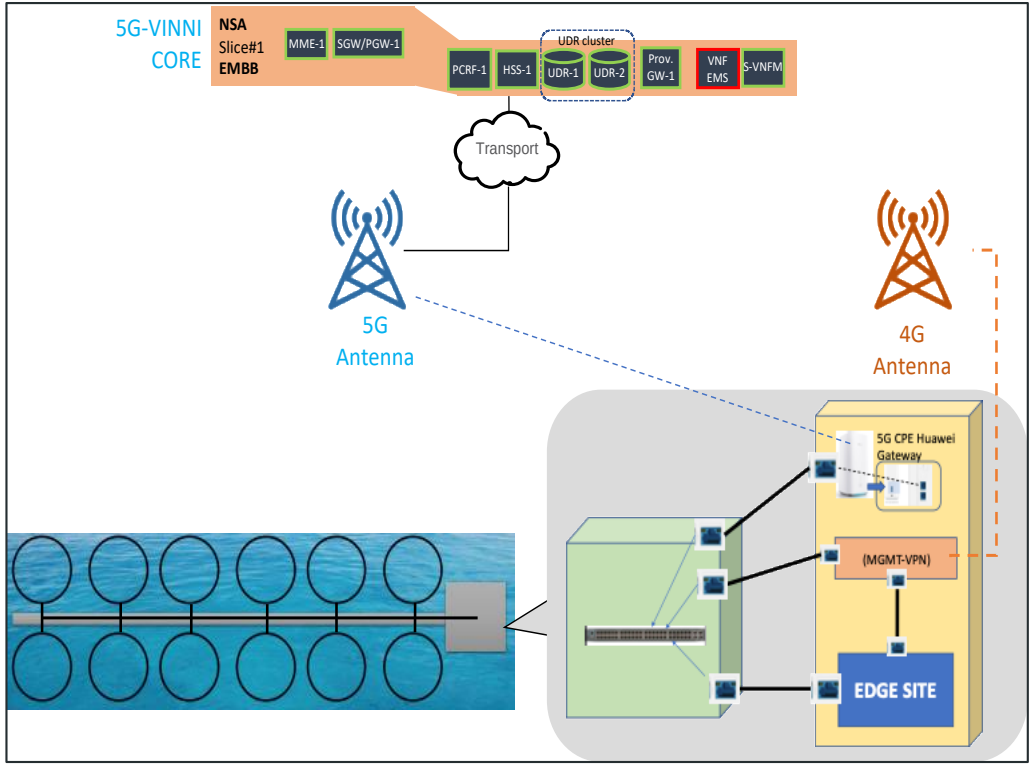
Overview of the Norwegian Fish-farm

Overview of the Norwegian Fish-farm

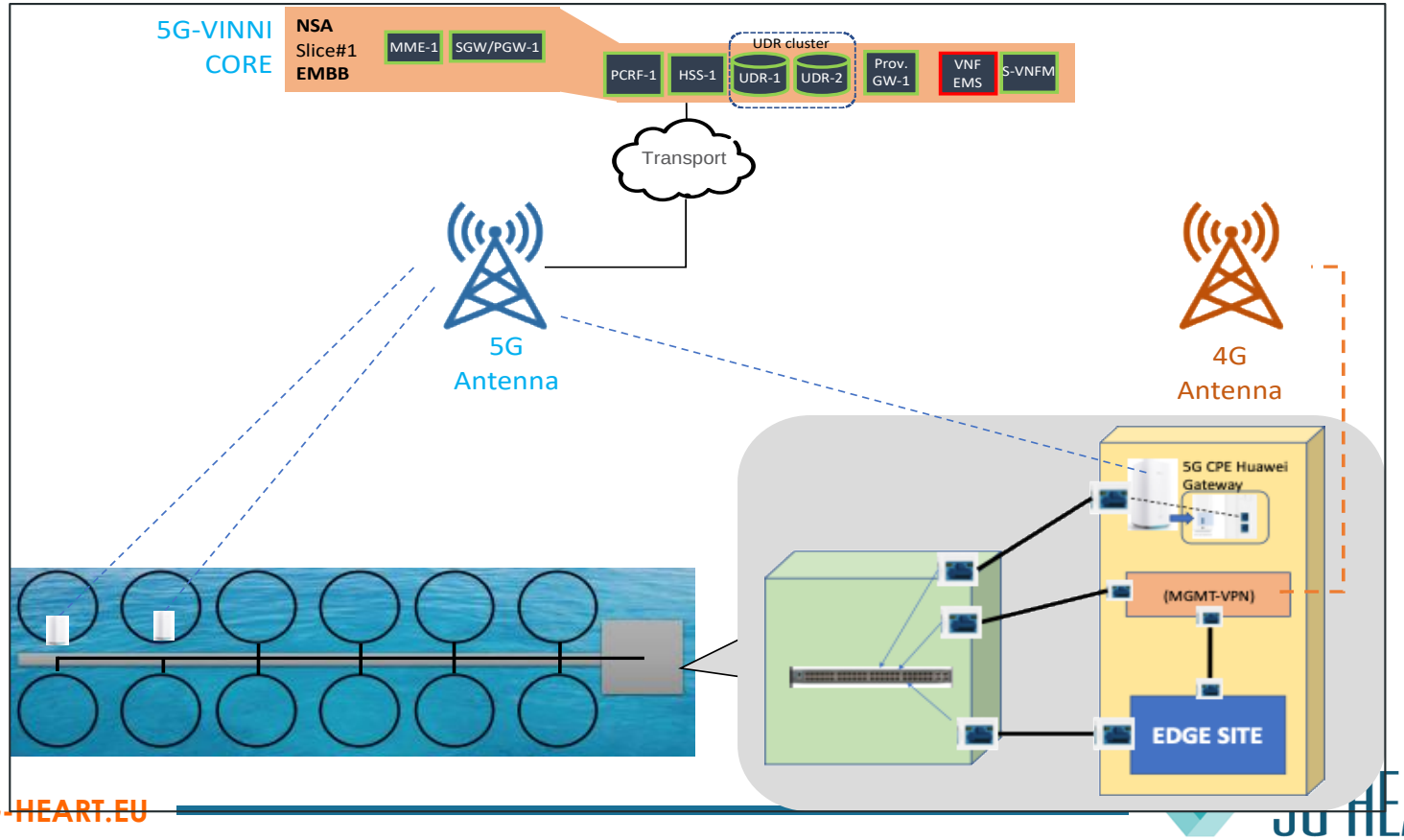
Fish Farm use case: Implementation in PHASE 1



Fish Farm use case: Implementation in PHASE 1



Fish Farm use case. Implementation in PHASE 2

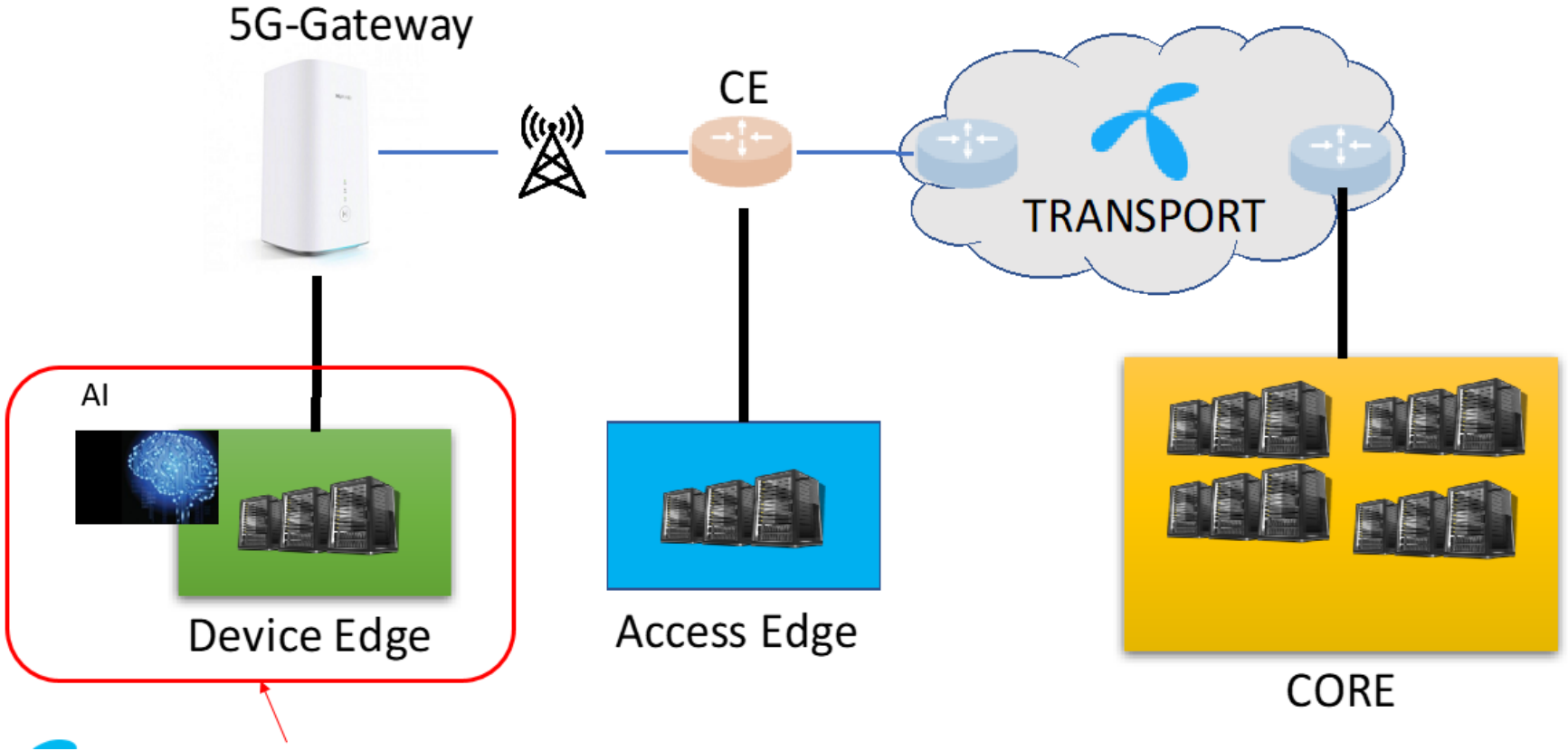


RAN Specifications

HUAWEI

Parameter	Value
Carrier frequency and bandwidth	LTE anchor (Band 1): • DL: 2132.6 MHz (EARFCN: 226) • UL: 1942.6 MHz (EARFCN: 18226) • BW: 5 MHz 5G NR, C-band (Band n78): • DL/UL: 3655 MHz (NR-ARFCN: 643667) • BW: 80 MHz 5G NR, mm-wave (Band n257) • DL/UL: 26900 MHz (NR-ARFCN: 2060832) • BW: 800 MHz
5G NR antenna	C-band: 64T64R active beamforming antenna mm-wave: 384T384R (4T4R effective) active antenna
5G beamwidth (3 dB)	Check
LTE antenna	4T4R RRU and passive antenna
LTE beamwidth (3dB) and gain	65° horizontal; 6.3° vertical Gain: 17.7 dBi

Edge Concepts – Device Edge PH1 for 5G-HEART



Edge site building material

NOKIA

3U OpenEdge Chassis

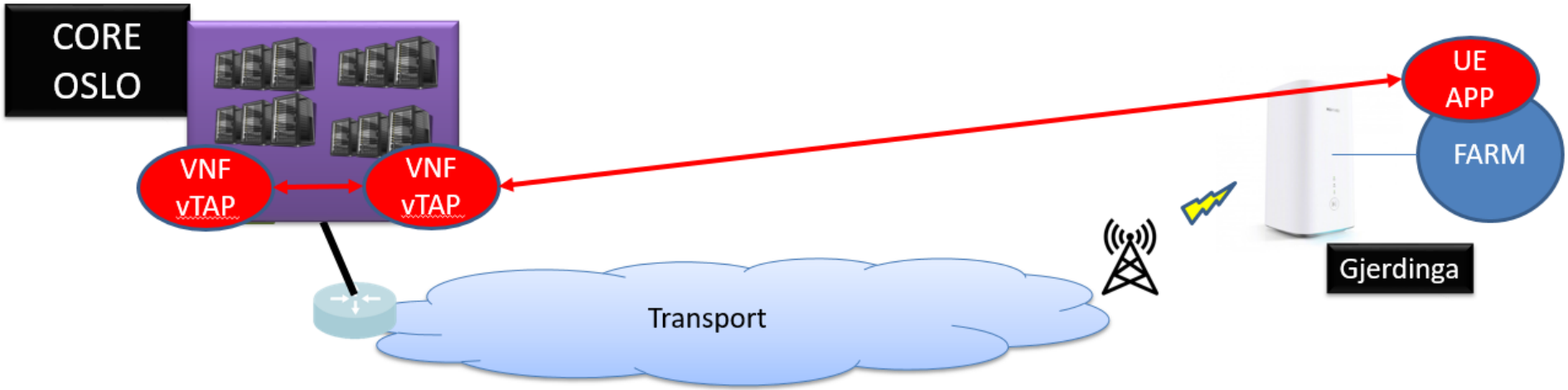
1U OpenEdge server

- 1x 3U Chassis
- 5 x Servers (24c, single CPU, 192GB RAM)
- 1x Z9100 leaf switch (32x100Gb ports)
- 2x GPU NVIDA capability for the servers
- Openstack Rocky release
- All servers can work as compute nodes
- High availability Openstack with 3 controllers
- CEPH storage solution with SSD disks

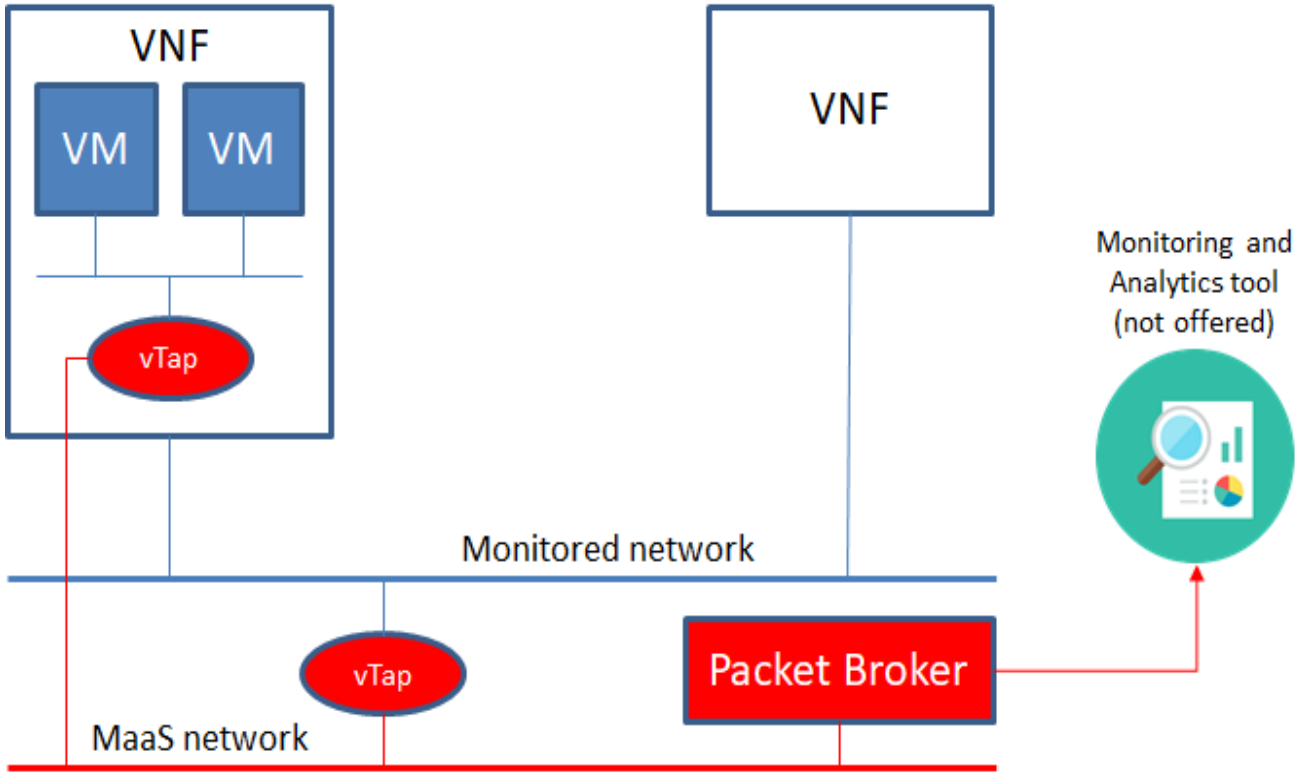
Airframe Z9100 Switch

*Indicative allocation. Final one will be part of LLD

Test Overview



Test Overview



Benefits from 5G

Benefits of 5G

- Incorporation of eMBB (for the high capacity of cameras), mMTC (for the huge number of sensors) and uRLLC (for the small latency needed for real-time data processing and drone operation). The network can support three isolated slices in parallel.
- The incorporation of a large number of sensors which is a key requirement for the Aquaculture platforms is offered by 5G
- The high throughput data transmission needed for the uplink traffic to be sent from gateways installed in different fish cages is supported by 5G
- Huge number of real time data needed for the data processing and analytics is offered from the high capacity and small cells of 5G and thus SMEs can optimize their operations and help reinvent their business models.
- 5G and IoT which is heavily used in the aquaculture sector, have a high impact on a company's operations for improving the productivity and health of fish

Future work

Future plans

- For future work the focus will be on developing new technology that is compatible with the 5G-network, while keeping the vision of improving sustainability in the industry.
- 5G will be vital in order to support the high uplink capacity needed for the marine aquaculture fields and this technology will be tested in the next months
- Equipment such as cameras with higher resolution and better focus will be potentially incorporated in the AQUAWINGS platform to enable higher fish productivity
- Higher number of data will be needed to extrapolate key performance indicators for the network metrics and fish biomass metrics to maintain a sustainable environmental footprint and improve the business operations
- Combine eMBB/uRLLC/mMTC slices, eMBB for high quality of video, uRLLC for low latency for drone and camera management

THANK YOU
FOR YOUR ATTENTION

5G-HEART.EU

This project received funding from the European Union's Horizon2020
research and innovation programme under grant agreement No 857034