Management Of Networked IoT Wearables – Very Large Scale Demonstration of Cultural Societal Applications

Overview of the MONICA Platform

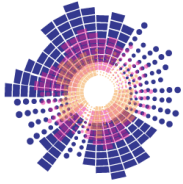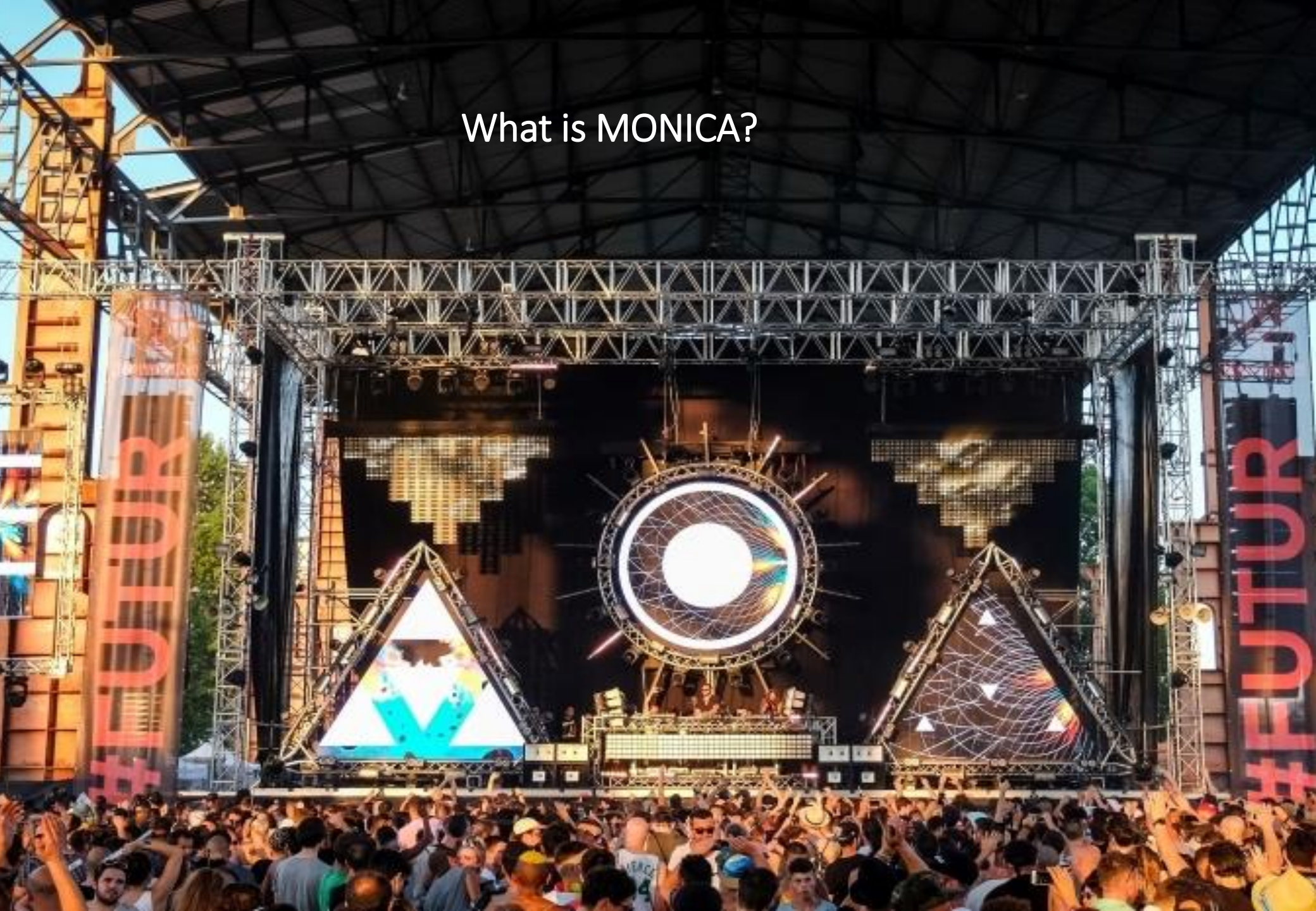Francesco Sottile

LINKS

MONICA

Outline

- MONICA Introduction and Objectives

- Use Cases

- Functional Architecture

- Scalability of the Wearable Network

- Overview of MONICA Subsystems

What is MONICA?

Large Scale IoT Deployment

Control the Sound

- Sound zones are established based on the existing sound system to accommodate the needs of the audience, performers and neighbours
  - Main zone with best sound in terms of loudness, directionality and quality, quiet spots and mitigation of noise outside concert area
- Real-time display of sound levels for monitoring and control

Strengthen Security

- Security set-up for private and public events using wearables, cameras, drones and smartphone apps
  - Real-time visualisation of crowd size and density
  - Early identification of emerging events, e.g. prediction of critical crowd situations
  - Guidance of security staff to incidents

Consortium – 29 partners, 9 countries

Fraunhofer FIT, Germany
City of Lyon - Acoucité, France
Atos IT Solutions and Services, Slovakia
Brüel & Kjær Sound & Vibration
Measurement A/S, Denmark
City of Bonn, Germany
CERTH Information Technologies
Institute, Greece
CNet Svenska AB, Sweden
Dexels BV, Netherlands
DigiSky SRL UAV & Robotics Systems,
Italy
Technical University of Denmark
City of Hamburg, Germany
Hamburg University of Applied Science,
Germany
Rinicom Ltd, UK
In-JeT ApS, Denmark
LINKS foundation, Italy
City of Copenhagen, Denmark
Kingston University, UK
Leeds Beckett University, UK
Movement Entertainment Srl, Italy
Optinvent S.A., France
Praesidio Group ApS, Denmark
Ring Advocacy ApS, Denmark
Telecom Italia S.p.A., Italy
Tivoli A/S, Denmark
City of Torino, Italy
VCA Technology Ltd, UK
Vaeksthus Zealand, Denmark
Yorkshire County Cricket Club Ltd, UK
Leeds Rugby, UK

MONICA Use Cases

- **Sound Monitoring and Control**
  - Monitor Sound Level
  - Adjust Sound Level

- **Crowd and Capacity Monitoring**
  - Monitor Crowd Based on Capacity
  - Manage Crowd Based on Capacity
  - Detect High Risk Queues
  - Re-direct High Risk Queues
  - Inform Staff , Inform Users

- **Security Incidents**
  - Detecting an Incident
  - Reporting an Incident
  - Handling an Incident

- **Health Incidents**
  - Detecting an Incident
  - Reporting an Incident
  - Handling an Incident

- **Missing Person**
  - Report Missing Person
  - Locate Missing Person
  - Report Found Person
  - Locate Parent / Guardian

- **Safety Incident**
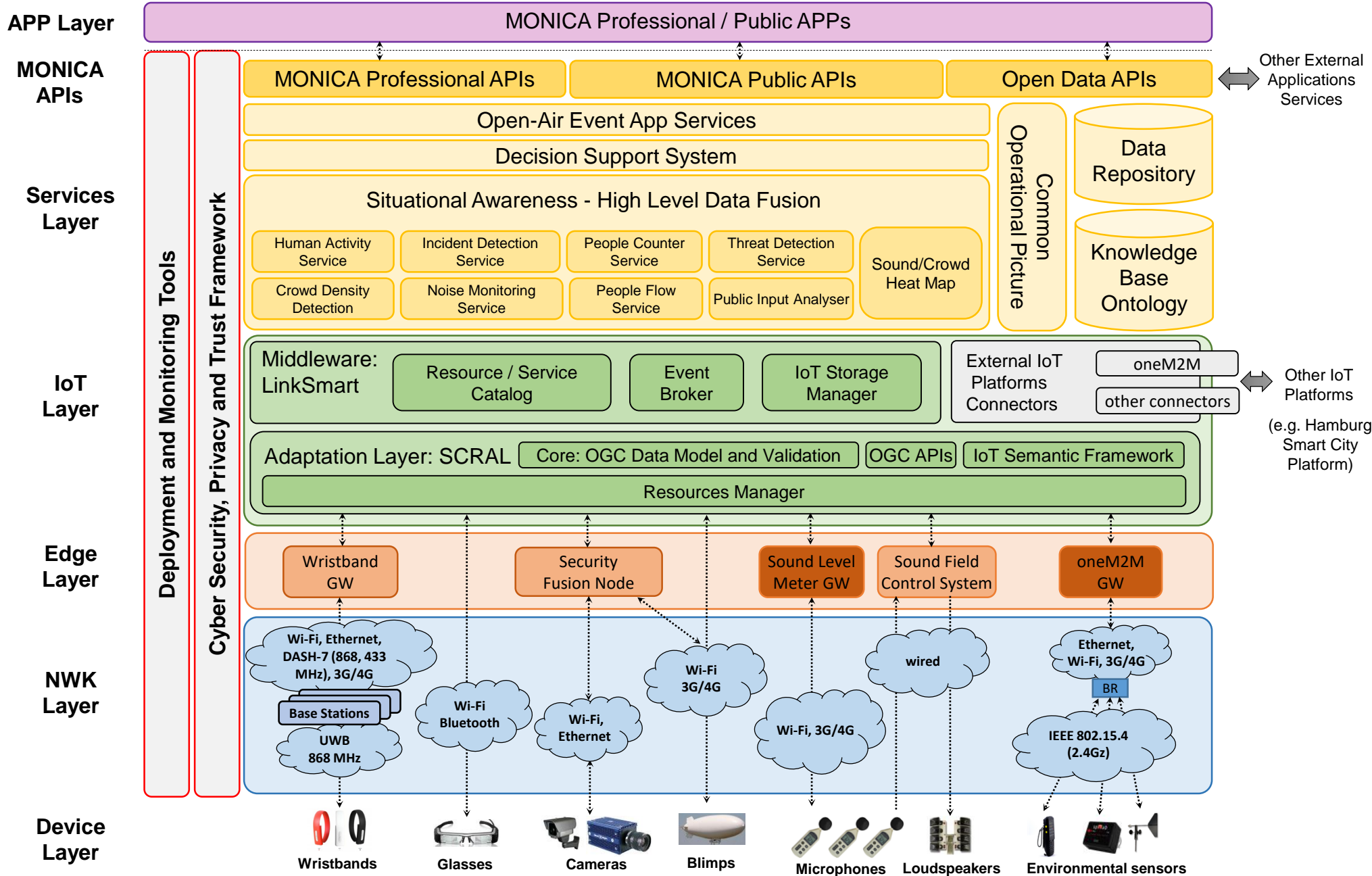 - Precautions at unsafe wind speeds

6 Pilots - 12 Demonstrations

- **Copenhagen – DANEMARK**
  - Tivoli

- **Turin – ITALY**
  - Kappa FuturFestival
  - MOVIDA

- **Bonn – GERMANY**
  - Rhein in Flammen
  - Pützchens Markt

- **Hamburg – GERMANY**
  - Hamburg DOM
  - Port Anniversary

- **Lyon – FRANCE**
  - Fête des Lumières
  - Nuits Sonores
  - Woodstower

- **Leeds – ENGLAND**
  - Yorkshire County Cricket Club
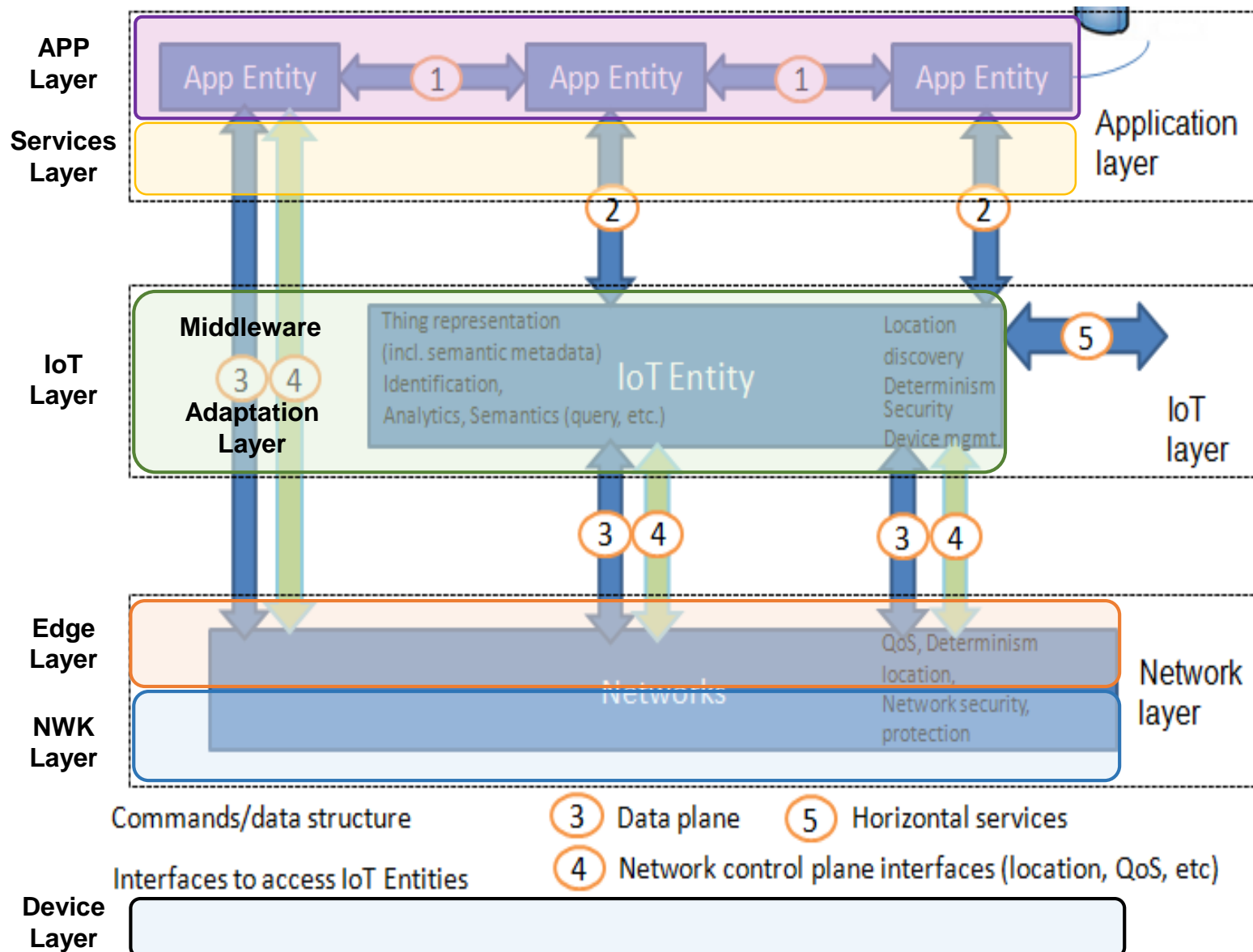 - Leeds Rhinos Rugby League

MONICA Functional Architecture

APP Layer

MONICA Professional / Public APPs

MONICA APIs

MONICA Professional APIs | MONICA Public APIs | Open Data APIs

Other External Applications Services

Services Layer

Open-Air Event App Services

Decision Support System

Situational Awareness - High Level Data Fusion

| Human Activity Service | Incident Detection Service | People Counter Service | Threat Detection Service | Sound/Crowd Heat Map |
| Crowd Density Detection | Noise Monitoring Service | People Flow Service | Public Input Analyser | |

Common Operational Picture

Data Repository

Knowledge Base Ontology

IoT Layer

Middleware: LinkSmart

Resource / Service Catalog | Event Broker | IoT Storage Manager

External IoT Platforms Connectors

oneM2M

other connectors

Other IoT Platforms

(e.g. Hamburg Smart City Platform)

Adaptation Layer: SCRAL | Core: OGC Data Model and Validation | OGC APIs | IoT Semantic Framework

Resources Manager

Edge Layer

Wristband GW | Security Fusion Node | Sound Level Meter GW | Sound Field Control System | oneM2M GW

NWK Layer

Wi-Fi, Ethernet, DASH-7 (868, 433 MHz), 3G/4G

Base Stations

UWB 868 MHz

Wi-Fi Bluetooth

Wi-Fi, Ethernet

Wi-Fi 3G/4G

wired

Wi-Fi, 3G/4G

Ethernet, Wi-Fi, 3G/4G

BR

IEEE 802.15.4 (2.4Gz)

Deployment and Monitoring Tools

Cyber Security, Privacy and Trust Framework

Device Layer

Wristbands | Glasses | Cameras | Blimps | Microphones | Loudspeakers | Environmental sensors
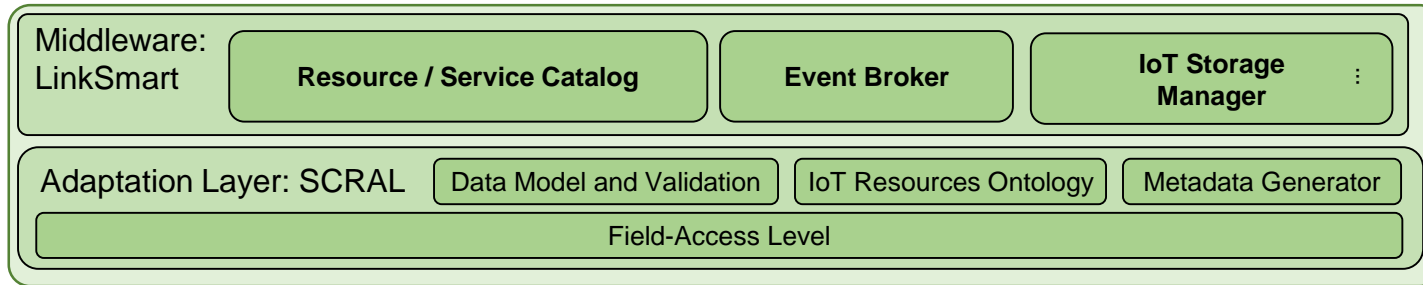
Mapping of MONICA Architecture to AIOTI HLA

Scalability of the Wearable Network Infrastructure

- Large scale is addressed by leveraging
  - time synchronization: **TDMA**
  - cluster architecture: **multiple base stations** (868MHz)
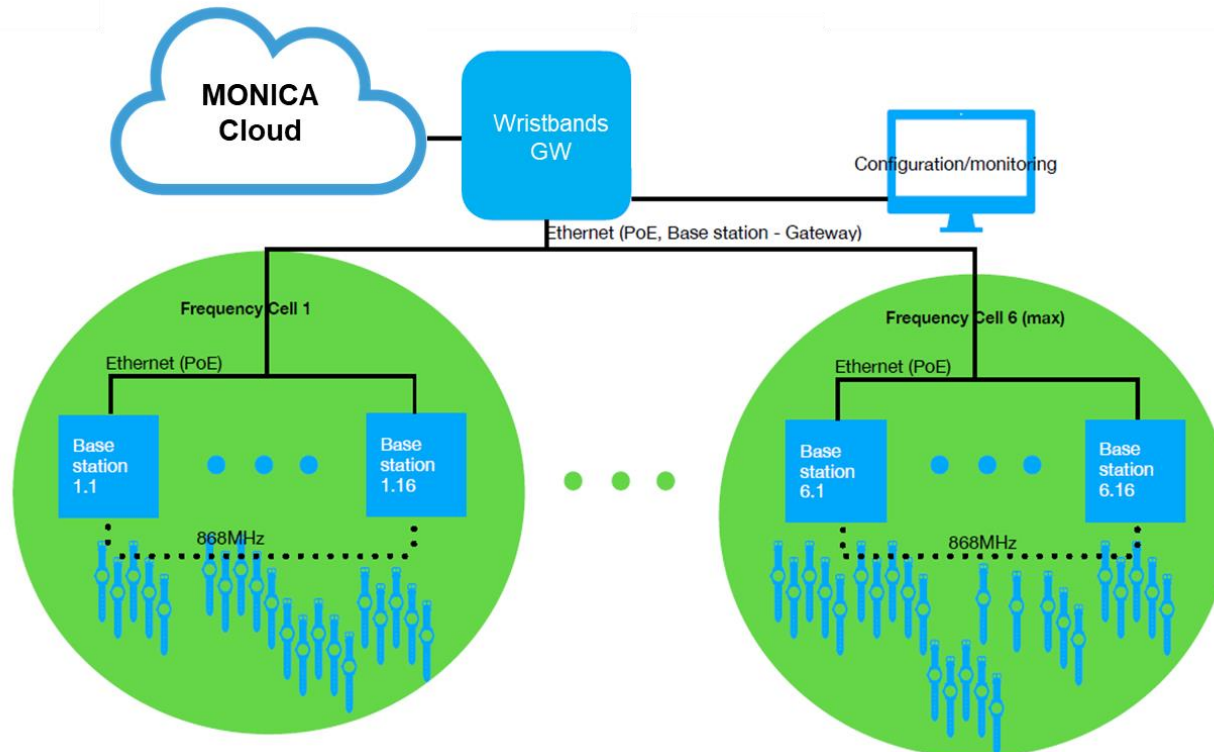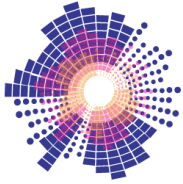
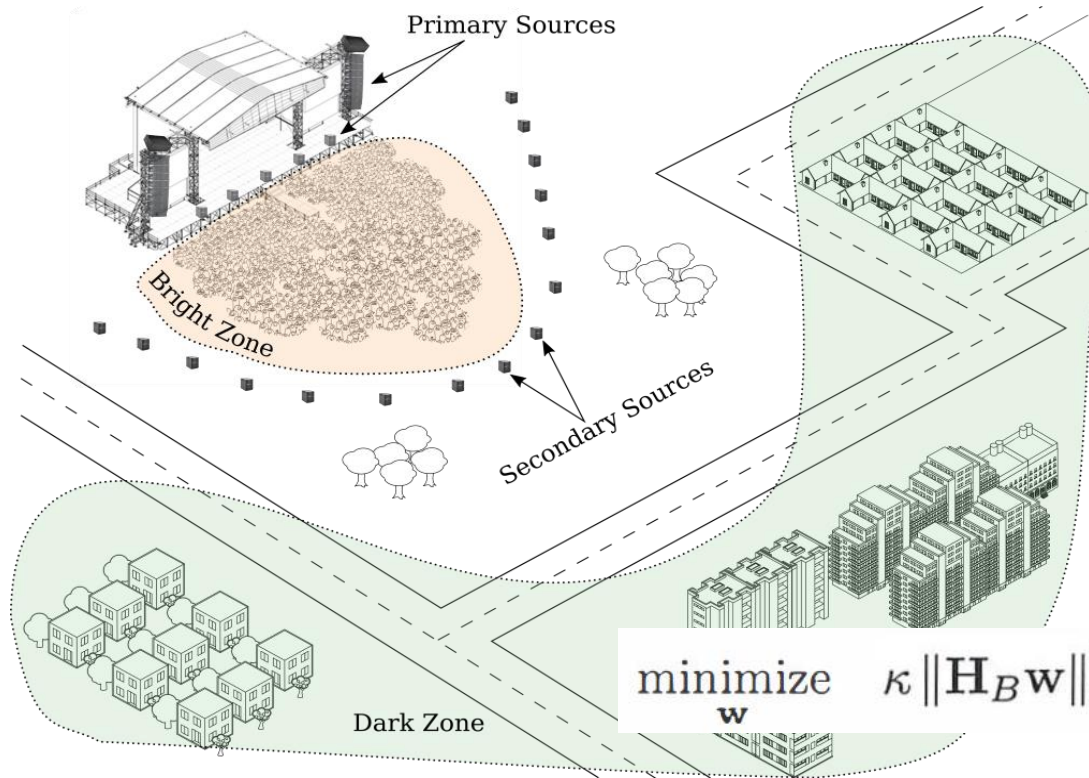# MOINCA IoT Platform

- **SCRAL - Device Management**
  - Keeps track of registered IoT devices and wearables
  - Adapting to device specific semantics
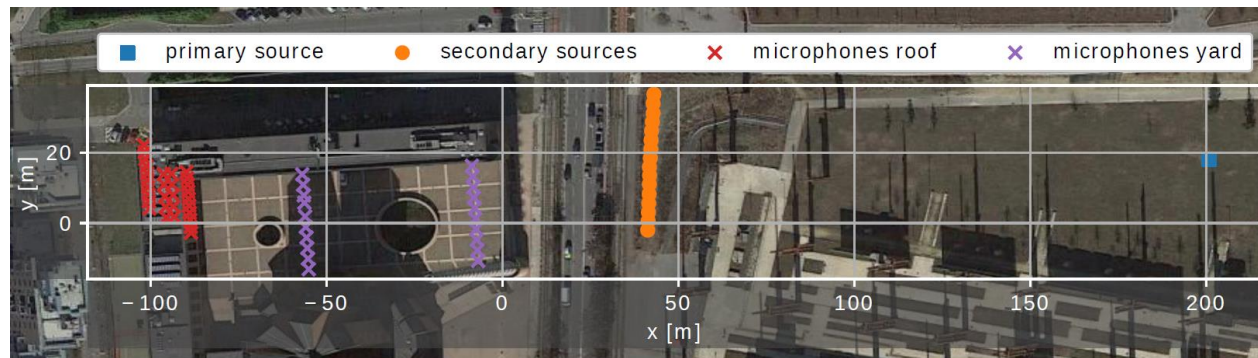 - Translation of device specific messages to OGC SensorThings model

- **LinkSmart® Middleware**
  - Resource and Service Catalogs providing directory services for things and services for Resource/Service discovery
  - OGC SensorThings v1.0 compliance
  - Real time forwarding of device measurements to Data Store and Service Layer

Adaptive Sound Field Control (ASFC)

Primary Sources

Bright Zone

Secondary Sources

Dark Zone

$$\underset{\mathbf{w}}{\text{minimize}} \quad \kappa \|\mathbf{H}_B \mathbf{w}\|_2^2 + (1 - \kappa) \|\mathbf{H}_D \mathbf{w} + \mathbf{h}_D\|_2^2$$

■ primary source   ● secondary sources   ✕ microphones roof   ✕ microphones yard

Video-based System Platform
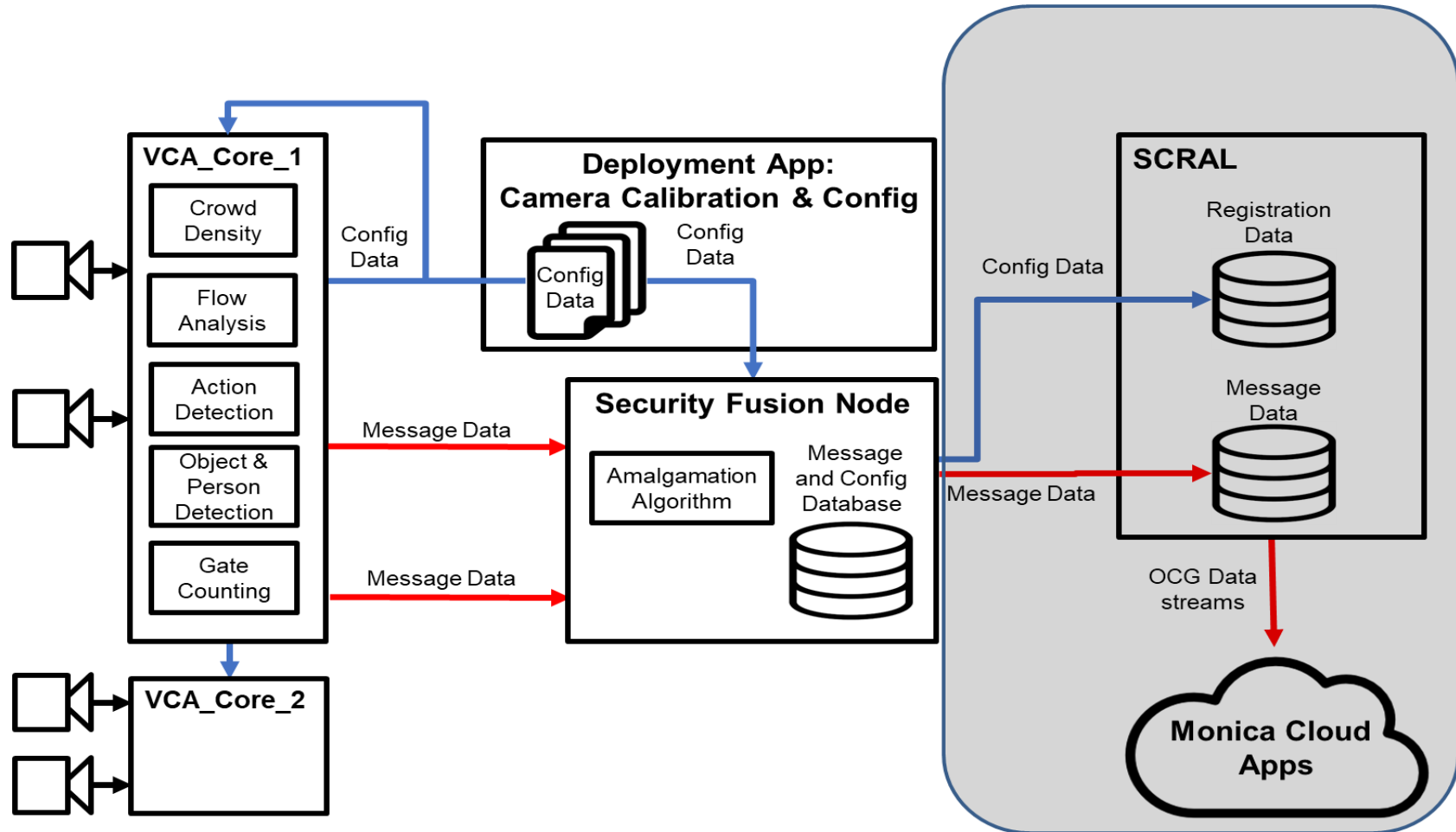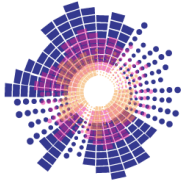
Situational Awareness & Decision Support

- **Situational Awareness**
  - Library of high level data fusion services, supporting/enabling event/incident detection

- **Common Operational Picture**
  - maintains an overview of the current state of the outdoor event

- **Decision Support System**
  - Provide event/incident intervention support using intervention strategies (always a <u>human in the loop</u>)
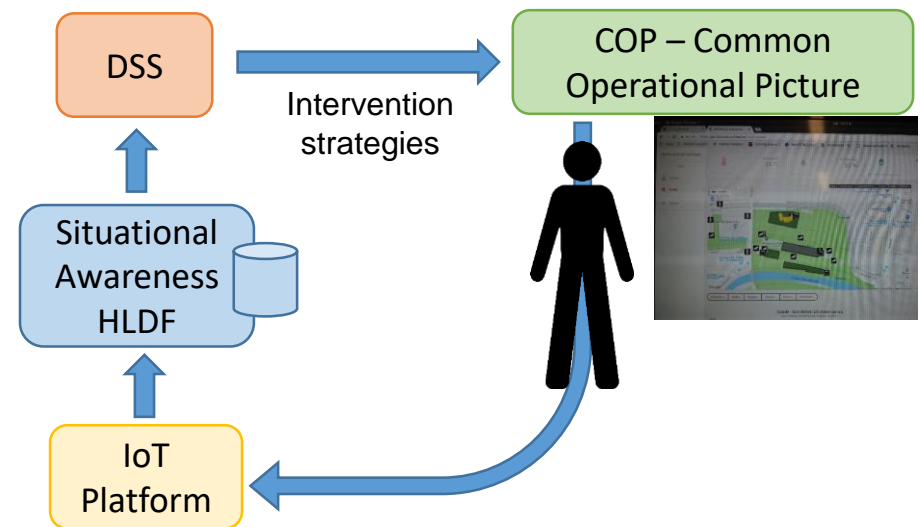
Thanks for your attention

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