Management Of Networked IoT Wearables – Very Large Scale Demonstration of Cultural Societal Applications
(Grant Agreement No 732350)

D12.5 Report on Standards, Regulations, and Policies for IoT Platforms

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Nathalie Frey	2019-06-27	Approved with minor comments

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1 Executive Summary

This report provides information regarding European harmonized radio communication standards and special EU Decisions that have been identified by MONICA partners for the Large-Scale Pilots executed across the European Union Member States during the project duration of three years.

Partners have succeeded in identifying some existing harmonized European Norms (EN's) for IoT which are recognized by all countries where the Pilot demonstrations of the MONICA capabilities take place. This is also in full alignment with the requirements set forth in the MONICA DoA of not directly engaging in any research and development activities. We know that Project MONICA is an Innovation Action that only apply existing technological elements and standards to demonstrate its innovation and new ideas.

As a result of the (until May 2019) non-harmonized technical and operational EU regulation of "Drones", named RPAS (Remotely Piloted Aircraft Systems or UAS (un-manned Aircraft Systems), regulation was entirely at the national level and very different from MS to MS (Member State). Therefore Partners have early on decided to replace the drone-platform with wire-tethered so called "blimps", which are small soft-balloon airships at no danger to citizens on ground but still able to carry small payloads such as sensors and miniature video cameras and the associated IoT Radio devices to communicate air-ground-air with the MONICA Infrastructure. See Section 9.

This report will furthermore *inter alia* cover some relevant provisions of the Radio Equipment Directive (RED) 2014/53/EU, which lay forth effective guidance for demonstrating and exhibiting equipment in its beta-phase, ahead of market launch.

An important element of the MONICA Project, is to assess/identify if the European suite of RF IoT standards is missing some elements, which may improve the performance and value of the results demonstrated. This report will explain a possible additional IoT standard or IoT standard upgrade, that has been identified in order to ensure a more dependable end-to-end latency for synchronized data interlinking of the many sensors applied with the digital MONICA sound field calculations.

It is the observation, that standards covering point-to-point IoT devices do not in general offer specified minimum latency and time jitter, so finally, this report will cover some proposed technical requirements to an eventual new IoT standard/standards upgrade and our liaison with ETSI TG28 to present and discuss the matter.

2 Introduction

The IoT elements of the MONICA project making use of radio frequency spectrum must adhere to the various European regulatory provisions as laid forth by CEPT/ECC and some relevant EU Decisions. – Wireless IoT devices are often referred to as Short Range Devices (SRD), in particular in the regulatory text.

Amongst the SRD's applied to MONICA, we find various types of IoT wearables, such as radio equipped wristbands or bracelets, which during pilot demonstrations will be worn by some or all members of the MONICA event audience, measured in numbers of up to tenths of thousands per event.

Also fixed infrastructure IoT radio nodes (Base Stations or Anchors) which relay data to and from the IoT devices adhere to the same family of European norms, EN's.

Quite recently, the R&TTE Directive[1] was replaced by the Radio Equipment Directive (RED)[2], which *inter alia* now also cover radio receivers and receive-only devices. The European Telecommunications Standards Institute (ETSI) has now finalised the upgrade of all applicable standards applied by MONICA to comply with the RED.

When a large number of densely packed radio devices operate at the same time, and in adjacent spectrum, unwanted emissions from such densely packed devices could generate intermodulation (IM) components, such that other radio services might be impacted. A mass testing of IoT devices like this have never been done before, and the MONICA project is therefore closely watching eventual generation of unwanted emissions. This is one of the reasons why it is of the utmost importance that MONICA IoT devices operate on approved and planned spectrum and in compliance with for instance European Telecommunications Standards/Technical Specifications developed by ETSI in cooperation (if required) with the applicable CEPT/ECC Working Groups and Project Teams.

Another reason for the preferred application of official, open communication standards/specifications is to be found in the provisions of the EU Competition Law, which in the field of telecommunications calls for open and published, technical RF interface specifications in order to safeguard full and fair competition in the devices market in Europe. This is in particular important, *ceteris paribus,* when the MONICA project moves into commercialisation, after the project has completed.

All MONICA Partners in the supply chain of IoT and other Radio devices for the MONICA project have duly made sure to observe adherence to standards, insofar such standards exist, or to similar endorsed technical specifications.

Due notification of national spectrum administrations regarding MONICA Pilots planned/temporary spectrum usage has been executed whenever required to follow national rules and regulations.

[1] 1999/5/EC
[2] 2014/53/EU

3 The Smart (Crowd) IoT wristband and its infrastructure

The crowd IoT wristband has been built to comply with

ETSI EN 300 220-2 V3.2.1 (2018-06)

Short Range Devices (SRD) operating in the frequency range 25 MHz to 1 000 MHz;

Part 2: Harmonised Standard for access to radio spectrum for non-specific radio equipment

This device can be handed out to the event audience upon entering the event and will by means of its three coloured LED's be able to send simple downlink information to the wearer under control of the SRD radio network at the event area and be able to send simple uplink information to the event organiser.

Technical Specifications of the crowd wristband:

Figure 1 The SENDRATO 800 MHz wristband

3.1.1 Technical overview

Product Description	Wristband	
Brand Name	SENDRATO	
Model	Sendrato SUM3	
ETSI Standard	ETSI EN 300 220-2	
CEPT Regulation	ERC/REC recommendation 70-03 - Annex 1 https://www.efis.dk/sitecontent.jsp?sitecontent=srd_regulations	
Max ERP Power	10 mW	
Operating Frequency	865.000 MHz – 867.500 MHz	
Modulation	GFSK	
No of Channels	6 Channels	
Receiver Type	Category 3	
Antenna Type	Integral	
Power Supply	Small cell Battery, DC 3V, 220 mAh	
	CH1: 865.000 MHz	CH4: 866.500 MHz
	CH2: 865.500 MHz	CH5: 867.000 MHz
	CH3: 866.000 MHz	

3.2 Technical Specification of the Sendrato BS1 Base Station

Figure 2 The Sendrato SB1 networked Base Station

3.2.1 Technical Overview

Product Description	Base station
Brand Name	SENDRATO
Model	Sendrato BS1
ETSI Standard	ETSI EN 300 220-2
CEPT Regulation	ERC/REC recommendation 70-03 - Annex 1 https://www.efis.dk/sitecontent.jsp?sitecontent=srd_regulations
Max ERP Power	10 mW
Operating Frequency	865.000 MHz – 867.500 MHz
Modulation	GFSK

No of Channels	6 Channels	
Receiver Type	Category 3	
Antenna Type	Integral	
Power Supply	Power over Ethernet	
Channel List	CH1: 865.000 MHz	CH4: 866.500 MHz
	CH2: 865.500 MHz	CH5: 867.000 MHz
	CH3: 866.000 MHz	

3.3 Transmission Parameters and carrier frequencies

TX duty cycle for a single wristband: 0.05%

TX duty cycle for a single base station: 1%

Base Station Antenna: Omni-Directional Hertz Dipole, 0 dBi

The wristband and its Base Station are making use of the License Exempt spectrum of the 800 MHz band, as follows (in MHz):

CH0: 865.0, CH1: 865.5, CH2: 866.0, CH3: 866.5, CH4: 867.0, CH5: 867.5

According to the ECA table in EFIS: https://www.efis.dk/views2/search-general.jsp the range 865 MHz - 868 for non-specific SRD's MHz is included in 862 MHz – 870 MHz as follows:

862 MHz - 870 MHz (5.323) (ECA13) (ECA36)	• MOBILE (5.317A)	• Wideband data transmission systems • Radio microphones and ALD • RFID • Tracking, tracing and data acquisition • Land military systems • Maritime military systems • Alarms • Non-specific SRDs

3.4 The applicable ETSI Standard for the 800 MHz crowd wristband

Figure 3 The ETSI Standard EN 300 220-2 – Find it here[3]

[3] https://www.etsi.org/deliver/etsi_en/300200_300299/30022002/03.02.01_60/en_30022002v030201p.pdf

3.5 The 800 MHz IoT wristband network infrastructure and elements

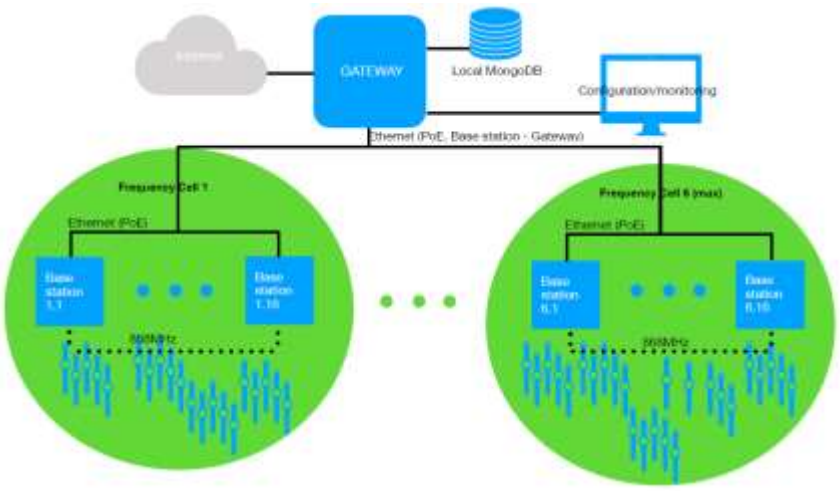

Figure 4 Frequency multiplexed cell distribution over the audience area of events

3.5.1 Two-way radio communication with the crowd wristbands

The RF communications with the wristbands take place over the 5 channels as indicated in Section 4.3.

Figure 5 Parallel channel structure (group polling) for a large number of IoT wearables

A group of up to 4 RX (downlink) channels can be used in parallel to address wristbands. (Group polling)

Each wristband has a unique ID, which determines the time-slot, in which it can transmit. There are three message types:

1) Location message as RSSI from triangulation of strongest BS
2) Button press, as ID + time stamp
3) Friend connect message, as ID1 + ID2 + time stamp

3.6 Crowd wristband technical conclusions

As illustrated above, the RF communication protocol has been developed to optimize the spectrum economy, whilst at the same time minimize the risk of generation of Intermodulation products from transmitters in close proximity within the crowd of the event audience. Such interference has not been detected during the pilots, where a large number of wristbands have been tested in real and open-air environments.

The ETSI EN 300 220-2 standard is a well-chosen platform for these types of applications. In particular the choice of the license exempt 862 MHz spectrum offers an RF coverage range, which is well suited for usual sized outdoor events, such as concerts, fairs and the like. It also provides for a very low power consumption (duty cycle etc.), which is paramount for lightweight wearable IoT devices.

4 The IoT/SRD UWB wearable Tracking Device and its infrastructure

It is of the utmost importance for the execution of the MONICA project, that service staff can be located across the event area. For this purpose, it was assessed, that more functions than needed for the crowd wearable should be added to serve the professional staff on-site.

A more expensive, but also more versatile tracking device based on UWB technology was selected to serve the professional staff, such as security officers, first-aid personnel, local traffic wardens etc. and the UWB standard ETSI EN 300 065 was identified as fulfilling the requirements.

4.1 Technical Specifications and EU regulatory platform

Figure 6 the UWB Tracking Device for the MONICA Service Staff

This device features a very high precision tracking capability (10 cm @100m distance) at the 6.5 GHz operating frequency range as specified in the Harmonized Standard alongside *inter alia* other frequency bands.

The device is equipped with an array of sensors:
Accelerometer, Gyroscope, Magnetometer

And actuators, Haptic motor, Buzzer

Including a screen

4.2 Advanced functionalities

- Notification by text messages
- Notification by haptic feedback
- Notification by buzzer
- Alert by push-button
- Detection of “no-movement” of the wearer
- Detect of “fast movement” (hitting/running/…)

How the MONICA Project is making use of all or parts of these advanced features and options can be found elsewhere in project descriptions.

4.3 The applicable ETSI Standard for the GHz range UWB wearable IoT device

This standard represents the most recent version. Find it in full using the link in the References section.

Figure 7 Front page of the ETSI EN 300 065-1. Find it here[4]

4.4 The applicable EU Provisions with regards to UWB operation in the Member States

The primary EU-Level provision for UWB, is the *COMMISSION DECISION (2007/131/EC) of 21 February 2007 on allowing the use of the radio spectrum for equipment using ultra-wideband technology in a harmonised manner in the Community*[5]

And in addition:

The *COMMISSION IMPLEMENTING DECISION (EU) 2017/1438 of 4 August 2017 amending Decision 2007/131/EC on allowing the use of the radio spectrum for equipment using ultra-wideband technology in a harmonised manner in the Community*, which sets forth an amendment, that highlights the meaning of "total power spectral density" as is described within ETSI EN 302 065-4.

The UWB based SRD/IoT technology has been high on the EU Commission's agenda for several years, and the EU Mandate to CEPT plus the subsequent adoption of Commission Decisions are harmonizing measures intended to safeguard the UWB take-up in the open market together with applicable ECC Decisions and ETSI EN's.

At the time of writing, a new provision has been published, repealing the above measures:

Commission Implementing Decision (EU) 2019/785 of 14 May 2019 on the harmonisation of radio spectrum for equipment using ultra-wideband technology in the Union and repealing Decision 2007/131/EC (notified under document C(2019) 3461) (Text with EEA relevance.) C/2019/3461. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32019D0785

[4] https://www.etsi.org/deliver/etsi_en/302000_302099/30206501/02.01.01_60/en_30206501v020101p.pdf
[5] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32007D0131&from=EN

5 The UWB Base Stations (Anchors)

These infrastructure elements adhere to the same regulatory RF provisions and standard as the wearable SRD/IoT devices with which it communicates.

5.1 Technical Specifications

Figure 8 the pole-mounted UWB anchor (Base Station)

- 6.5 GHz operational spectrum bands in accordance with ETSI EN
- High precision localization and two-way data communication
- IP67 specified (dust and water resistant)
- Cable connections: 10/100Mbit/s PoE (Power over Ethernet)
- Bluetooth connectivity

5.2 Technical Conclusions on UWB devices

As the carrier spectrum of this UWB device is in the 6.5 GHz range, the practical coverage distance is approximately 200m line-of-sight, which may be a blocking limitation for larger event areas, where establishment of full coverage is not practical and too costly in particular for a pilot event.

6 The 800 MHz Staff Tracking Device for larger event areas

Some of the pilot tests conducted in Germany were taking place across areas larger than practical for the 5 GHz tracking devices. The topology in question required a very high number of base stations making such high carrier frequencies not economically feasible for this project.

Therefore, other SRD frequencies were studied and found likewise in the 800 MHz band, which fits the regulatory environment in Germany as stated below. To assist in accurate tracking, these devices contain a GPS receiver.

6.1 800 MHz IoT/SRD license exempt spectrum in Germany

Germany	863.000 - 870.000 MHz	Non-specific SRDs
Germany	865.000 - 868.000 MHz	RFID

6.2 Technical Specification

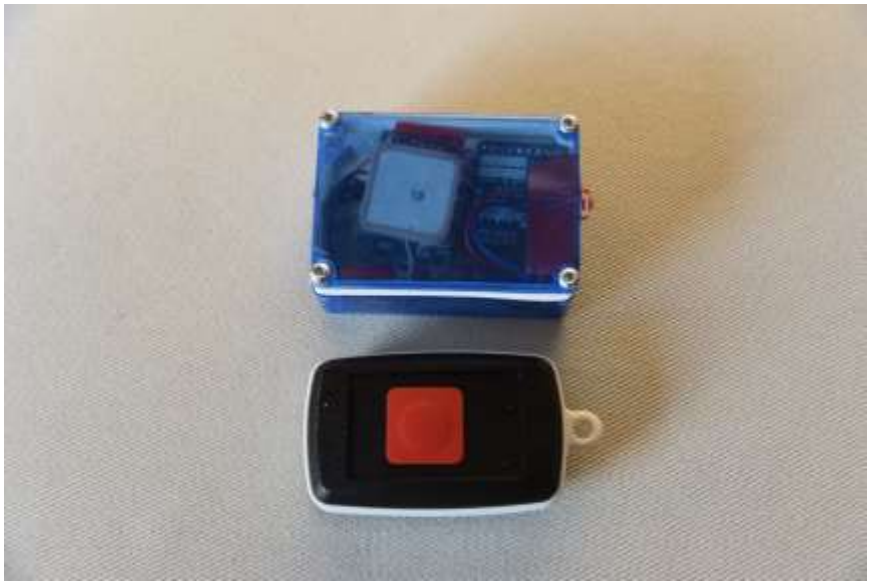

Figure 9: 800 MHz Staff Tracker. View

Figure 10: 800 MHz Staff Tracker. View 2

For all the tests conducted in MONICA the RFM95W-868S2 radio module (https://www.hoperf.com/modules/lora/RFM95.html) is applied and provided from a German vendor, and the spectrum chosen is: (in full compliance with Section 7.1)

866.750.000 MHz

867.000.000 MHz

867.250.000 MHz

867.500.000 MHz

867.750.000 MHz

868.000.000 MHz

Channel bandwidth: 125 kHz

Transmit power: <10 mW

The TX duty cycle is 4.3 %, sending 21 bytes per packet with a delivery interval of 8s and a TX time of 350 msec.

6.3 Test Specification

For future applications/commercialisation of such tracking solution, this ETSI EN may be applied:

Figure 11 A suggestion for a possible future reference specification

7 The RED (2014/53/EU) and a procedure for testing beta-products at pilot events

One of the significant take-backs from the MONICA Product in terms of European Radio Regulations is dealing with the operation and demonstration of brand new and often novel RF pilot devices (beta-devices), having not yet been CE-marked or in the process of being so. This is an area, where care must be observed, as different national views may be taken across the Member States.

However, the RED, Article 9.2[6] has proven to be very helpful for a project such as MONICA, where outdoor IoT devices are handed out to the audience (such as the crowd wristband) and operated within a limited geographical area, like a and open-air concert or a sporting event. In the meaning of the RED Art 9.2 this corresponds to an exhibition or a trade show, where new electronic devices are displayed and demonstrated.

7.1 Device hand-back is essential

At meetings with the Danish spectrum Administration (Energistyrelsen) Project MONICA has early on been advised, that RF devices handed out to the individual members of the audience at the event entry must be handed back again such that non-compliant equipment does not end up outside the exhibition area.

Instruction to hand-back the wrist bands was at all pilots elegantly indicated to the wearer through an “over-the-air” controlled constant blinking red LED in the wearable IoT device. All test devices were returned to project MONICA this way. This is the result of the fact that all IoT devices are under full control of the Base Stations deployed at the event area.

[6] At trade fairs, exhibitions and similar events, Member States shall not create any obstacles to the display of radio equipment which does not comply with this Directive, provided that a visible sign clearly indicates that such radio equipment may not be made available on the market or put into service until it has been brought into conformity with this Directive. Demonstration of radio equipment may only take place provided that adequate measures, as prescribed by Member States, have been taken to avoid harmful interference, electromagnetic disturbances and risk to the health or safety of persons or of domestic animals or to property.

8 Miscellaneous RF links at pilot events

8.1 The B&K 2245 Sound Level Meter operating at 2.4 GHz WLAN links

Figure 12 Sound Level Meter (SLM) RF linked to the MONICA AFSC

This advanced SLM is used by MONICA in the acoustic loop connecting to the ASFC system in real time calculations of the mitigating sound. It has an integrated RF module conforming to the

ETSI EN 300 328 V2.1.1: Wideband transmission systems; Data transmission equipment operating in the 2.4 GHz ISM band and using wide band modulation techniques; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU.

As such it can be categorized as a networked IoT/SRD delivering sensor data to the MONICA acoustic loop.

8.2 The corresponding ETSI Standard

This very new version of the EN 300 328 is currently in the ETSI approval process as compliant with the new RED directive, replacing the ETSI EN 300 328 V2.1.1 as stated above.

Figure 13: The brand new harmonized ETSI standard aimed at the 2.4 GHz band

9 The use of drones (UAS) in MONICA as a high-altitude sensor platform

In the early conception of the project it was decided to deploy a drone overhead of the pilot event area, in order to carry radio connected sensors picking up meteorological data for the ASFC real time sound field calculations, video signal for the crowd monitoring and a microphone, streaming the audio above the event for the acoustic loop.

Having studied the current non-harmonized (national only) drone regulation across Europe, technical as well as safety related, it was decided to select a much more safe and in some technical aspects more elegant solution, in the form of a tethered (line connected to the ground) soft air balloon (a so-called “blimp”) to carry the small pieces of sensor equipment. Such small airship is not running out of power, and does not create propeller noise, which would have to be filtered out of the digital audio stream from the on-board microphone.

9.1 The brand-new EU regulatory package regarding UAS for all of Europe

In March and May 2019, the EU Commission published the two first Regulations regarding UAS matters, such as operations and safety. These will be valid for all EU Member States.

1. *COMMISSION DELEGATED REGULATION (EU) 2019/945 of 12 March 2019 on unmanned aircraft systems and on third-country operators of unmanned aircraft systems* Commission Delegated Regulation (EU) 2019/945
2. *COMMISSION IMPLEMENTING REGULATION (EU) 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft* Commission Implementing Regulation (EU) 2019/947

In pursuance of these EU provisions, is the MONICA “blimp” defined as a UAS? We will discuss this in the following.

10 The characteristics of the MONICA blimp

The overall characteristics of the MONICA blimp is summarized in this figure

Field	Condition	Value	Measurement unit
Length	inflated	5	meter
Width (max circumference)	inflated	1.8	meter
Weight	Deflated	4.5	kilograms
Volume	Inflated	9	Cubic Meters
Theoretical Payload	Sea Level	4.5	Kilograms
Real Overall Payload for partners	Turin Pilot	1	Kilogram

Figure 14 some figures which relate to the new EU Regulation of UAS

In studying the (EU) 2019/945 this blimp is categorized as a CLASS 3 UAS, which is a tethered UAS being "lighter-than-air" without any means of powered thrust. Further it must comply with:

- have an MTOM[7] of less than 25 kg, including payload, and have a maximum characteristic dimension of less than 3 m; [should be waivered]
- in the case of a tethered UAS, have a tensile length of the tether that is less than 50 m and a mechanical strength of no less than:
    - for lighter-than-air aircraft, 4 times the force exerted by the combination of the maximum static thrust [which is zero] and the aerodynamic force of the maximum allowed wind speed in flight;

The marking of the UAS should be this label

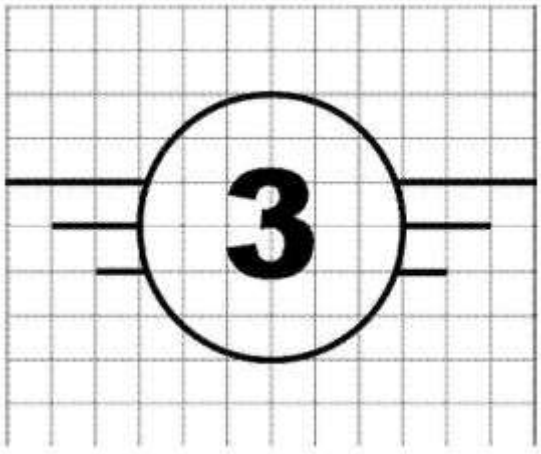

Figure 15 The marking of a Class 3 UAS

10.1 The blimp compliance with the new EU regulation

Apart from the length of the inflated blimp [which should be waivered by the national regulator] it seems that this UAS is fitting well the EU CLASS 3 UAS.

[7] Maximum Take-Off Mass

Consequently, as EU Member States adopts the new regulation in their national law, then this UAS can be operated across the European Union provided the operator follows the further provisions of deployment and operation.

Figure 16: The inflated blimp with payload, ready for launch

Figure 17: The payload of battery, stabilized camera and sensor array

11 A proposal for an upgraded/new IoT/SRD RF standard for low latency requirements

In real-time processing of time critical sensor data, it is often of significance to have control over the latency and the latency fluctuations of the received data.

In MONICA a number of sensors deliver continuously sensor data to the ASFC system in the acoustic loop. Not all data is time critical, but as the ASFC is executing heavy real-time algorithms to calculate the mitigating acoustic field aimed to reach the space from where the sensor data was sampled (in particular, temperature, humidity, wind speed, barometer and all related gradients which are shifting dynamically).

It is obvious, that the mitigating signal's effectiveness drops if it is to "old", when it reach the spatial segment of mitigation.

MONICA applies both networked IoT devices (WLAN, Operated LTE Mobile Networks) and direct end-to-end RF devices. The networked IoT devices will contribute with latency characteristics that fluctuates with varying network load, and will thus introduce jitter in the data stream. This applies to all networked IoT devices.

Close study of the current ETSI portfolio of IoT/SRD standards have shown, that latency has so far not been considered an issue for applications of IoT devices foreseen.

11.1 The time critical data routing in the acoustic loop

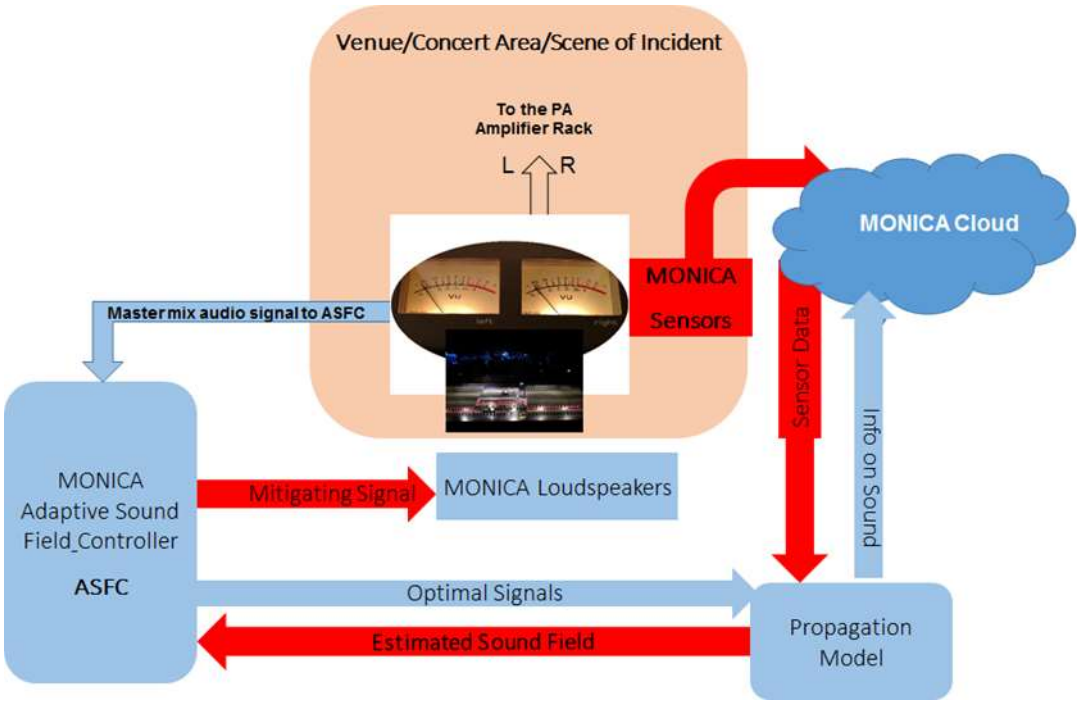

Figure 18 the time-critical path from the sensors to the ASFC

11.2 The latency timing - order of magnitude. An example

An acoustic signal with higher frequency components (5 kHz +) is easier to mitigate, especially at closer distances from the MONICA loudspeaker. To get a very rough illustration of latency influence on mitigation, consider a simple example of a sinusoidal original sound wave of 5 kHz. This sound's cycle time is 0.2 ms and thus shifts its phase 180 deg at any point in space every 0.1 ms. So, latency and latency time jitter in this order of magnitude may either in theory amplify the original signal or extinguish it. A typical ideal latency for this simple example should then be 0.05 ms or 50 µs.

11.3 Proposed end-to-end principle at the RF layer. Basic requirements

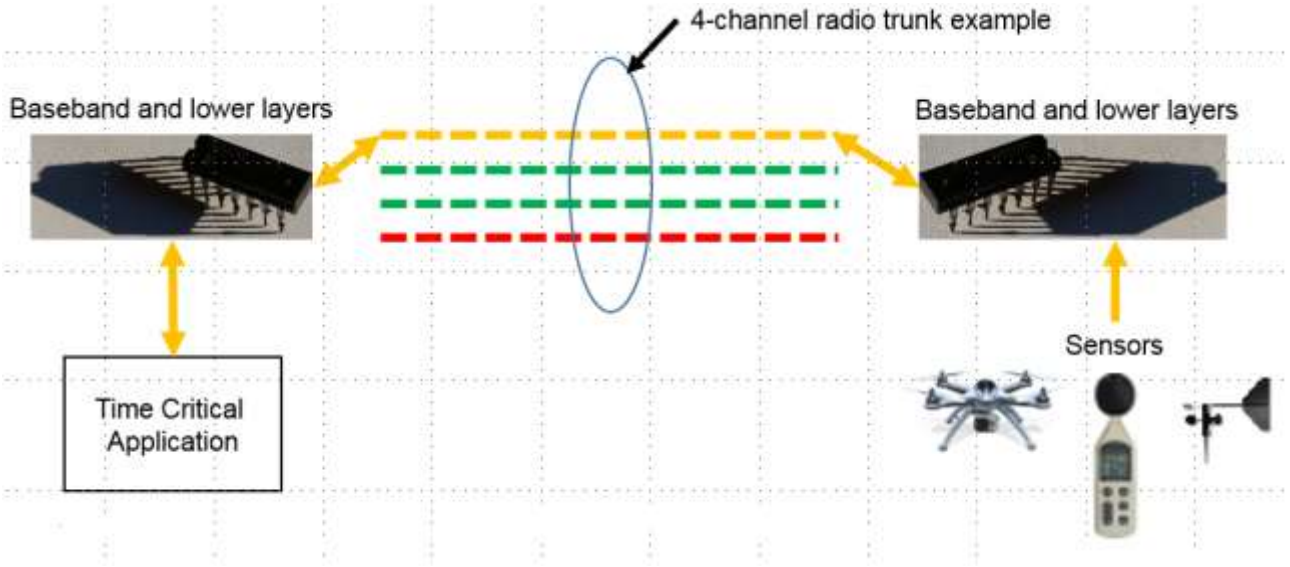

Figure 19 the chip-trunking principle – 4 channel trunk offering 25 kHz in 4 x 6.25 kHz sub-channels

For direct link (non-networked) IoT/SRD devices the quality and dependability of the applied RF link is sometimes critical. Often, the spectrum at the scene of deployment is regulated around a 25 kHz channel raster, so it could be a flexible way to let the network layer select and handle the best operating sub-channel as illustrated in the figure.

11.4 Basic spectrum bands and other parameters

It is in general recommended to allocate spectrum for non-networked IoT/SRD operation at events such as studied by project MONICA, which allow for the delivery of dependable RF connections at medium range distances under 1 km, end-to-end.

Furthermore it has been the experience, that spectrum should be selected in bands, which are regulated under a license exempt regime, such as the 800 MHz bands, which has been used by project MONICA with success.

It was also proven to be useful to apply RF devices as far as possible, which comply with harmonized ETSI standards, in communication with the national authorities.

In a possible forthcoming elaboration of a new Low-Latency-Optimized standard it is proposed to concentrate the work on current IoT/SRD standard profiles, such as found for instance in the EN 300 220 series. Similar Spectrum Bands, RF power and emission masks and other RF characteristics should be considered.

11.5 Next steps in standards making

According to the ETSI working procedures, it will require the support from at least four full ETSI members to open a new Work Item to start the work on a standard upgrade or a new standard.

In May 2019 at the ETSI meeting of TG 28, this proposal was presented and TG members are now elaborating on the input.

If enough interest from MONICA partners, also being ETSI members, then the work can start in ETSI in 2nd half of 2019. RING is offering support on behalf of MONICA during the final stage of the project.

12 Conclusion

The MONICA project has in general been applying existing RF standards and specifications for the large number of applications required. It has throughout been well understood, that the choice of radio frequency spectrum should be made from the CEPT license exempt frequency ranges in order to reduce any regulatory costs and fees to run the pilot tests.

Also, a number of RF links used at event areas has been realized by using systems operated by licensed cellular operators, a fact which made regulatory bureaucracy minimal. Furthermore, a number of devices were operating by means of approved RF devices (WLAN, Bluetooth) and presented no regulatory attendance. They are therefore not mentioned in this report on regulations.

Within the framework of the CEPT/ECC and EC spectrum regulation of IoT (or SRD (Short Range Devices)) the project time span since 2017 has seen rapid developments and changes, to which the MONICA project has suffered no impact, due to the formal choice of de-jure standards and current spectrum regulation. See Section 4.4 on UWB.

The MONICA project has been breaking new grounds in the field of spectrum engineering. When thousands of IoT wearables are fitted to a very densely packed audience such as a rock concert audience, then possible overlapping transmissions from spatially close range IoT devices, may generate spectral Intermodulation components, which may or may not cause harmful interference to other adjacent services. By applying a cell-by-cell polling scheme as described, overlapping transmissions was avoided and no interference was reported.

The difficult choice of a high-altitude platform for sensors at the pilot events was challenged by a non-harmonized regime in the EU. Therefore, the blimp solution was suggested and the national regulation of Italy was chosen as this was a known territory for the partner, delivering the blimp.

Now finally the EU Commission has published Regulatory measures (March and May 2019) on safety and operational matters. This may be of great assistance to future EU Commission projects.

Finally, the new Radio Equipment Directive (RED) 2014/53/EU was offering valuable assistance in its Art 9.2 on exhibition and demonstration of beta-stage RF equipment in a gated environment like a trade show or fair. For MONICA it was of great value, as a closed/gated pilot event area could be regarded as an exhibition with gated access and exit.

There is no doubt that other EU LSP's can benefit from these provisions.

The main design elements of the document are:

Headings: You must use the style headings because they also control the Table of contents and often also internal references. Numbering is legal style, e.g. 1 -> 1.1 -> 1.1.1 -> etc. It is recommended to use 'Title Case' in Heading1 only and 'Sentence case' in all following headings.

Body Text: Body text is used for all body text. It is equal to the Normal style with 6pt space after the paragraph and with justified text. There should not be an extra line break between paragraphs.

Normal: The Normal style is the default style. It uses Arial 10pt, Left-justified text and language English (U.K.). Please do not use English (US). The Normal style can be used for tables or other design elements, but not for ordinary body text.

Captions: The style Caption defines Figure and Table captions. It is Arial 9pt bold centred. Place captions below figures and above tables.

13 List of Figures

13.1 Figures

14 References

CEPT	Report 70: In response to the EC Permanent Mandate on the ”Annual update of the technical annex of the Commission Decision on the technical harmonisation of radio spectrum for use by short range devices”
	https://www.ecodocdb.dk/download/1ebaaede-1ab7/CEPTRep070.pdf
CEPT	ERC Recommendation 70-03: Relating to the use of Short Range Devices (SRD) with Subsequent amendments of 8 February 2019
	https://www.ecodocdb.dk/document/845
EU	2014/53/EU the Radio Equipment Directive
	https://eur-lex.europa.eu/legal-content/GA/TXT/?uri=celex:32014L0053
EU	EU Commission: COMMISSION IMPLEMENTING DECISION 2014/702/EU of 7 October 2014 amending Decision 2007/131/EC “on allowing the use of the radio spectrum for equipment using ultra-wideband technology in a harmonised manner in the Community”
	https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1560770489142&uri=CELEX:32014D0702
	https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1560770583283&uri=CELEX:32007D0131
ETSI	Easy search in the current portfolio of ETSI deliverables
	https://www.etsi.org/standards-search#page=1&search=EN300%20392&title=1&etsiNumber=1&content=1&version=0&onApproval=1&published=1&historical=1&startDate=1988-01-15&endDate=2016-10-10&harmonized=0&keyword=&TB=&stdType=&frequency=&mandate=&collection=&sort=1