# Wirepas, At a Glance

## European Company with a Global Presence

- HQ: **Tampere, Finland**
- Established: **2010**
- Segment: **Wireless Massive IoT**
- Employees: **70**
- Creators of **DECT nr+ non-cellular 5G Standard**

## Robust IP

**90+** Patents

**15+** Years of Research

## Customer Traction

**200+**
Licensees

**~10M**
devices connected

## Strong Licensing Partner Ecosystem

MAERSK, SCHAEFFLER, FUJITSU, DB SCHENKER, PROLOGIS, SONY, FAGERHULT Lighting Group, KINEXON, adani, Haltian, here, Giesecke+Devrient, illumiPure, blueup, orange, verizon, inpixon, RedLore, PARAGON ID, INGY, CONFIDEX, SULZER

## Multiple End Markets


Automotive


Food & Beverage


Electronics


Machinery / Metal Products


Warehouses


Condition Monitoring


Electricity


Water


Gas


Smart Microcities


Building Automation


Access / Safety / Sensors


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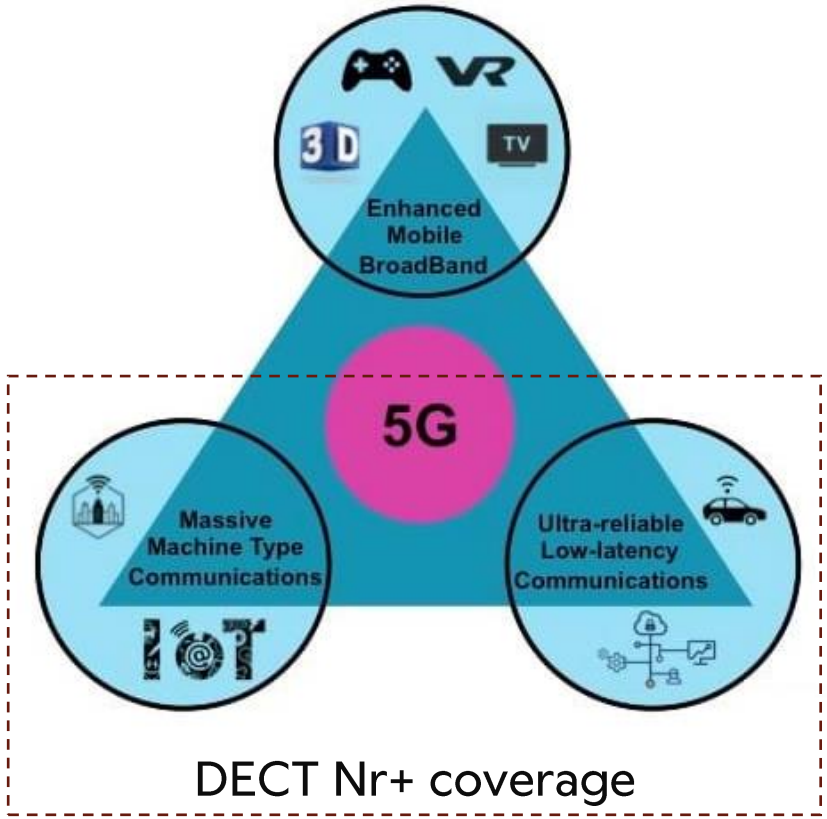
# DECT NR+ introduction

1. Global standard by **ETSI TC-DECT** – using DECT band (1,9GHz) to provide massive scale IoT connectivity
2. NR+ is the world's first non-cellular, non-operated **5G approved Mesh** technology standard bringing technology to the **mMTC**)
3. NR+ is the State-of-the-art ultra-reliable Mesh protocol over OFDM/HARQ PHY layer
4. **5G and Mesh** under unlicensed frequency band
    1. Dimensioned to connect every (low bitrate) IoT device on the planet
    2. Up to 3km range per hop
    3. IPV6 ready (Release 1)
    4. Natively supporting IPv6 (**Release 2: Dec 2023**)
    5. Designed for Low Power Routing
5. Making the DECT spectrum freely available for IoT applications World-Wide
    - 1,9 GHz used to be known as "the golden frequency"
    - 10 to 20MHz band almost unused and freely available for IoT



DECT Nr+ coverage

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# A global standard

Europe & Australasia*

1880 – 1900 MHz
(potential extension in Europe to also include 1900 – 1920 MHz)

US & Canada

1920 – 1930 MHz
("DECT 6.0")

Japan

1893 – 1906 MHz
("J-DECT")

Latin America**

1910 – 1930 MHz

Brazil

1910 – 1920 MHz

South Korea

1786 – 1792 MHz

Taiwan

1880 – 1895 MHz

# DECT Forum and ETSI

Drive the business and technology roadmap

Develop standards and technical specifications

Protect and expand frequencies

Create application profiles to support interoperability

Campaign for the DECT technology

Development of System Reference Documents

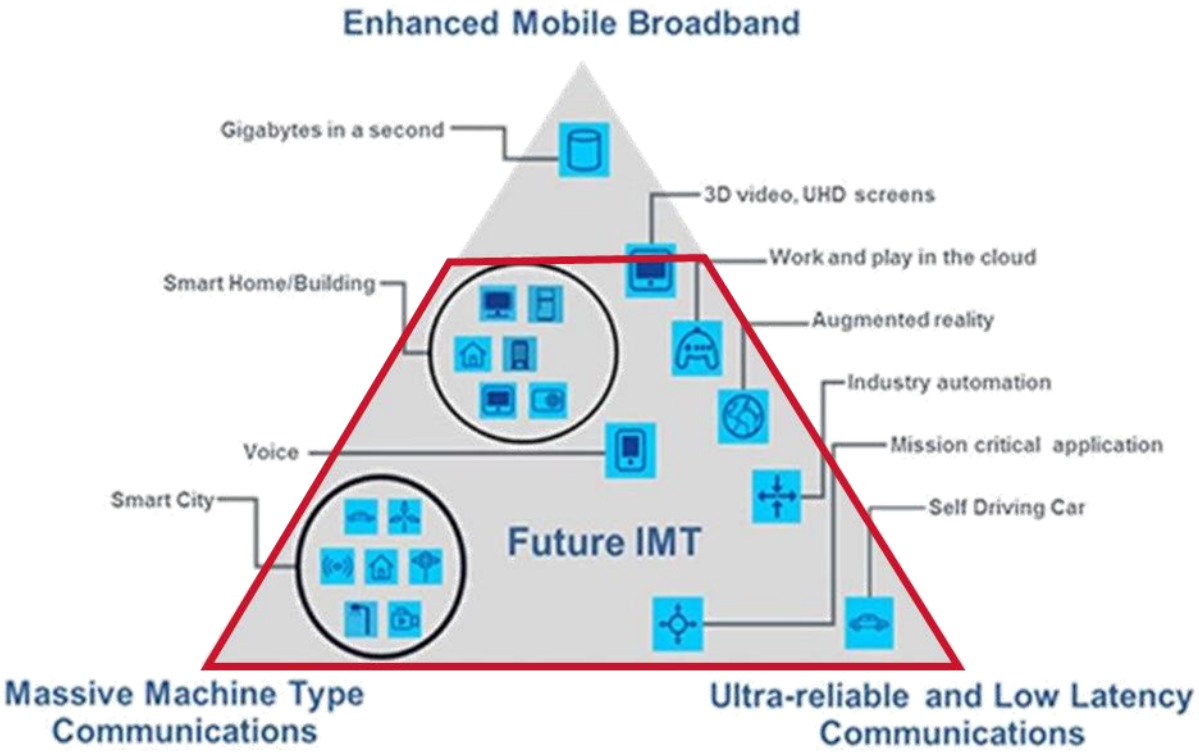
Create and maintain certification programs

Maintaining the relationship with CEPT and ITU-R

Activities go hand in hand and complement each other

# DECT NR+ is a 5G technology

- ITU-R approved DECT NR+ to be part of 5G.
  - International Telecommunication Union (ITU) is a United Nations specialized agency for information and communication
- DECT NR+ meets the massive Machine Type Communication (mMTC) and the Ultra-Reliable and Low Latency Communication (ULLRC) service requirements set by ITU-R for 5G technology.
- DECT NR+ meets both requirements with the ETSI TS 103 636 standards series.



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# DECT NR+ for private networks

- Can be deployed and operated by anyone and used anywhere.
- Its operation is simple, autonomous, and able to co-exist with other local networks sharing the spectrum.
- It is application agnostic enabling rapid adoption of different use cases and fostering digitalization.
- It focuses on ultra-reliable low latency communication and massive-scale machine communication networks exploiting mesh topology.

# Private network, designed for shared spectrum operation

- DECT band at 1.9 GHz provides a unique spectrum to operate. DECT NR+ and classical DECT can operate with minimal interference sharing the common spectrum asset.
  - Interference management is possible to optimize as the technologies in this band are known. This provides the state of art shared spectrum performance.
  - Autonomous de-centralized frequency channel selection optimizes the local spectrum use improving the reliability
  - Local and optimal spectrum operation minimizes connectivity management, which is needed for scaling for large systems.
- DECT NR+ supports multiple TDD bands, licensed and unlicenced bands, from 450 MHz up to 6 GHz range.

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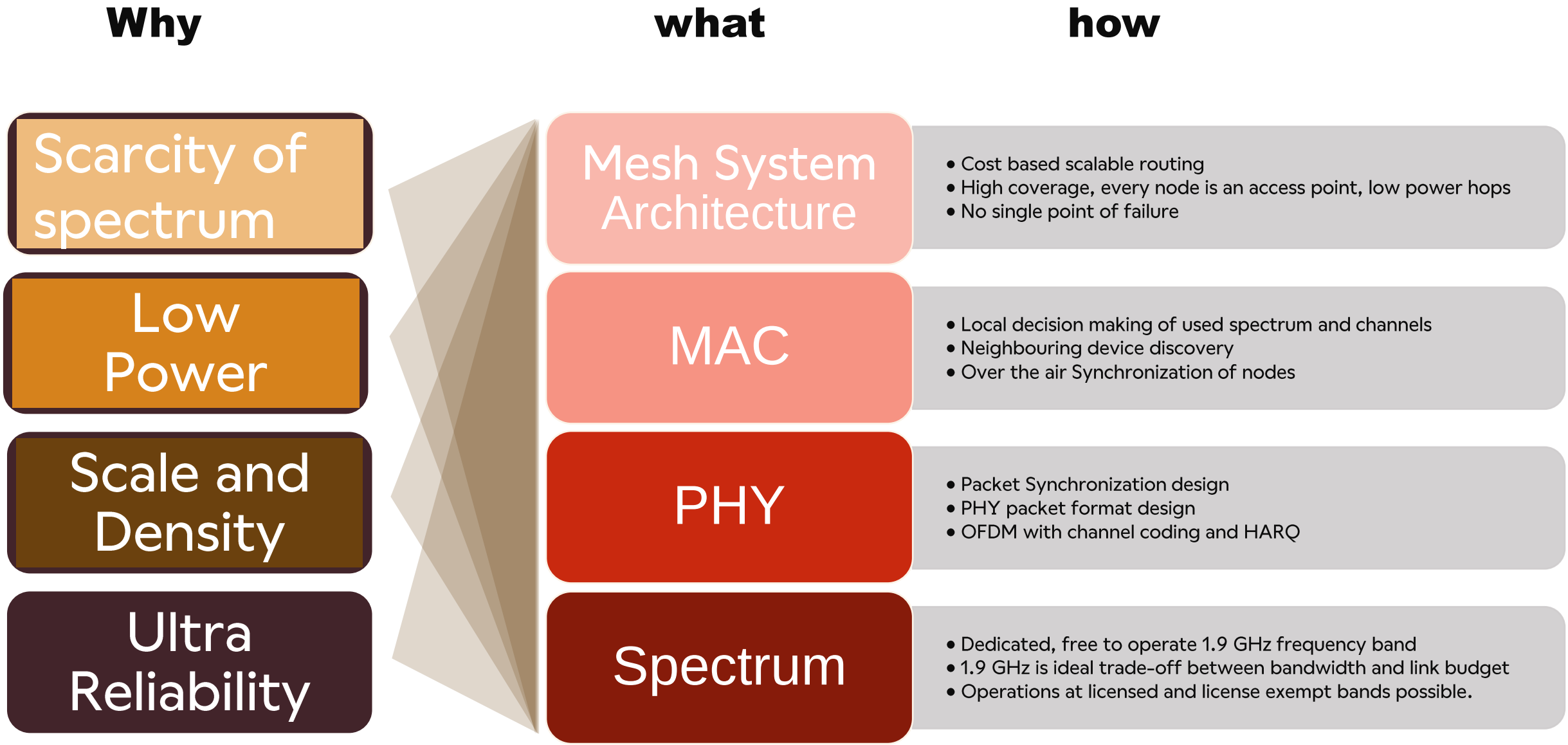
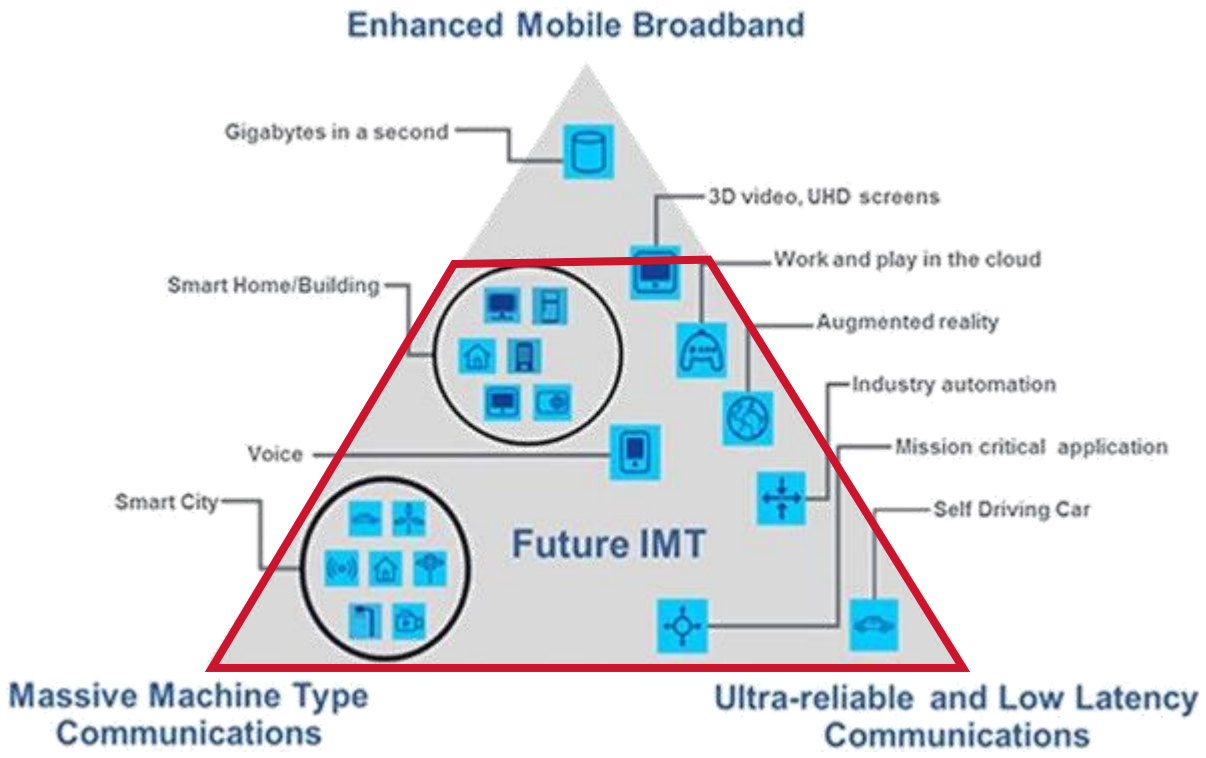
# Private network, designed for shared spectrum operation

- DECT-NR+ technology supports multiple network topologies which can share the same spectrum. One device can support any topologies with the same design.
  - Mesh enables a network that does not have a limit in range. Each device is extending range or increases communication reliability.
  - Star topology enables minimal latency operation.
  - Point-to-point connections thanks to local decisions



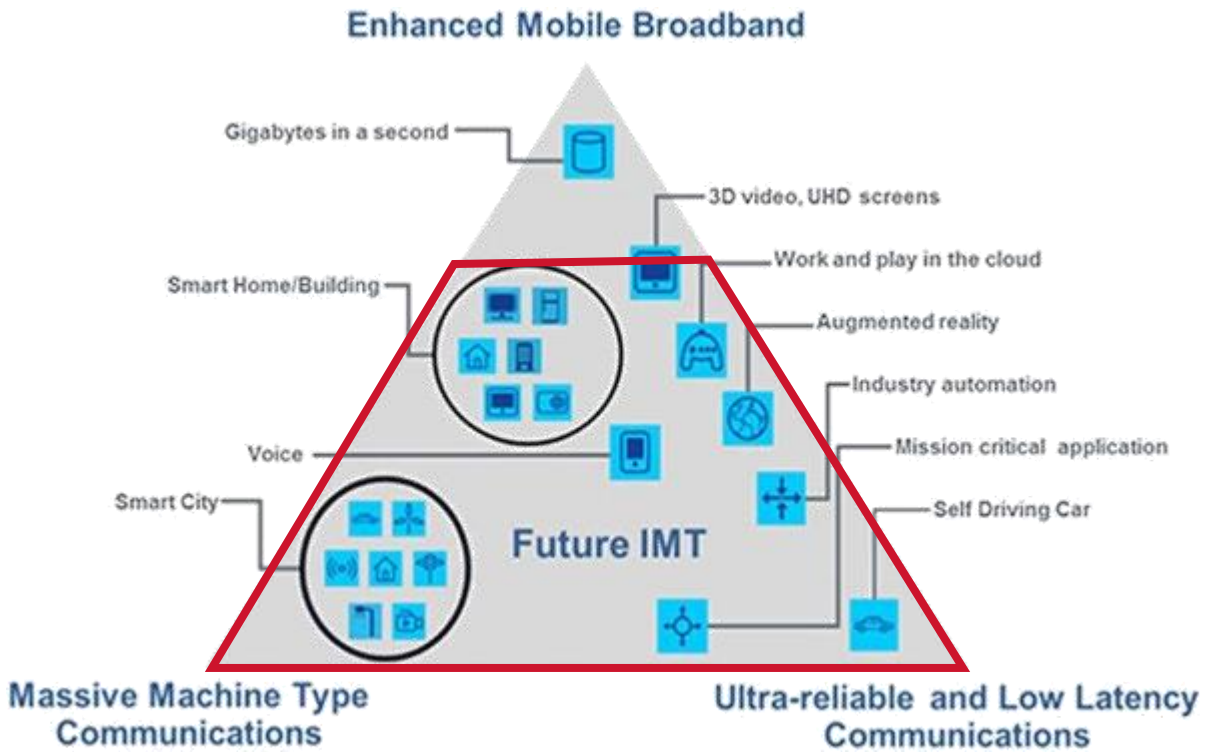
# DECT NR+ Density

- Device density is an important requirement for industrial and utilities operations.
- The density of > 1000 units in very close proximity is achieved by local autonomous operation, where devices can coordinate the routing between them by using FDMA and TDMA operation and wide power ctrl range down to -40 dBm to limit the overhearing.
- The number of devices in a network is so high that centralized control would not improve the performance, as the control plane traffic becomes significant.



# DECT NR+ Latency

- DECT NR+ physical layer is designed to support low latency operation. The time from receiving mode to transmission mode is very short < 14 us (i.e. guard interval).
- The device can have multiple receiving and transmission events within one 10ms radio frame.
- The standard enables less than 1ms radio layer latencies in a single link.
- Each radio link may operate with low latency in a mesh operation to minimize the e2e latency.

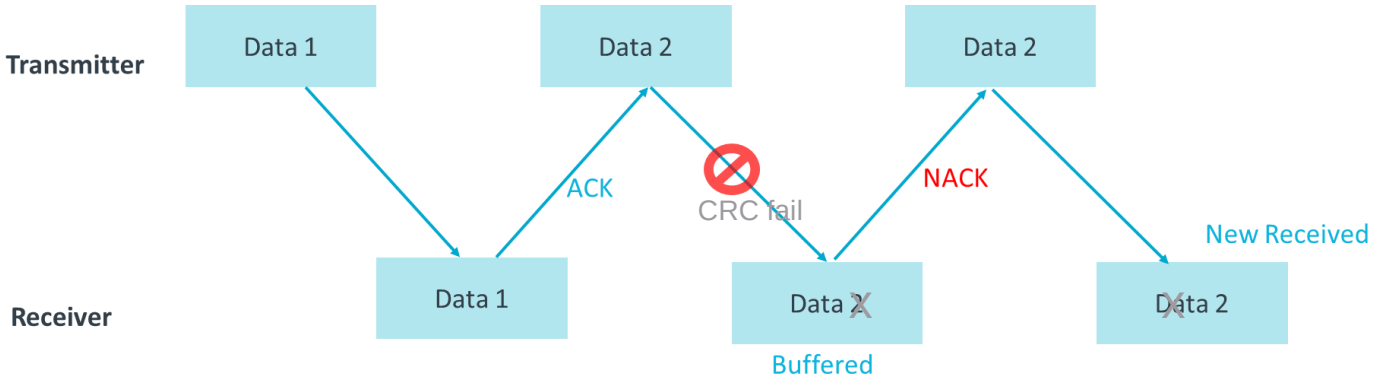


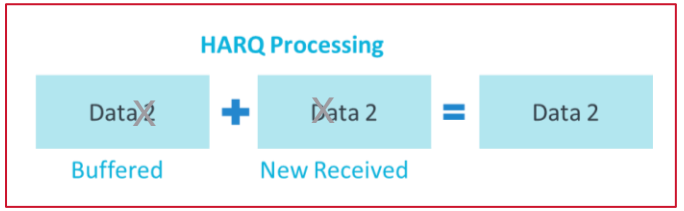
# Low Power Consumption


- DECT NR+ has a unique feature set for power savings
  - Dynamic power control of transmissions, -40dBM to +23dBM
  - The Relay device, which manages the radio usage in its cluster, can tell child nodes when the Relay device can be reached for uplink data forwarding
    - Even Relay devices can sleep
  - The Relay device pages the child devices in beacon messages, telling a child when it must listen for downlink data
    - Leaf only needs to listen to beacon message, beacon period from 10ms up to 32s
- DECT NR+ defines routing and re-transmissions on radio stack level, enabling the “multi-core or multi-domain systems to carry out reliable radio communications without waking up other cores

# Range and Reliability

- Uses cellular technology algorithms proven in billions of devices globally
- DECT NR+ can use Transmission (TX) power levels up to +23 dBm
  - **Over 3 km** range in Line-of-Sight
  - Hundreds of meters of range even in challenging urban and factory environments
- Relay scans channels for interference avoidance, updates the cluster's radio resource allocation, and can instruct children to change channels
- Hybrid Automatic Repeat Request (HARQ) for range and reliability
  - Hybrid means it has a Forward Error Correction and repeat request



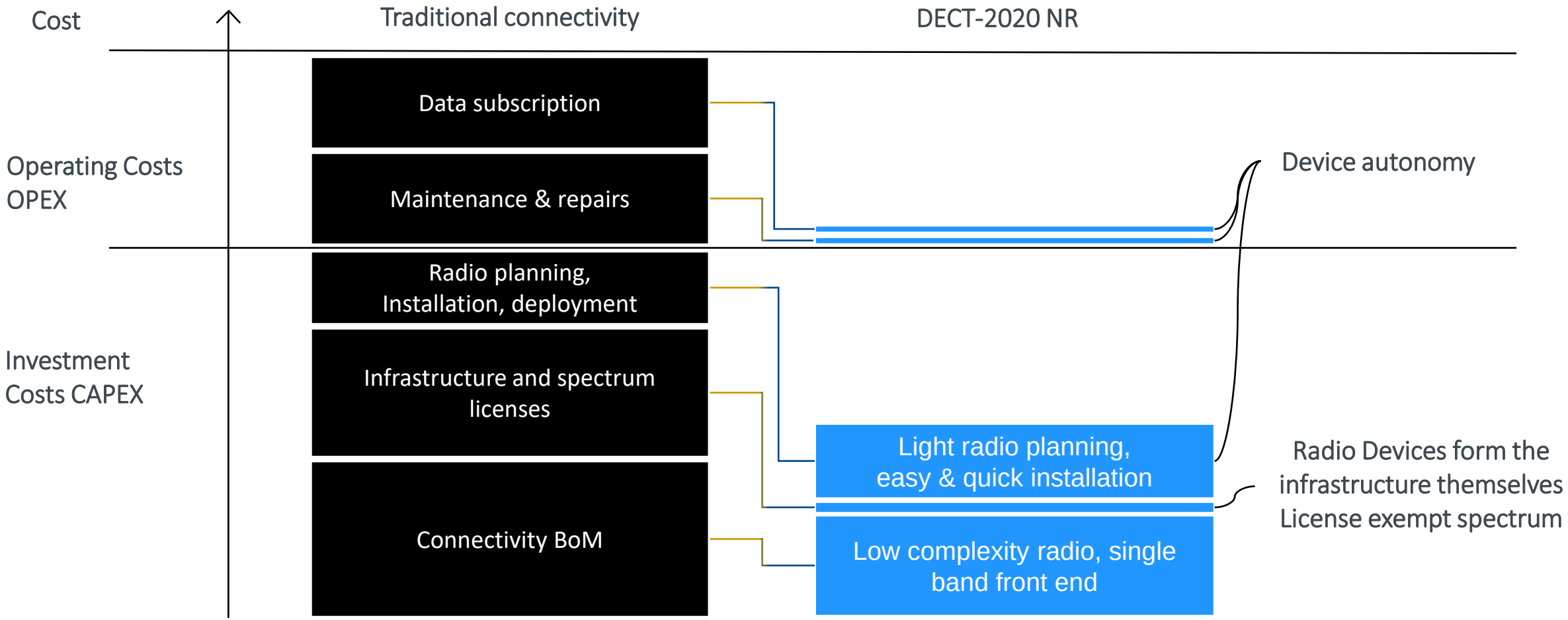



# Low Power Routing


- DECT NR+ has a unique feature set for power savings
  - Dynamic power control of transmissions, -40dBM to +23dBM
  - Enables Very Low power routing – all devices (can be routers)
- DECT NR+ defines routing and re-transmissions at the radio layer – no need to wake up the core

→ Allows to deploy massive IoT networks with very low powered infrastructure

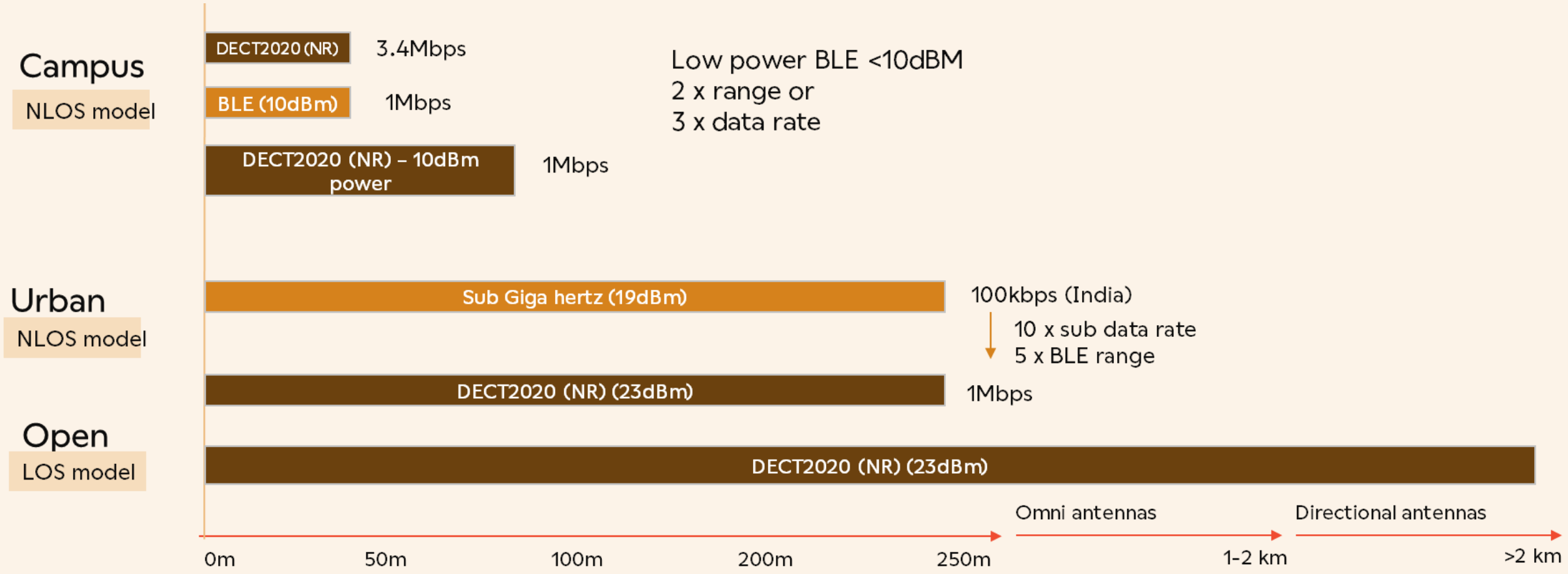
# Total cost of ownership



# DECT NR+ benefits - summary

- Long range
- Very High density
- Simple to deploy: Low power routing
- Autonomous and Decentralized
- High Reliability and QOS:
  - No single-point-of-failure
  - Frequency agility
- Natively supporting IPv6
- The first 5G technology which can support shared spectrum and multiple local networks in mobile system frequencies
- Free of charge and license-free
- Dedicated 1,9 GHz global band → Enables true long-range radio in Europe

# Physical layer options

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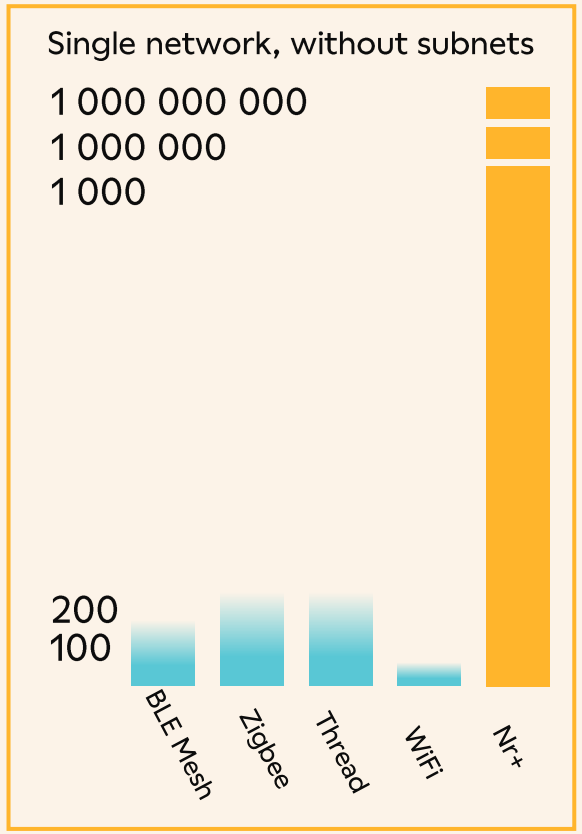
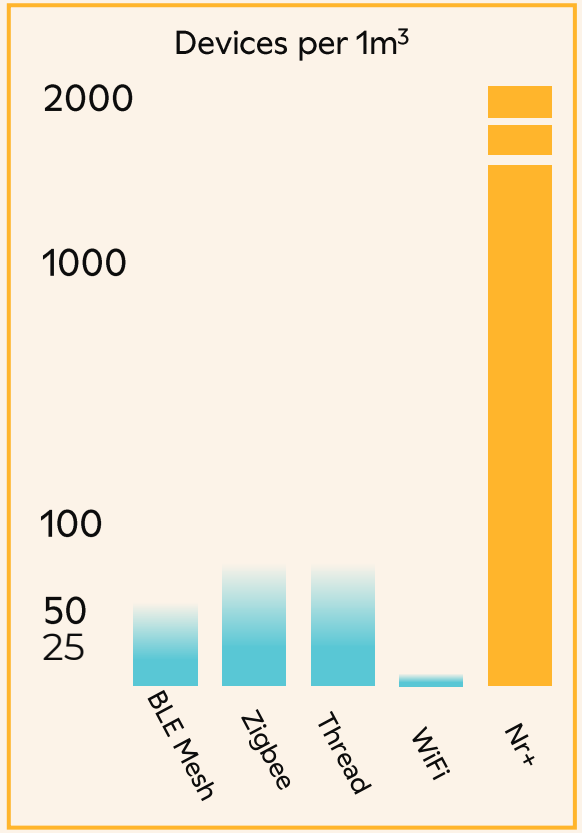
# DECT nr+ performance compared to other mesh technologies - Wirepas implementation

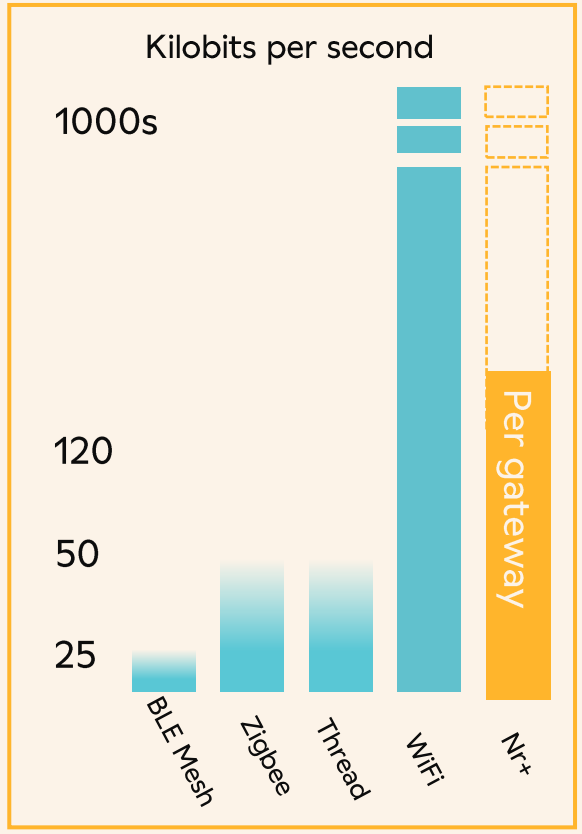
## Scale per network



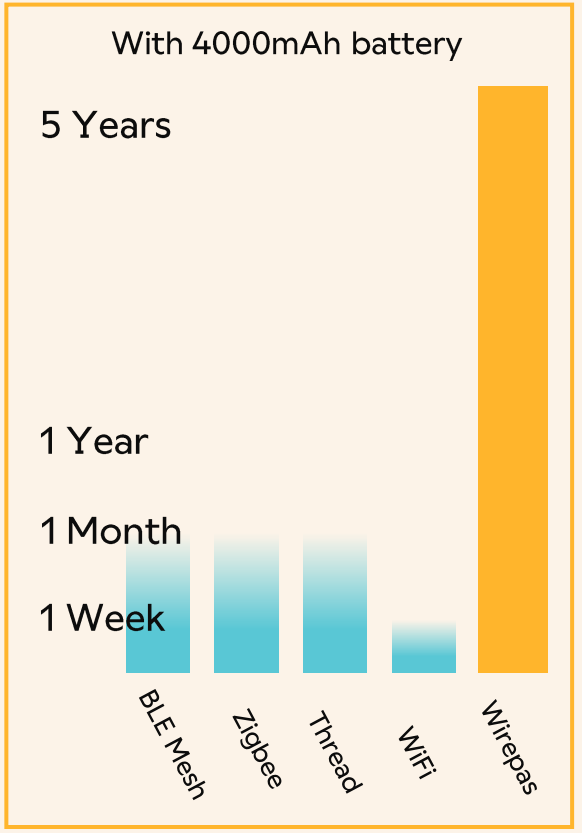

## Density of devices




## Throughput




## Battery lifetime of routing device



# Specification structure

- ETSI has published Release 1 DECT-2020 NR specifications:
  - TS103.636-1, DECT-2020 New Radio (NR); Part 1: Overview; Release #1
  - TS103.636-2, DECT-2020 New Radio (NR); Part 2: Radio reception and transmission requirements; Release #1
  - TS103.636-3, DECT-2020 New Radio (NR); Part 3: Physical layer; Release #1
  - TS103.636-4, DECT-2020 New Radio (NR); Part 4: MAC layer; Release #1
  - TS103.636-5, DECT-2020 New Radio (NR); Part 5: DLC and Convergence layers, Release #1
- Harmonized standard for DECT-2020 NR under development
- New work item approved on Application Profiles
  - Smart meter profile is the first one to be defined
  - Intension is to define how DECT-2020 NR is configured for supporting DLMS
  - Other use case profiles under development.
- ETSI press release can be found here.
- TC-DECT is working further to provide additions to this specification series in following releases.

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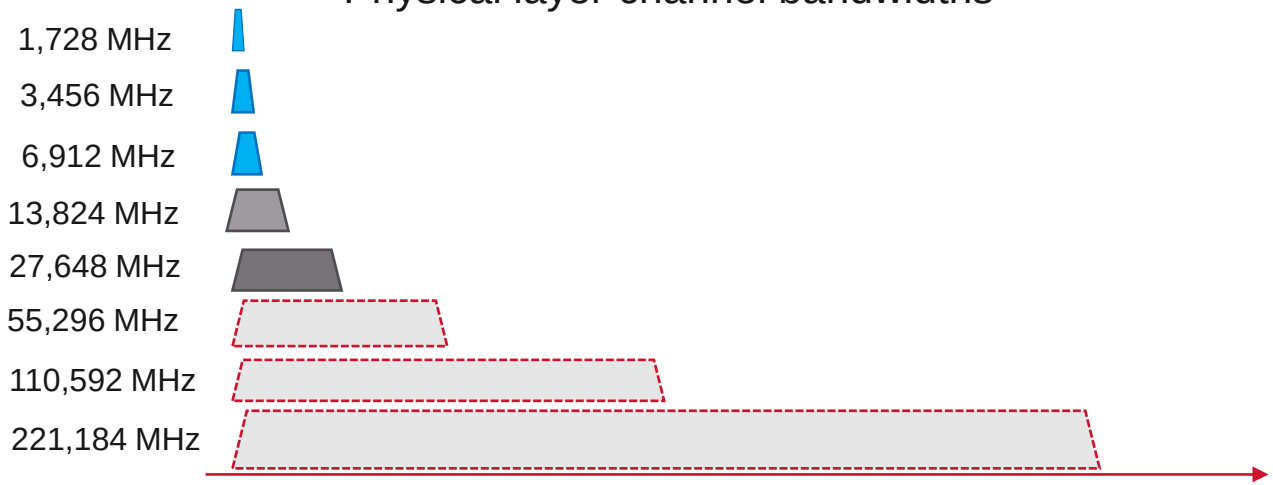
# DECT-2020 NR Radio requirements

# Radio transmission requirements: Operating bands and channel bandwidths

- DECT-2020 technology has flexible spectrum support, 19 bands up to 6 GHz frequencies.
- Release 1 already supports variable operating channel bandwidth(s) up to 221 MHz offering in future latency and performance boost option.
- Release 1 supports 1,728, 3,456 and 6,912 MHz operating channel options.

Physical layer channel bandwidths




Operating band numbering

| Band number | Receiving band (MHz) | Transmitting band (MHz) |
|---|---|---|
| 1 | 1 880 to 1 900 | 1 880 to 1 900 |
| 2 | 1 900 to 1 920 | 1 900 to 1 920 |
| 3 | 2 400 to 2 483,5 | 2 400 to 2 483,5 |
| 4 | 902 to 928 | 902 to 928 |
| 5 | 450 to 470 | 450 to 470 |
| 6 | 698 to 806 | 698 to 806 |
| 7 | 716 to 728 | 716 to 728 |
| 8 | 1 432 to 1 517 | 1 432 to 1 517 |
| 9 | 1 910 to 1 930 | 1 910 to 1 930 |
| 10 | 2 010 to 2 025 | 2 010 to 2 025 |
| 11 | 2 300 to 2 400 | 2 300 to 2 400 |
| 12 | 2 500 to 2 620 | 2 500 to 2 620 |
| 13 | 3 300 to 3 400 | 3 300 to 3 400 |
| 14 | 3 400 to 3 600 | 3 400 to 3 600 |
| 15 | 3 600 to 3 700 | 3 600 to 3 700 |
| 16 | 4 800 to 4 990 | 4 800 to 4 990 |
| 17 | 5 725 to 5 875 | 5 725 to 5 875 |
| 18 | 5 150 to 5 350 | 5 150 to 5 350 |
| 19 | 5 470 to 5 725 | 5 470 to 5 725 |
| 20 | 3 800 to 4 200 | 3 800 to 4 200 |

# Radio transmission requirements

- Receiver requirements
  - Sensitivity, adjacent channel and blocking requirements
  - Sensitivity scales from -99,7 dBm @1.728 MHz depending on operating channel bandwidth.
  - Receiver decoding requirements.
- Transmitter requirements
  - Four different power classes: 23 dBm, 21 dBm, 19 dBm and 10 dBm maximum TX power levels.
  - LBT -operation and no duty cycle limitations.
  - Minimum power down to -40 dBm.
  - Transmitter behaviour comparable to LTE-M UE requirements.
- Frequency channel numbering
  - Absolute channel numbering throughout all bands.
  - Uniform neighbour information across all bands.
- Measurements
  - Received signal and demodulated signal received power.
  - Received demodulated signal quality

**Table 6.2.1-3: Transmit Power**

| Bit field | TX Power [dBm] |
|---|---|
| 0000 | -40 |
| 0001 | -30 |
| 0010 | -20 |
| 0011 | -16 |
| 0100 | -12 |
| 0101 | -8 |
| 0110 | -4 |
| 0111 | 0 |
| 1000 | 4 |
| 1001 | 7 |
| 1010 | 10 |
| 1011 | 13 |
| 1100 | 16 |
| 1101 | 19 |
| 1110 | 21 |
| 1111 | 23 |

Single set of requirements enables same design to be used in any part of the system.

Absolute frequency channel numbering provides straightforward multiband support, neighbor frequency information is explicit across all operating bands

Neighboring RD’s signal measurements supports the device centric autonomous operation and mobility

# USE CASES

Wirepas

# Nr+ scales to millions of meters in 1 $Km^2$

Courtesy Google : Dharavi, Mumbai

# Architecture – RF network interface card

Any
MDM

Any
Head end
System

Meter manufacturer


Network Interface Card

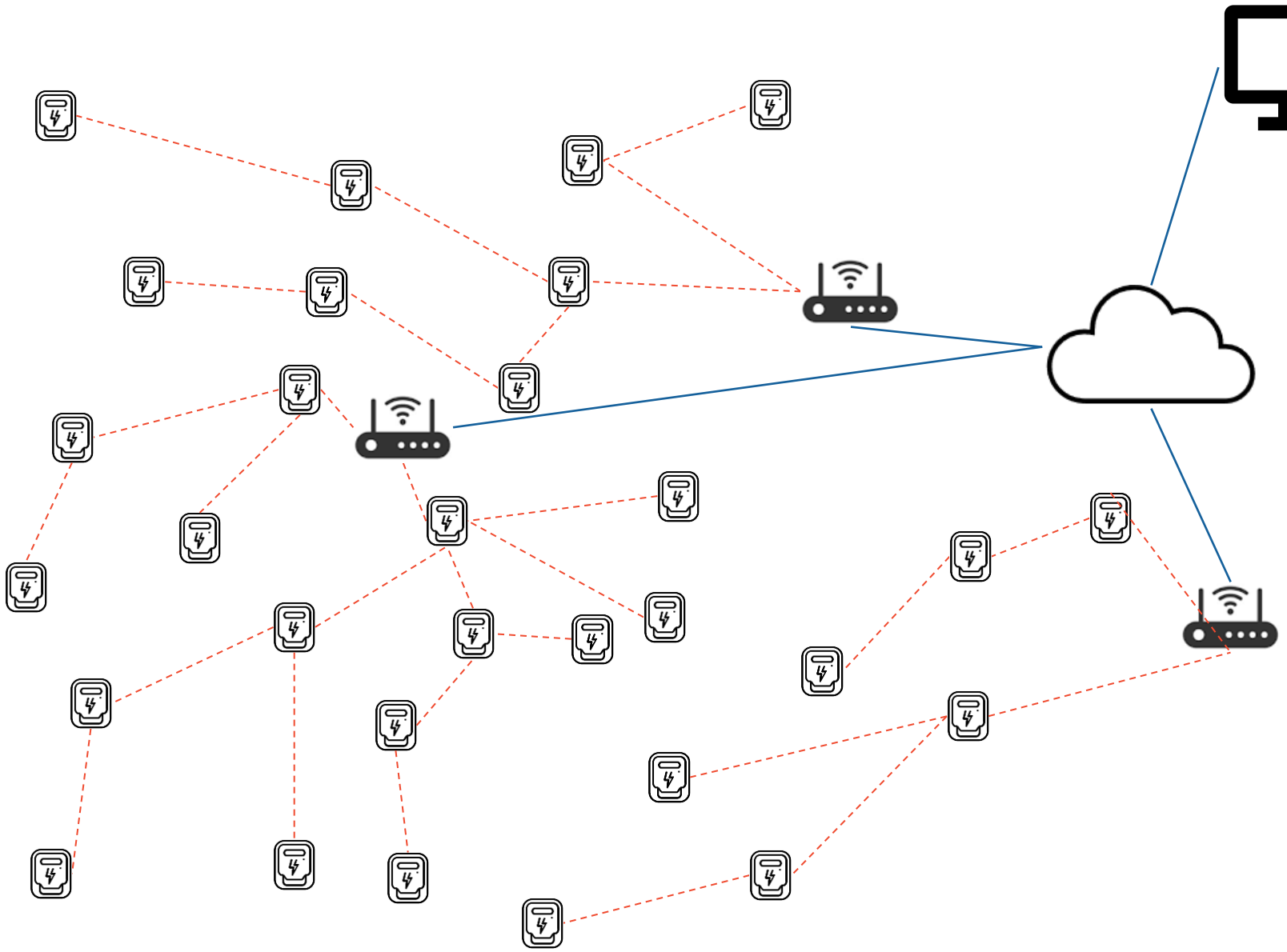
DLMS
app

Nr+
Mesh

Radio
Chip

Any
Gateway
hardware

# AMI solution based on nr+



Head-End System

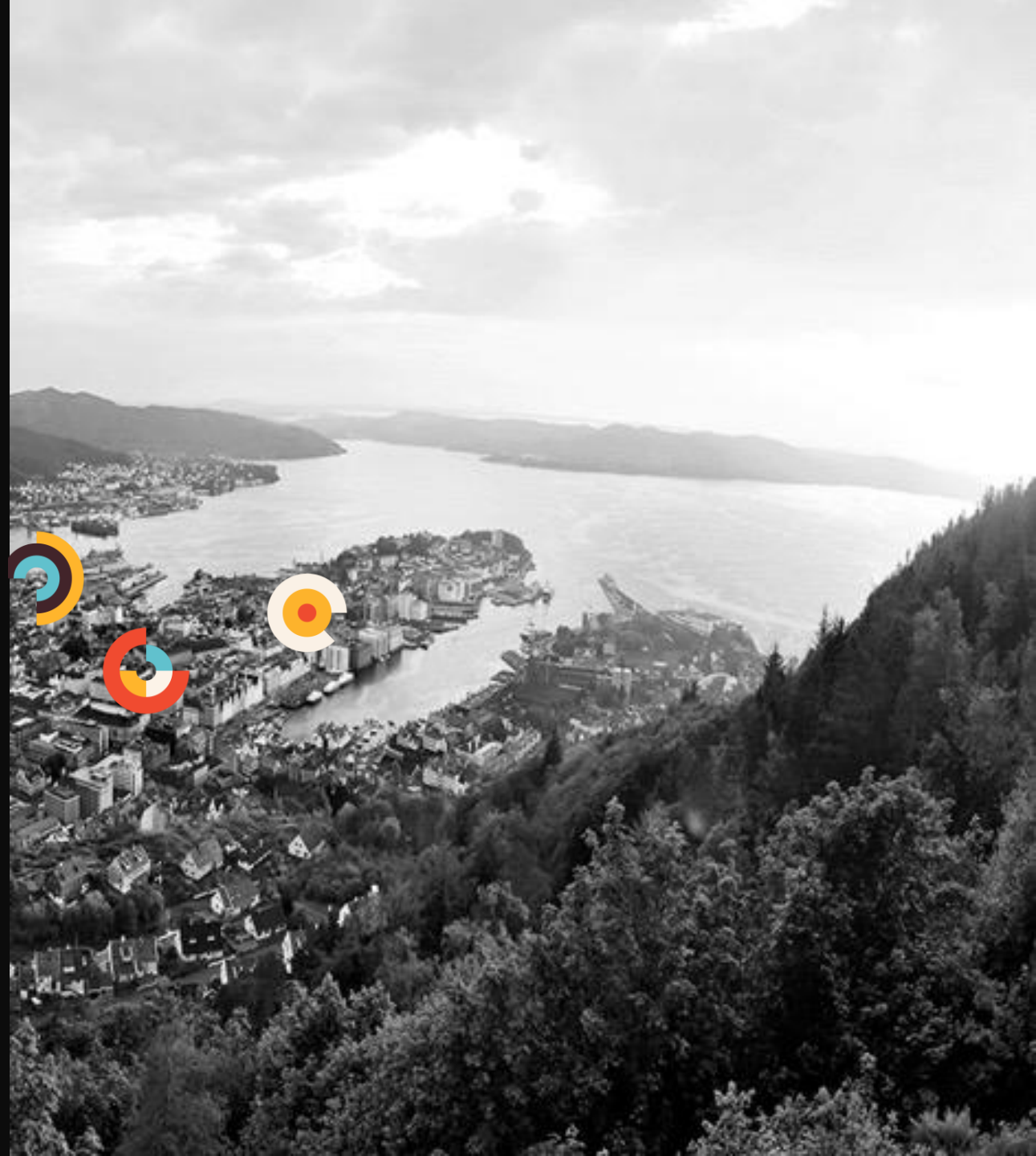
- Deployments require almost no planning
- Dynamic mesh routing delivers SLA over 99.9%
- License Free global Dect band
- Multi-gateway architecture, with no single point of failure
- Proven in the most demanding environments: Over 920,000 units in 1 single network

# ELVIA (largest utility in Norway)

## Smart meters

920 000 electricity meters in a single Wirepas Massive network in the greater Oslo area. World record in mesh size (x1000). Benefits for the utility:

- 100% coverage without base stations, repeaters or antennas.
- SLA >99.9%, higher than cellular networks.
- Future proof with over the air updates.
- >99% data free, only 1 out of 300 meters have a cellular modem for back haul.



# Buildings and Multi Dwelling Units

**Numerous uses cases** such as wireless condition monitoring system and HVAC, construction site management solution, smart locker, lighting control, occupancy analytics, smart tracking in hospitals


- 100% coverage across the building
- Sensing and control of the entire building in a single network
- Very limited number of gateways in the building
  - Every node is a low power router
- Automatic and secure provisioning of all devices
- In a license-free spectrum (no telecom fees)

# EMERGENCY LIGHTING

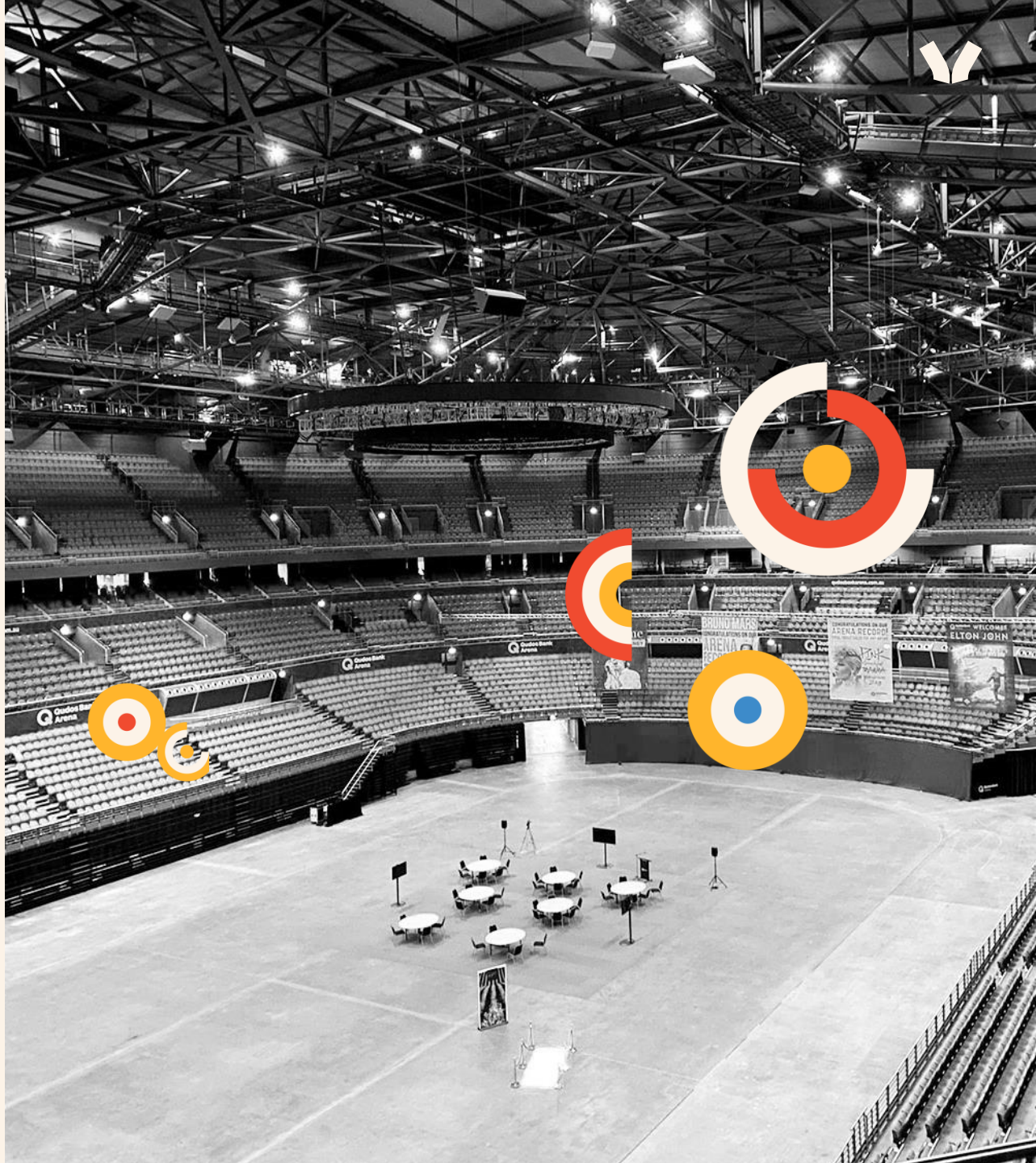
# Emergency lighting

Already 1000 sites have been deployed in a record time in Australia, New Zealand and the UK.

— Wirepas based emergency lighting only needs a single RF gateway – no extra infrastructure required

— Dynamic self-managed mesh makes the deployment extremely simple and reliable

— Qudos Bank Arena in Sydney: 2500 emergency lights now seamlessly connected. The system received building compliance in a record time.



# Why Dect nr+ for emergency lights?

- Easy installation and commissioning with automatic devices pairing.
- No limit in scale enabling a single emergency network for a complete building(s).
- Optimized maintenance & future-proof with Over the Air Update in all devices.
- High availability and reliability independent of the environment and conditions – no subnetworks or clusters.
- High energy efficiency for low-power battery-operated sensors.

# Value

## Easiest installation

Decentralized operation
No network manager – devices are the network

## Reliability & security

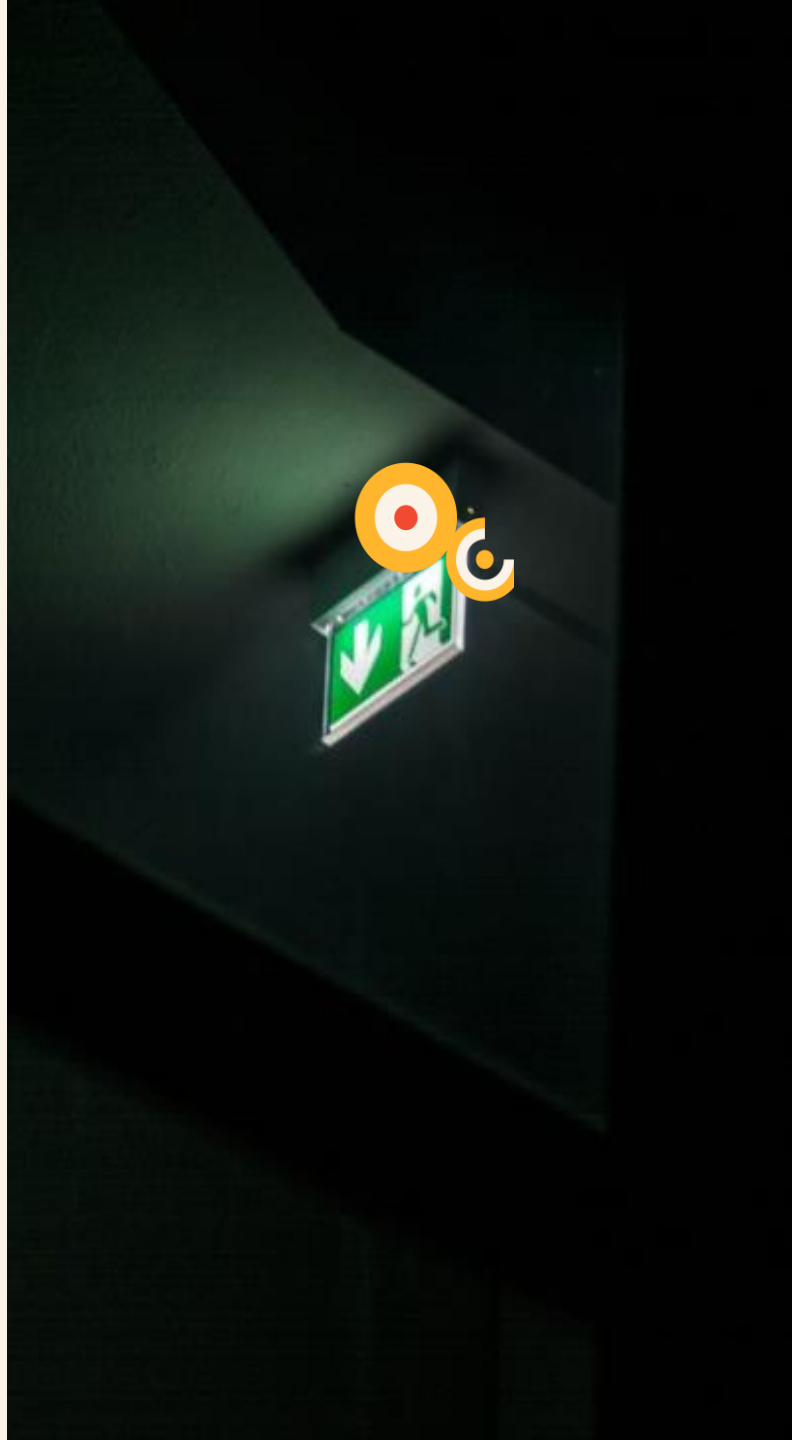
Hop by Hop acknowledgement
Encrypted communications
Self healing & No SPOF

## Lowest TCO and maintenance cost

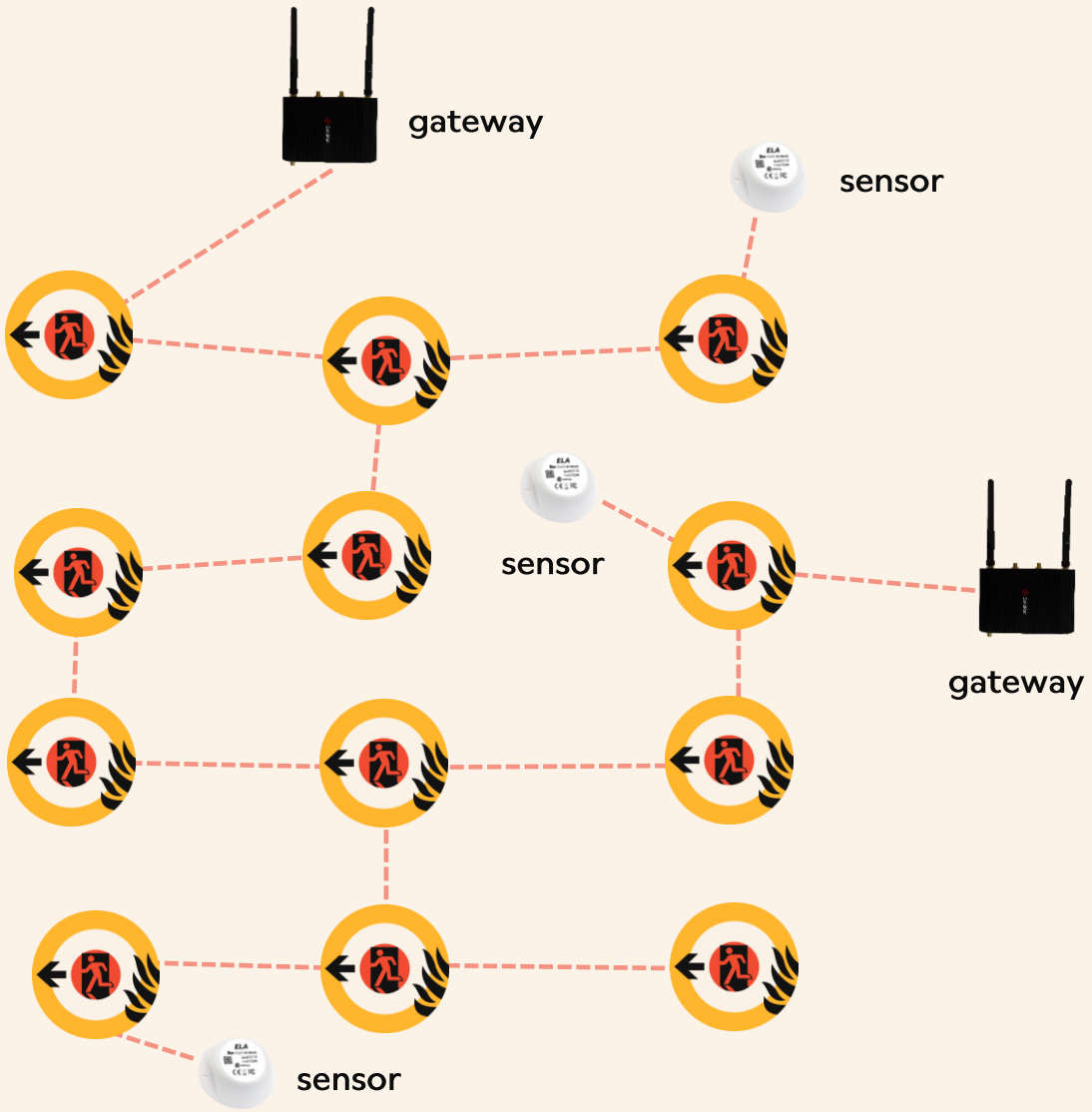
Built-in Over-The-Air update
Automatic provisioning

## Future proof

Fit for purpose performances
Multi-gateway network
Mixed mode



# Operating principle




- All signs and sensors **in the same Network no reliance on electrical network.**
- Automatic commissioning (plug & connect)
  - Any authenticated sign / sensor can join the network
- No single point of failure:
  - Any sign can be a router
  - No coordinator
  - Multi-gateway system
  - Guaranteed connectivity and reliability
- Ready to receive new additional battery-operated sensors