

# Introduction to DECT NR+

Nordic Tech Webinar

*Kristian Sæther / Product Manager*

*Martin Lesund / Technical Marketing Manager*

*June 15 2022*

# Today's hosts

Martin Lesund



Technical Marketing Manager

PMT



Kristian Sæther



Product Manager, Cellular IoT

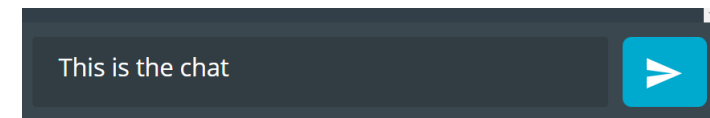
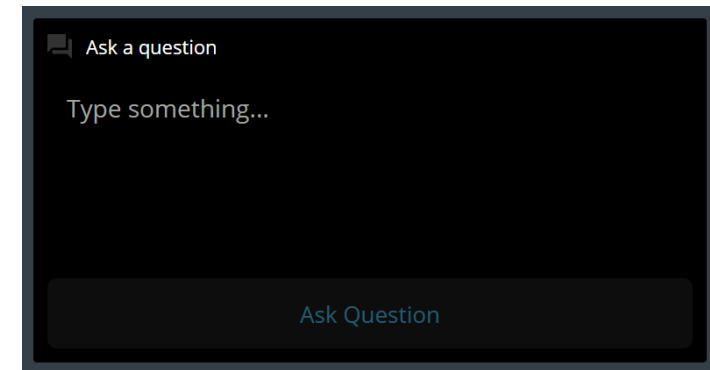
PMT



# Practicalities

- Duration: about 60 minutes
- Questions are encouraged!
  - Please type questions in the top of the right sidebar
  - All questions are anonymous
  - Try to keep them relevant to the topic
  - We will answer towards the end
- The chat is not anonymous, and should not be used for questions
- Go to DevZone if you have more questions after the webinar

A recording of the webinar will be available together with the presentation at [webinars.nordicsemi.com](https://webinars.nordicsemi.com)



# Agenda

- Beginning of DECT NR+
  - DECT forum developed what, why?
  - Added as a 5G standard as first non-cellular
  - Result is NR+, key features
- Where it fits in 5G triangle, what is 5G, where it fits compared to other competing technologies
- Use-cases and features
- Network protocol layers
- Benefits
- Nordic & NR+, what is Nordic doing with this technology



Overview part

# Expanding Existing Technology

Nordic strong contributor to new 5G, ETSI DECT-2020 NR standard



DECT 2020 reinvents the familiar DECT technology standardized by ETSI three decades ago. Supporting highly reliable low-latency connection between large numbers of densely-packed devices, it's a scalable, cost-effective solution for enterprise IoT and machine-to-machine applications including industrial automation, sensor networks, logistics and smart buildings.

## WORLD'S FIRST NON-CELLULAR 5G TECHNOLOGY, ETSI DECT-2020, GETS ITU-R APPROVAL

- Nordic is the main contributor to the physical layer and a key contributor to the medium access layer of the specification
- Leverage our cellular investments with the initial solution being built around the nRF91 Series
- In partnership with Wirepas, a Finnish massive IoT wireless solution SW specialist company.

# Key advantages

5G standard



Non-cellular 5G technology  
Meets the ITU-R  
mMTC and URLLC requirements

License-exempt



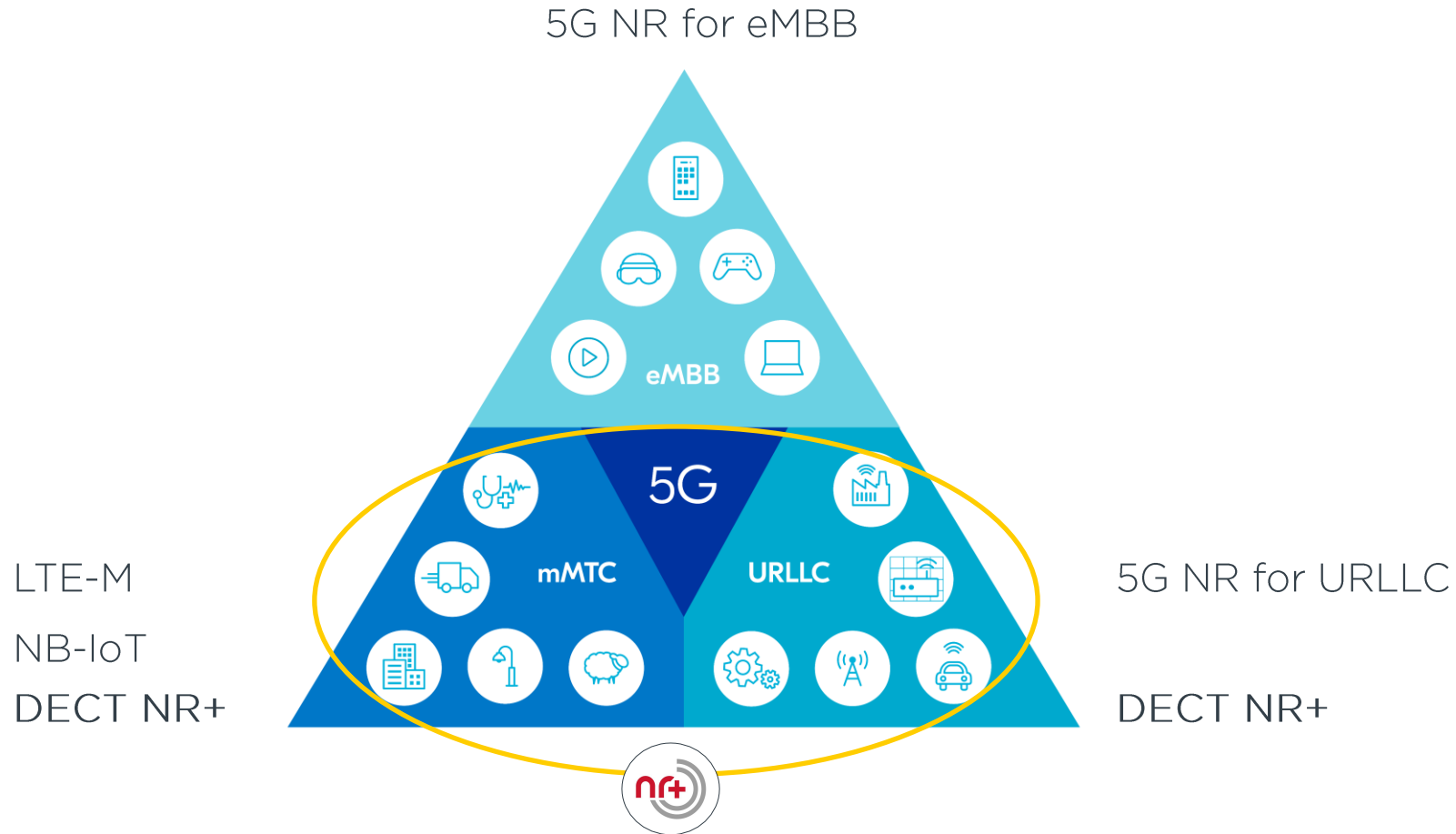
Operates on 1.9 GHz band  
Global and license-exempt

Reliable



Scaling from 100 to 1M nodes  
per sq-km  
Ultra-high >99.99% reliability  
built into the lower layer to  
offload application layers

# The 5G triangle (IMT-2020)



\*eMBB = enhanced Mobile Broadband

\*mMTC = massive Machine Type Communication

\*URLLC = Ultra Reliable Low Latency Communication



# NR+ Key Features

- 1.9 GHz License-exempt band
- P2P, Star- and Mesh network topologies
- Low latency operation
- High reliability built on proven cellular technology standards
- Scalable physical layer (*network size 4B devices & 16M networks*)
- Up-to-date security based on AES and CCM
- Ultra low power consumption devices



## Technical part

First non-cellular standard approved for 5G

# Dedicated NR+ Spectrum

- Allow for single products to be deployed worldwide
  - › Removing the cost of creating and maintaining product versions for different regions due to RF
- 1.9 GHz range including:
  - › 1880 MHz to 1900 MHz | Europe, South Africa, much of Asia, Hong Kong, Australia, and New Zealand
  - › 1900 MHz to 1920 MHz | Potential DECT Extension Band in Europe, under discussion at CEPT
  - › 1786 MHz to 1892 MHz | Korea
  - › 1880 MHz to 1895 MHz | Taiwan
  - › *1893 MHz to 1906 MHz* | *Japan, under discussion*
  - › 1910 MHz to 1920 MHz | Brazil
  - › 1910 MHz to 1930 MHz | Latin America excluding Brazil
  - › 1920 MHz to 1930 MHz | USA & Canada
  - › *1880 MHz to 1930 MHz* | *India - Legacy DECT only now, DECT NR+ not approved (yet)*
- NR+ provides coexistence with legacy DECT on the DECT band
- What about China?
  - › No DECT legacy band ~1.9 GHz today. Blocked and allocated to China Mobile for TD-SCDMA and for TD-LTE (TDD band)
  - › One option for China could be to start with the 2,4 GHz ISM band up to 10 dBm power.
  - › A separate DECT working group to influence China is in the making



1.9 GHz  
Global and license-free spectrum

# Applications

## Smart Industries



Large factories  
Warehouses  
Smart buildings  
Asset tracking  
Moving robotics

## Smart cities



Smart street lighting  
Parking  
Traffic management  
Bin collection

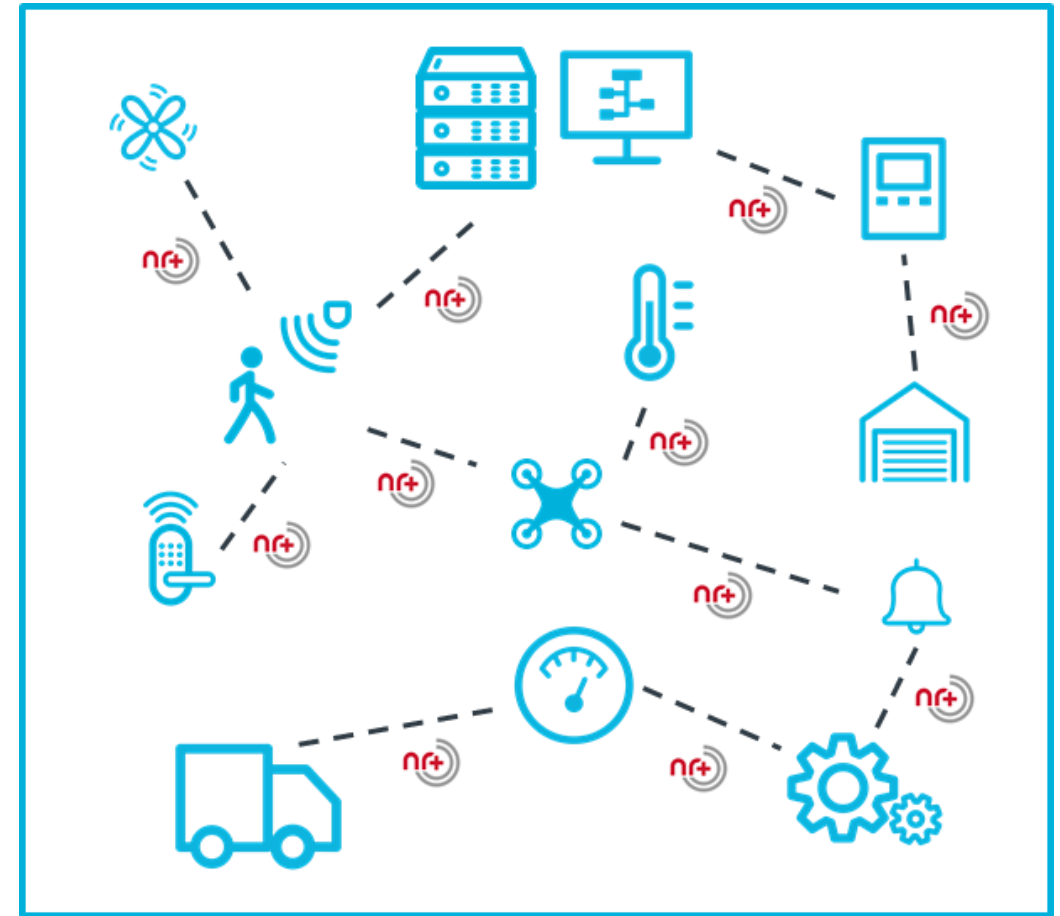
## Professional audio



Large arenas  
Stadiums  
High bitrates (for the same density) up to 24-bit prof. quality audio

# NR+ for Smart Industries

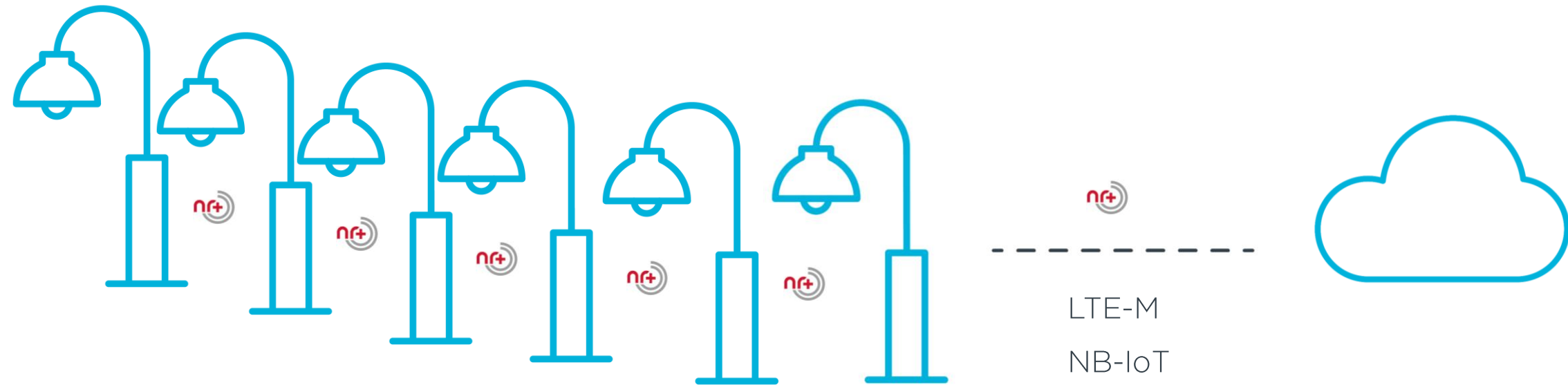
- Self-driving factory vehicles
- Massive amount of connected equipment
- Strict low latency requirements
- Self-healing and self-organizing properties
- Secure, private network



# NR+ for Smart City

## Smart Street Lights

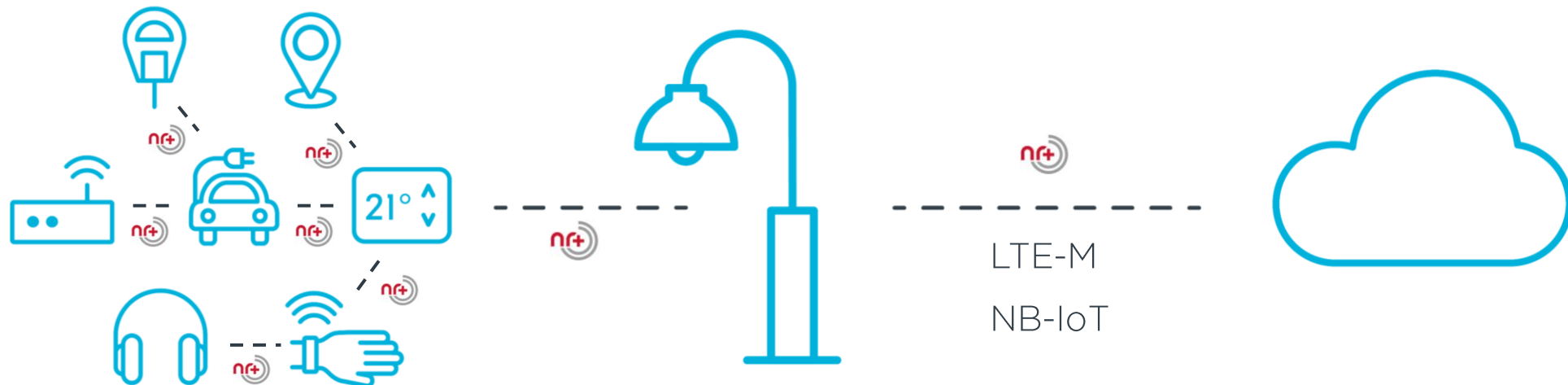
- Energy savings, dynamic light control, real-time diagnostics and maintenance
- Add more for smart city; environmental monitoring, camera, speaker, information



# NR+ for Smart City

## Smart Street Lights

- Scale city-wide using same network infrastructure





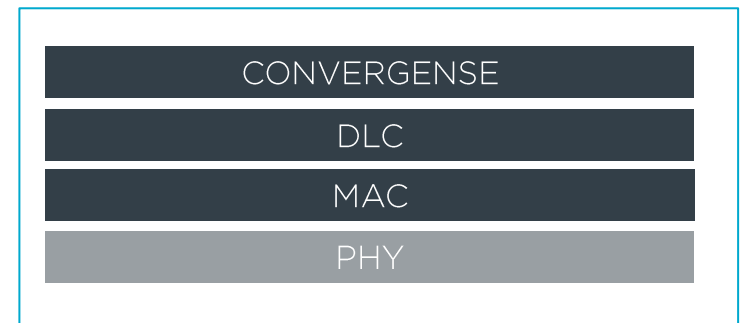


Network protocol layers



# NR+ Network Protocol Layers

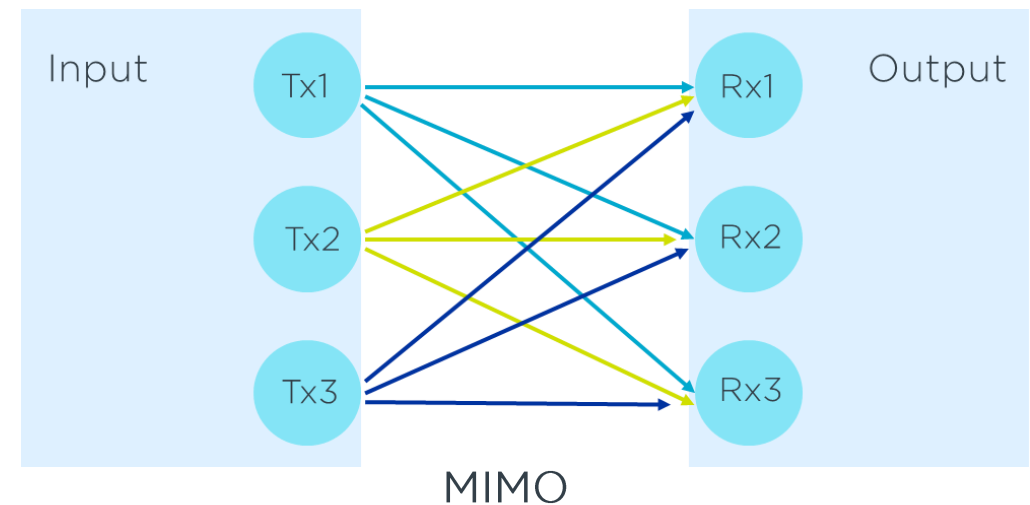
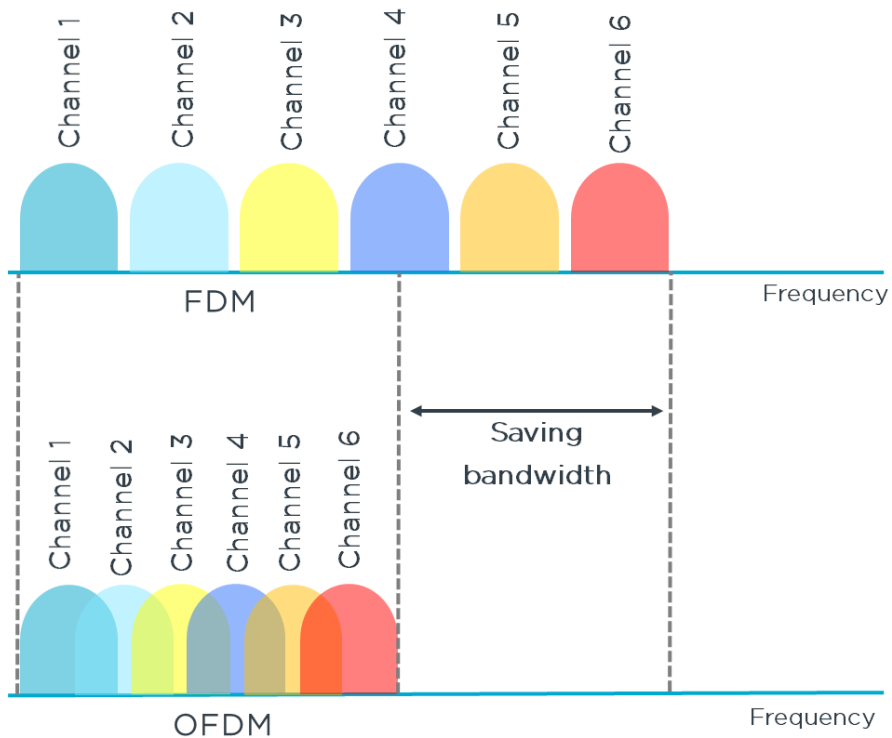
- Physical (PHY) layer
- Medium Access Control (MAC) layer
- Data Link Control (DLC) layer
- Convergence (CVG) layer



# NR+: Physical (PHY) layer

PHY

- Cycle prefix (OFDM) modulation for UL and DL (with MIMO support)
  - Resulting nominal bandwidth scaling from 1.728MHz, 3.456, 6.912, 13.824, 20.736, 27.648, 41.472, 55.296, 82.944, 110.592, 165.888, 221.184 MHz
  - Sub-carrier spacing (SCS) is scalable: 27kHz, 54kHz, 108kHz, 216kHz

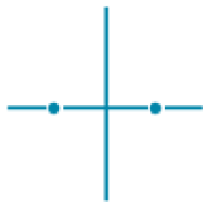


# NR+: Physical (PHY) layer

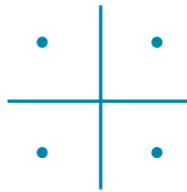
PHY

- Physical Data Channel (PDC) modulation supporting BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM, 1024-QAM
- With supporting “turbo coding rates”:  $\frac{1}{2}$ ,  $\frac{2}{3}$ ,  $\frac{3}{4}$ ,  $\frac{5}{6}$

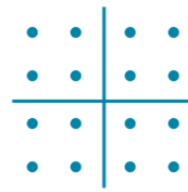
**BPSK**  
1 bits/symbol



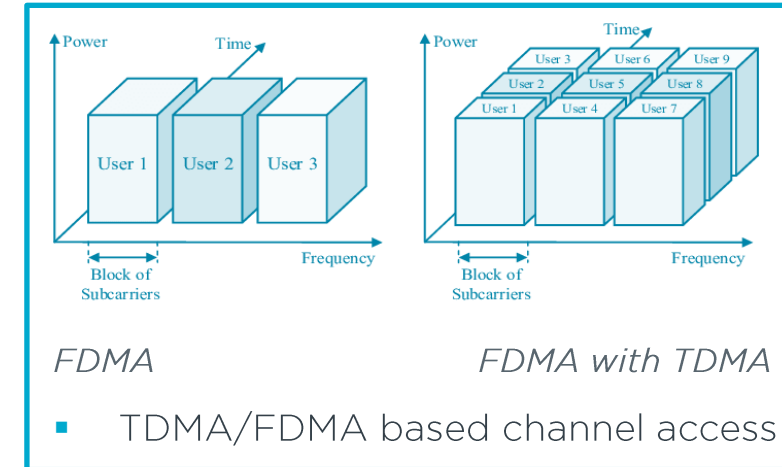
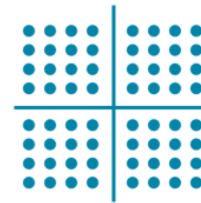
**QPSK**  
2 bits/symbol



**16QAM**  
4 bits/symbol



**64QAM**  
6 bits/symbol



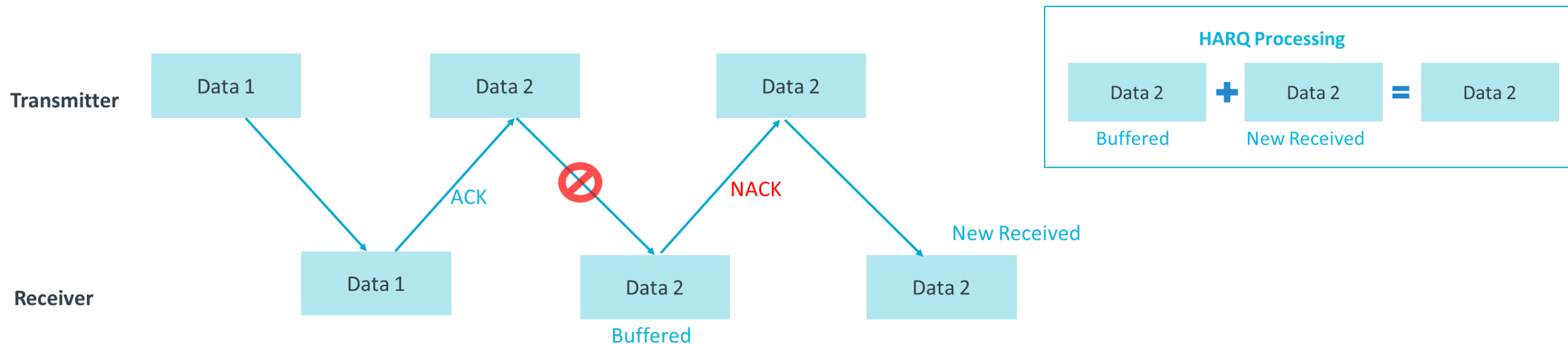
- High data rate scalability
  - Spec. scales up to 9Gbit/s data rate
  - Nordic's Initial plan is 3Mbit/s and optimized for low power devices



# NR+: Physical (PHY) layer

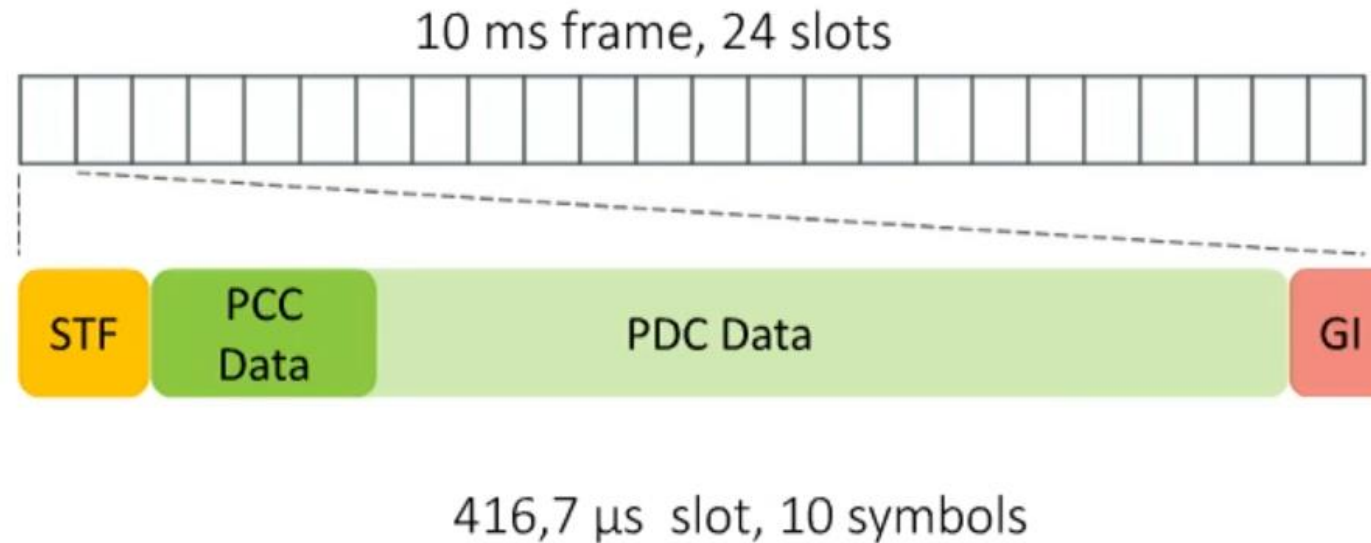
PHY

- Hybrid automatic repeat request (HARQ) methodology
  - HARQ retransmission latency < 417µs
- Improves reliability (*Supports up to 8 HARQ processes*)
- Higher protocol layers don't need to do retransmissions (saves resources)
- HARQ is used automatically for retransmissions of unicast connections



# NR+: Physical (PHY) layer

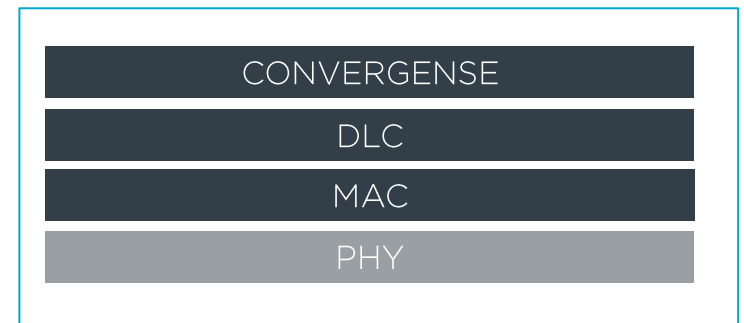
PHY



- Basic operating bandwidth channel is 1.728MHz
- Basic frame link is 10ms.
- Split into 24 time slots, which can be aggregated or split to sub-slots

# NR+ Network Protocol Layers

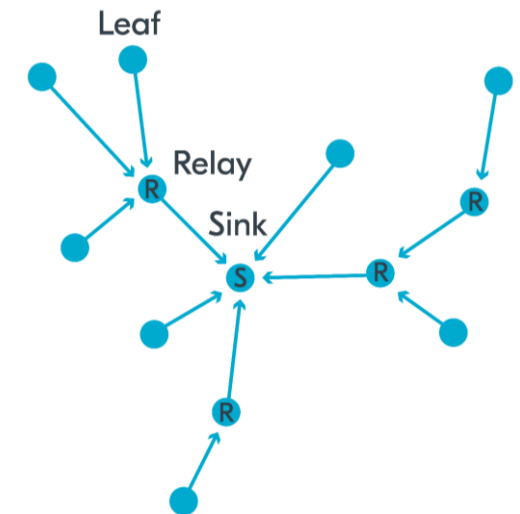
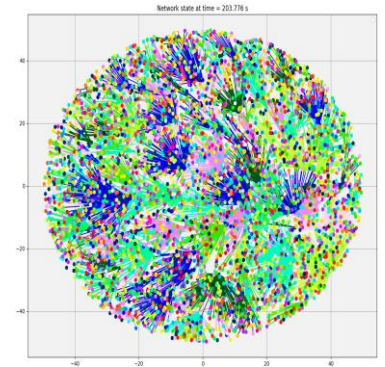
- Physical (PHY) layer
- Medium Access Control (MAC) layer
- Data Link Control (DLC) layer
- Convergence (CVG) layer



# NR+: MAC layer

- Point-to-point, star- and mesh network topologies supported
- Device roles can be appointed autonomously to support “Device provisioning”, “Self-organizing”, and “Self-healing” features
- Ultra high-density node networks ensured by the IDs construction:
  - Network ID (32-bit) enables 16,7M unique global NWs and 256 overlapping NWs in a radio area
  - Radio Device ID (48-bit) enables 4B unique RDs in a single NW and 65K within radio communication distance
- Special addresses are reserved for Broadcast and Backend traffic

MAC

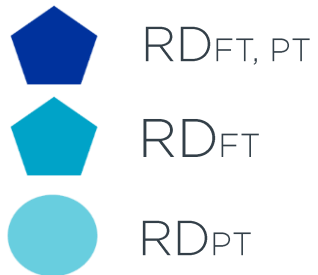


Simple NR+ Network

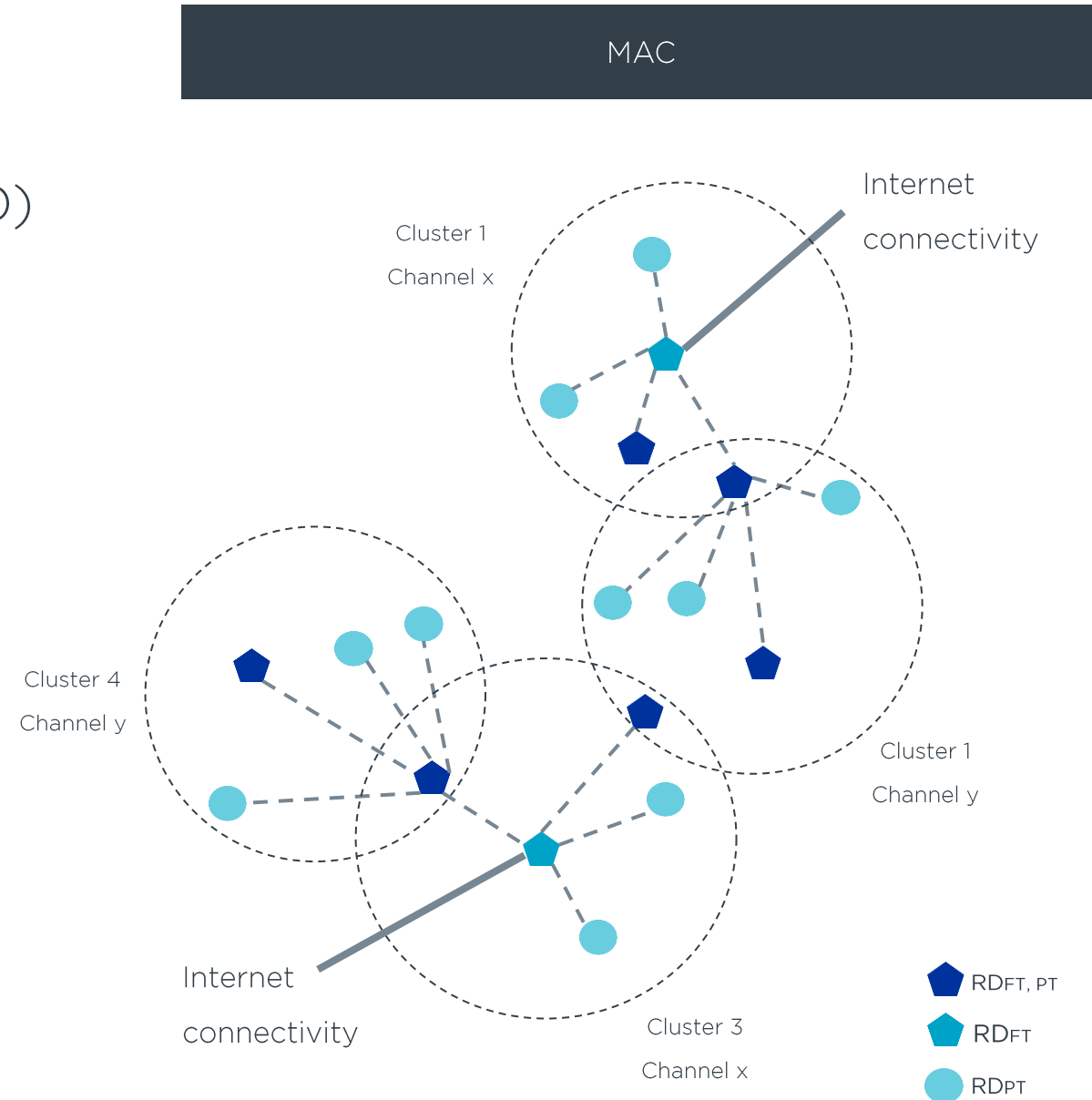
# Network Routing

- Operation modes of Radio Device (RD)
  - FT – Routing device to other clusters
  - PT – Data sending device

- An RD can be FT, PT or both



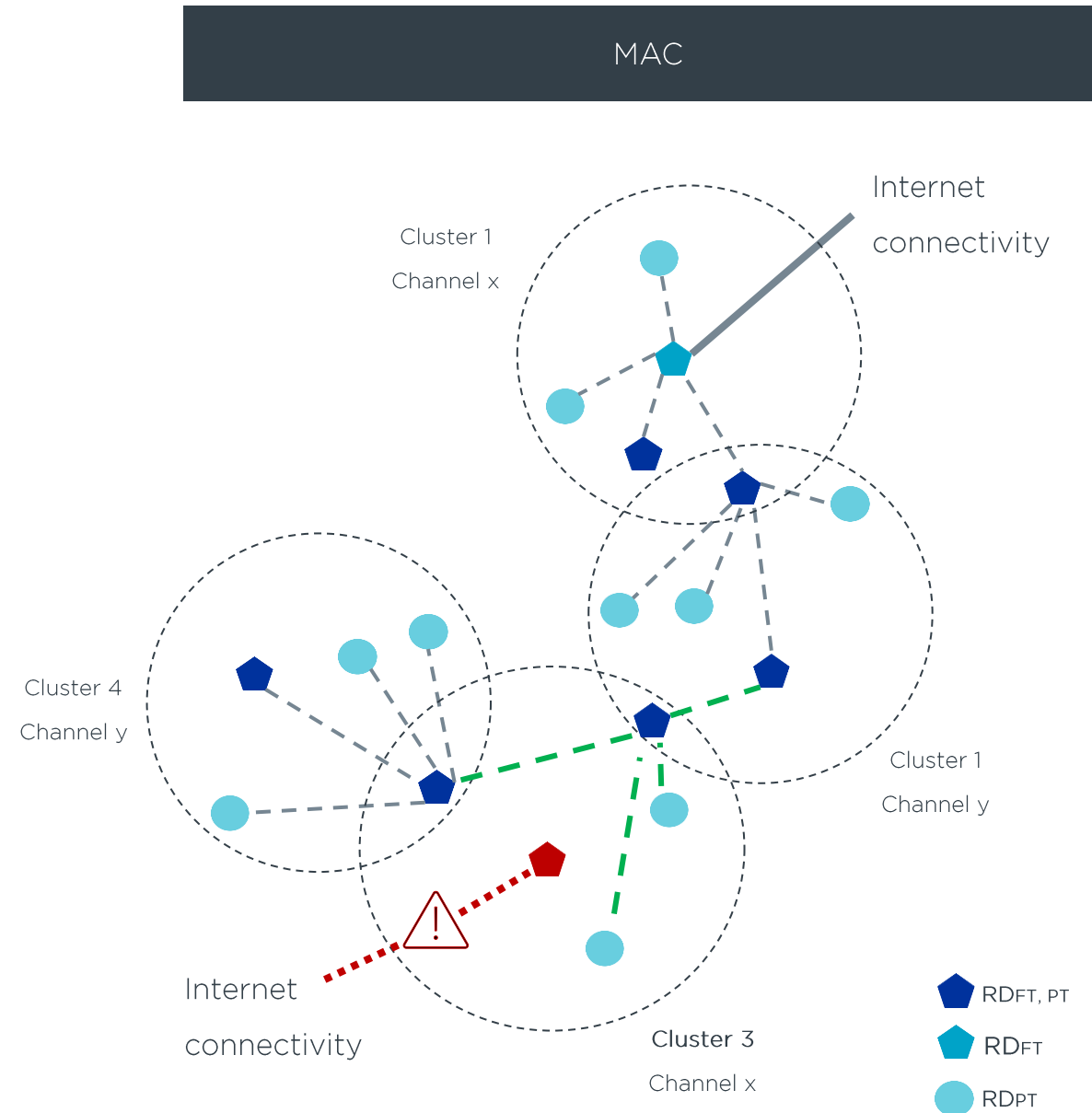
- FT = Fixed termination point
- PT = Portable termination point





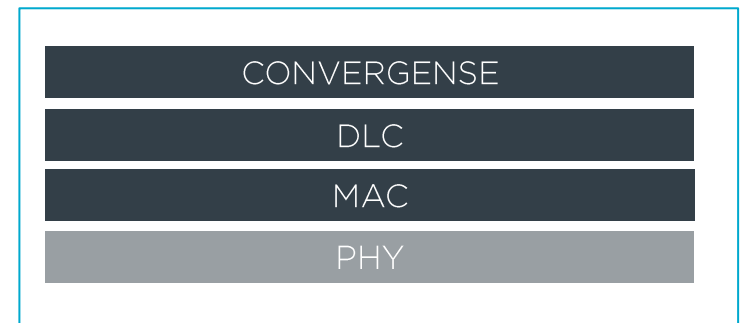
# Network Routing

- The Sink Radio Device in Cluster 3 is removed/disconnected
- The RDs will automatically re-route to the top Sink node, without interaction from application layer



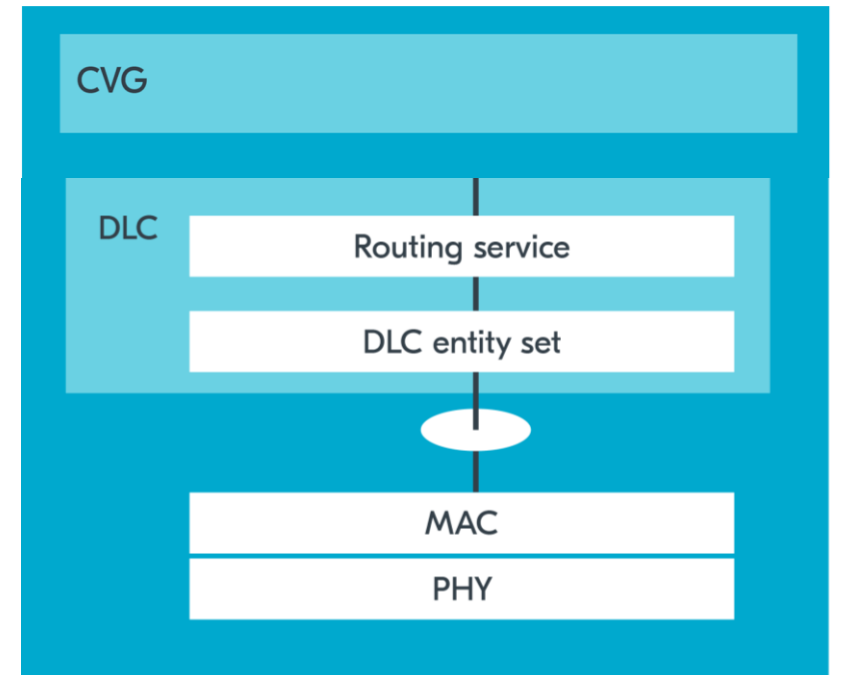
# NR+ Network Protocol Layers

- Physical (PHY) layer
- Medium Access Control (MAC) layer
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- Convergence (CVG) layer



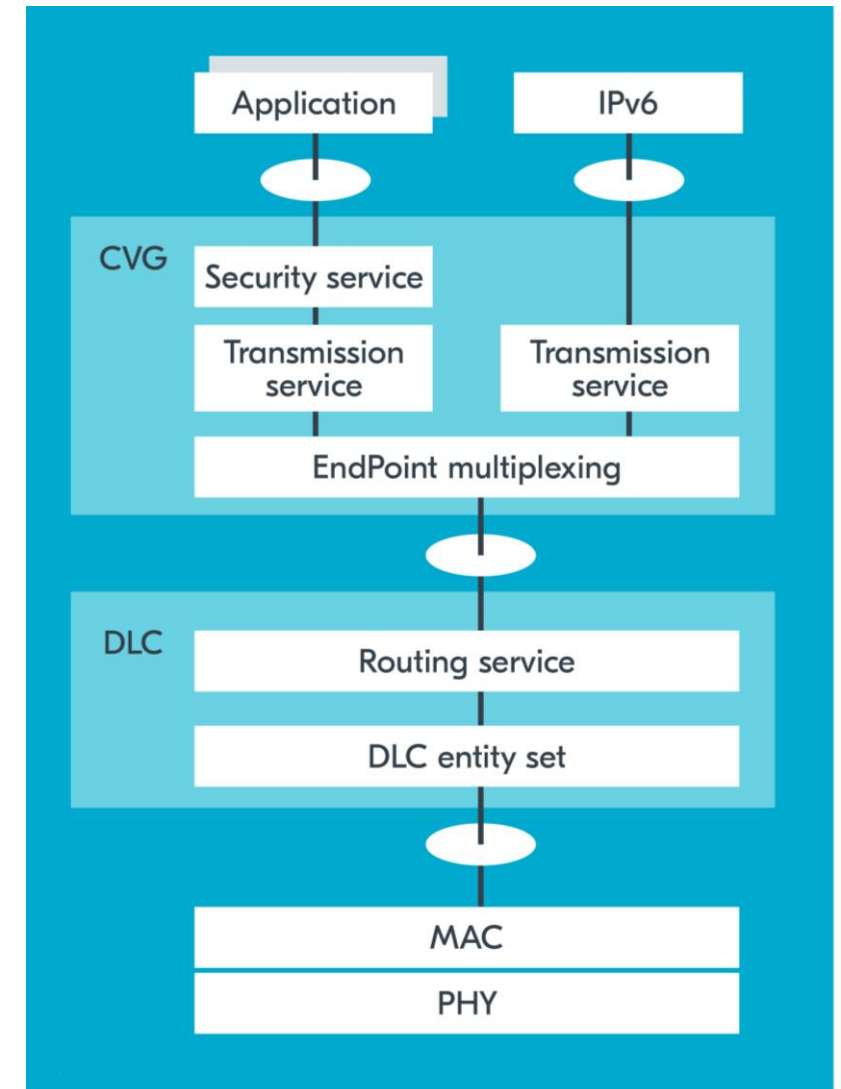
# NR+: Data Link Control (DLC) layer

- DLC Provides the necessary segmentation and packet routing functions for the MAC layer

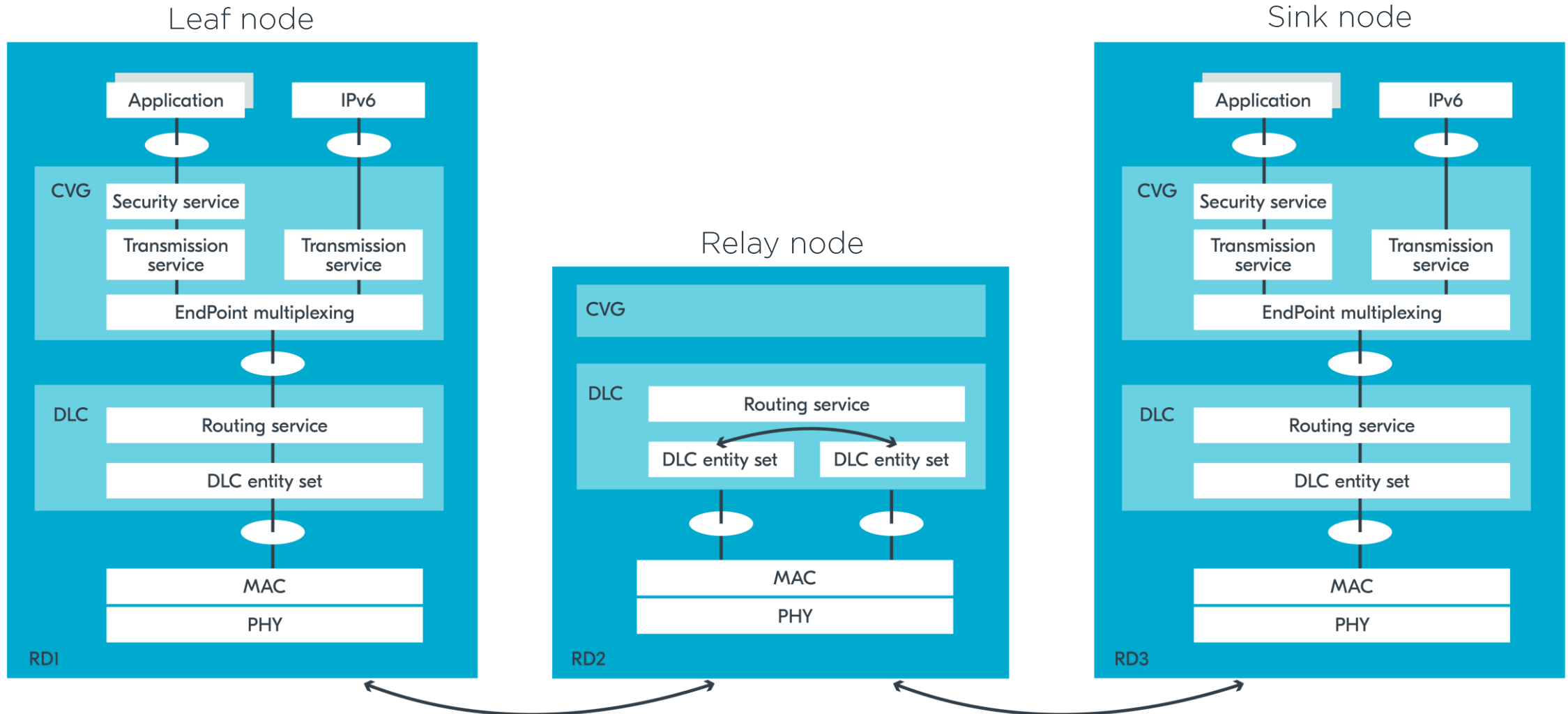


# NR+: Convergence (CVG) layer

- CVG provides adaptation functions between the application layer protocols and the NR+ radio interface
  - Security service with ciphering and integrity protection
  - Transmission service with segmentation and reassembly, retransmission, flow control, lifetime control, duplicate removal, delivery order service
  - Endpoint multiplexing service



# Network Architecture of a Mesh topology configuration





# Official specification

## DECT-2020 New Radio (NR) Specification (Release 1)

- [Part 1: Overview](#)
- [Part 2: Radio reception and transmission requirements](#)
- [Part 3: Physical layer](#)
- [Part 4: MAC layer](#)
- [Part 5: DLC and Convergence layers](#)
  
- [Final Evaluation report on DECT-2020 NR](#)

# Key advantages



Self-healing



Decentralized



License-exempt



Global spectrum



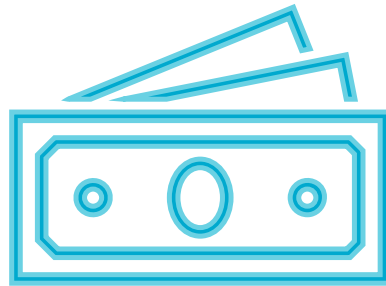
Ultra-low latency



Highly scalable

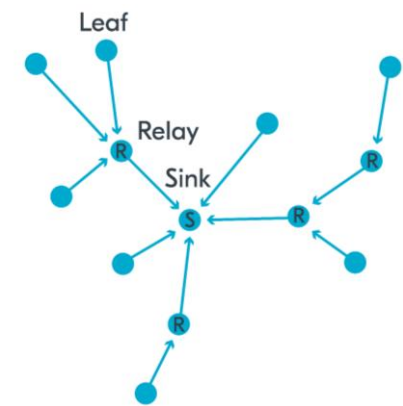
# Benefits

## Low cost of ownership



- No base stations
- No SIM needed
- No subscription
- Easy install

## Scalable & reliable



- No single point of failure
- Completely autonomous
- Years of battery life
- Secure
- Over the Air updates

Scaling from 100 to 1M nodes per sq-km



# Nordic and NR+ Summary

## WHY

NR+ is the big missing piece in IoT: A new 5G standard for mMTC and URLLC using a global license-exempt spectrum.

## HOW

Build on the existing nRF91 Series in partnership with Wirepas to create the first complete NR+ solution together



## WHEN

First Nordic products will be available in 2023

Follow Nordic NR+ here: <https://www.nordicsemi.com/Products/DECT-NR>

Subscribe to news here: <https://response.nordicsemi.com/subscribe-to-our-newsletters>

Q&A

# Comparing vs. other short-range wireless

	Reliability	Security	Bandwidth	Range	Future Proofing
NR+	High	Medium	Medium to High	High	High
Wi-Fi	Medium	Medium	High	Medium	Medium
Bluetooth	Medium	Medium	Low	Low	Medium
802.15.4	Medium	Medium	Low to Medium	Medium	Medium
ISM RF	Low	Low	Medium	Low	Low

Source: [ABI Research](#)