

Introduction to DECT NR+

Nordic Tech Webinar

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Martin Lesund / Technical Marketing Manager

June 15 2022

Today's hosts

Martin Lesund



Technical Marketing Manager

PMT



Kristian Sæther



Product Manager, Cellular IoT

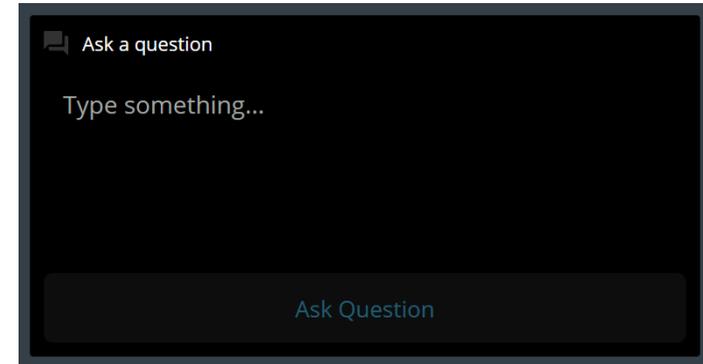
PMT



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



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



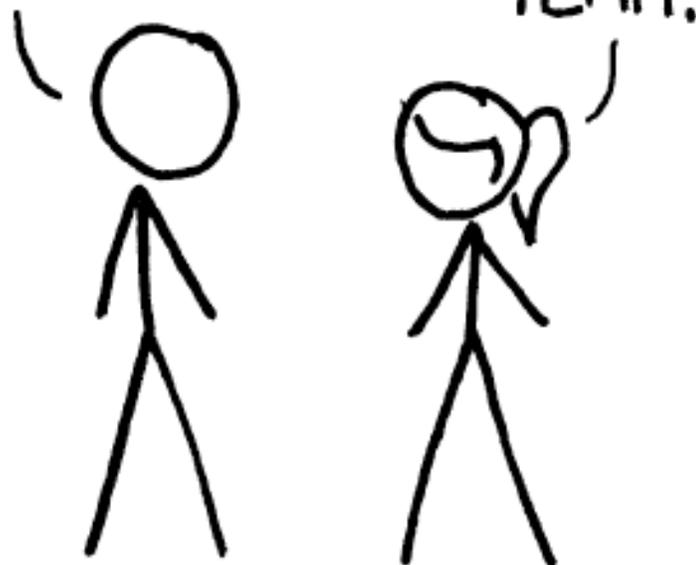
Overview part

HOW STANDARDS PROLIFERATE:

(SEE: A/C CHARGERS, CHARACTER ENCODINGS, INSTANT MESSAGING, ETC.)

SITUATION:
THERE ARE
14 COMPETING
STANDARDS.

14?! RIDICULOUS!
WE NEED TO DEVELOP
ONE UNIVERSAL STANDARD
THAT COVERS EVERYONE'S
USE CASES.



SOON:

SITUATION:
THERE ARE
15 COMPETING
STANDARDS.



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



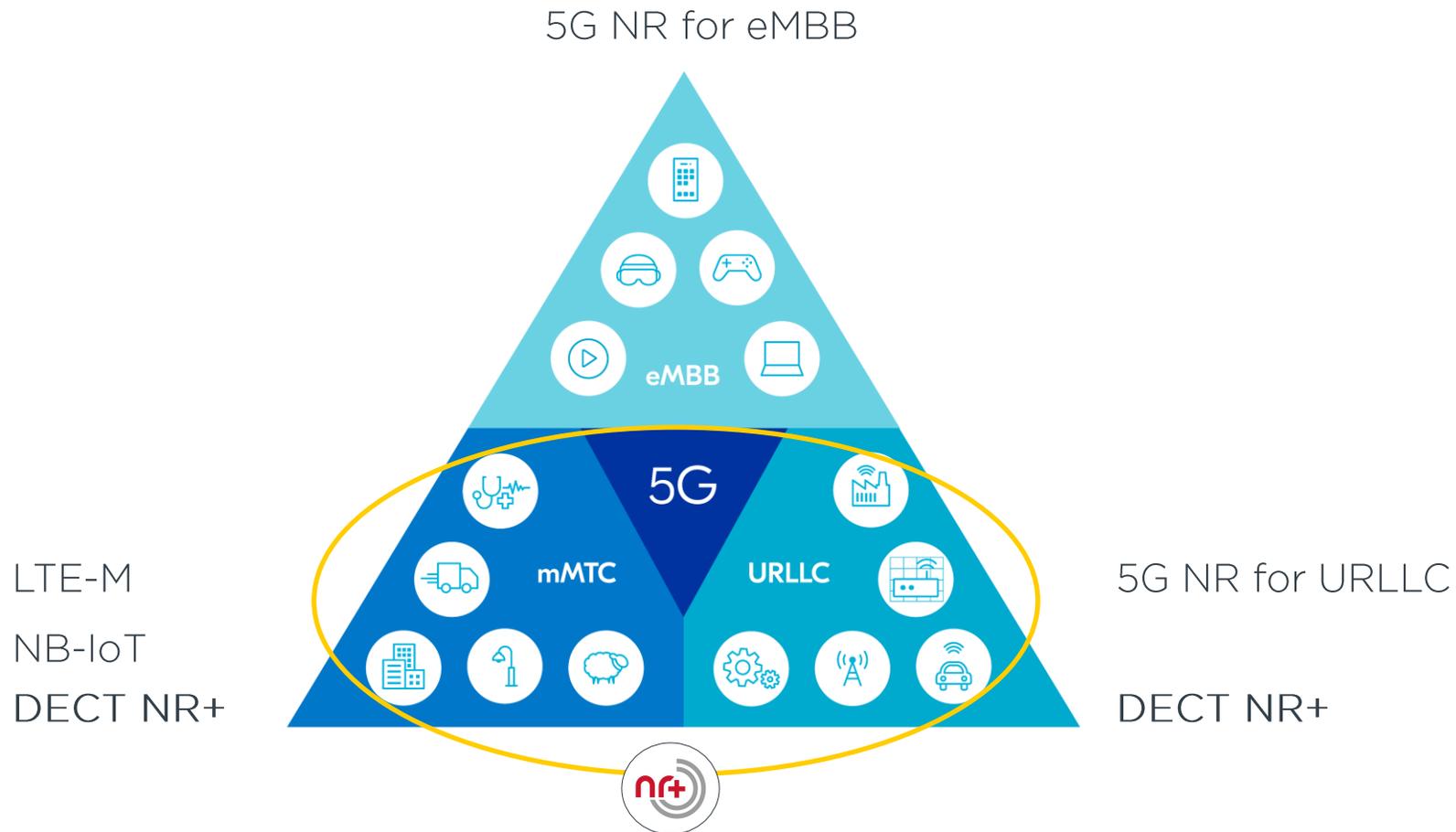
Operates on 1.9 GHz band
Global and license-exempt

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

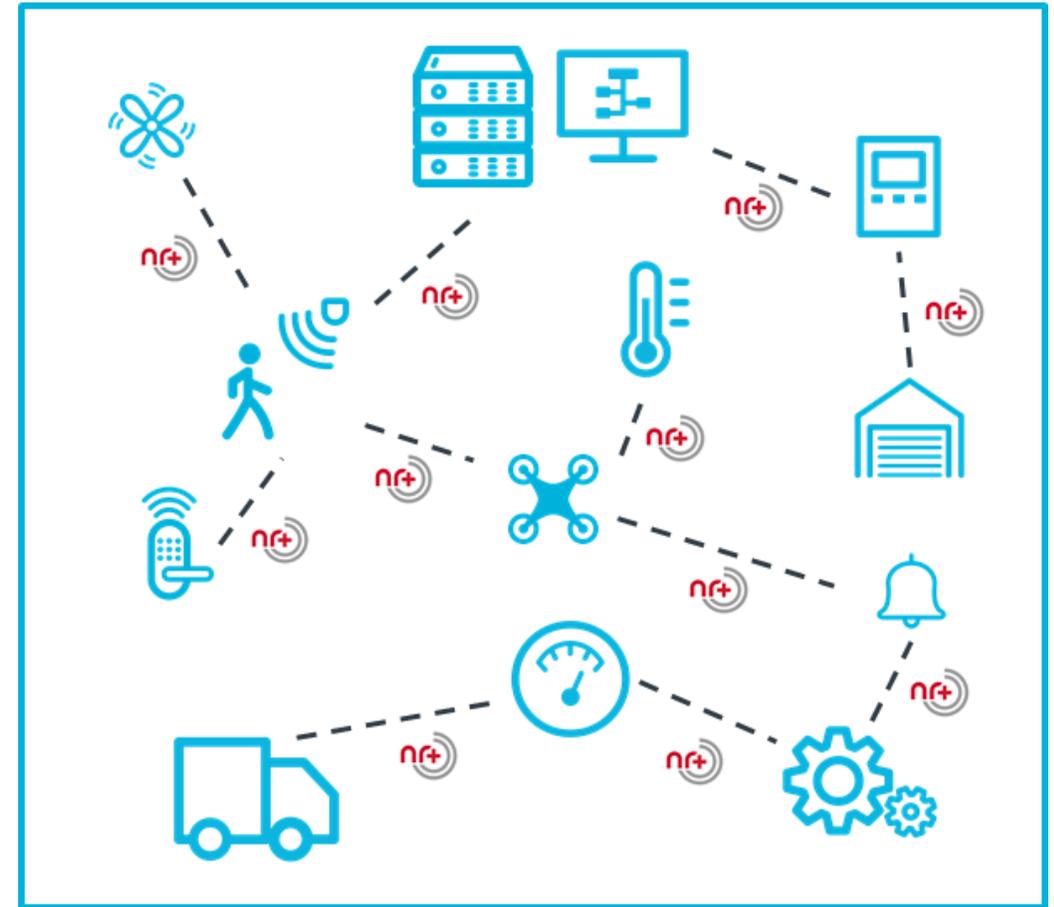
Professional audio



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

NR+ for Smart Industries

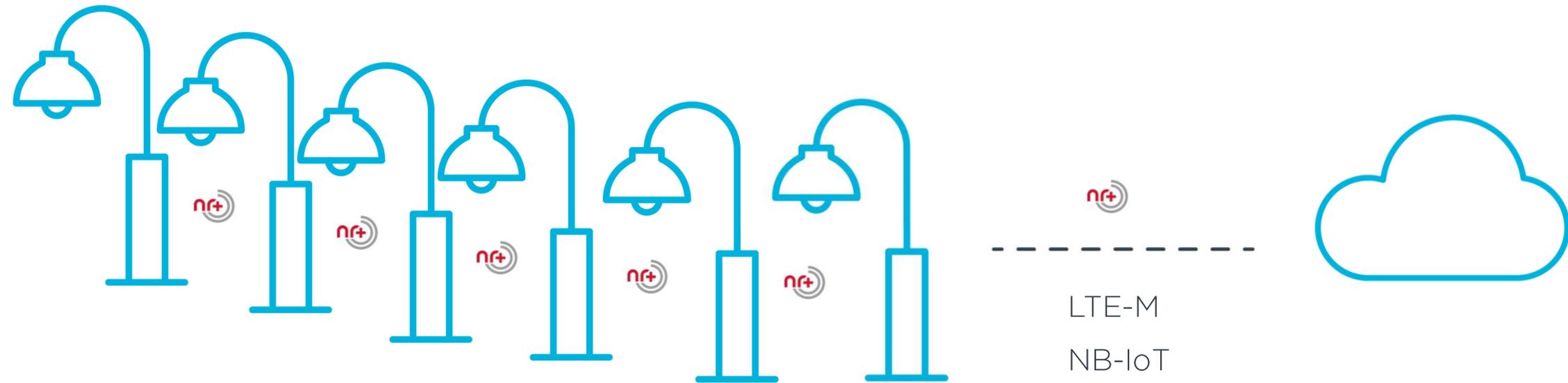
- Self-driving factory vehicles
- Massive amount of connected equipment
- Strict low latency requirements
- Self-healing and self-organizing properties
- Secure, private network



NR+ for Smart City

Smart Street Lights

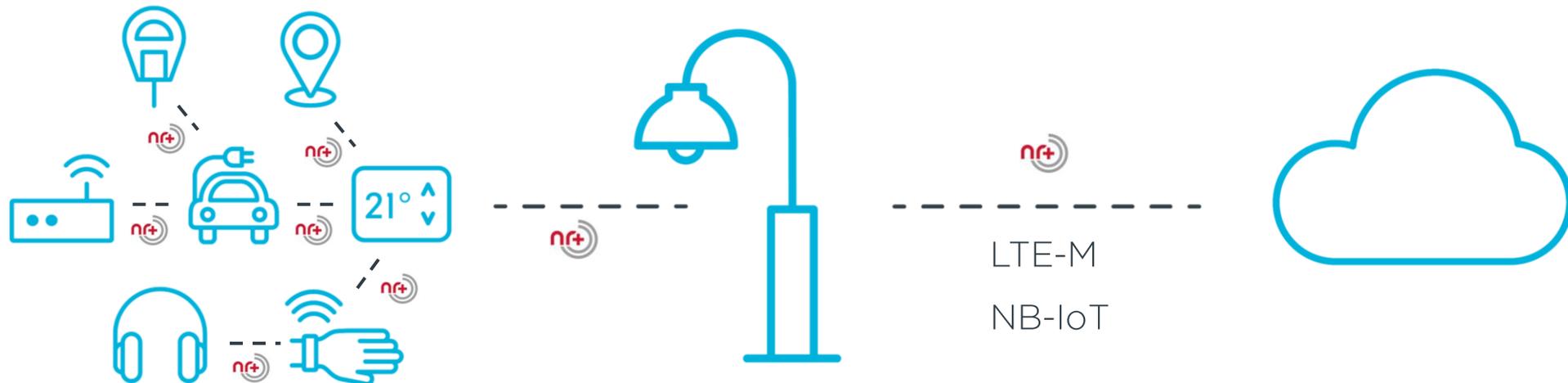
- Energy savings, dynamic light control, real-time diagnostics and maintenance
- Add more for smart city; environmental monitoring, camera, speaker, information

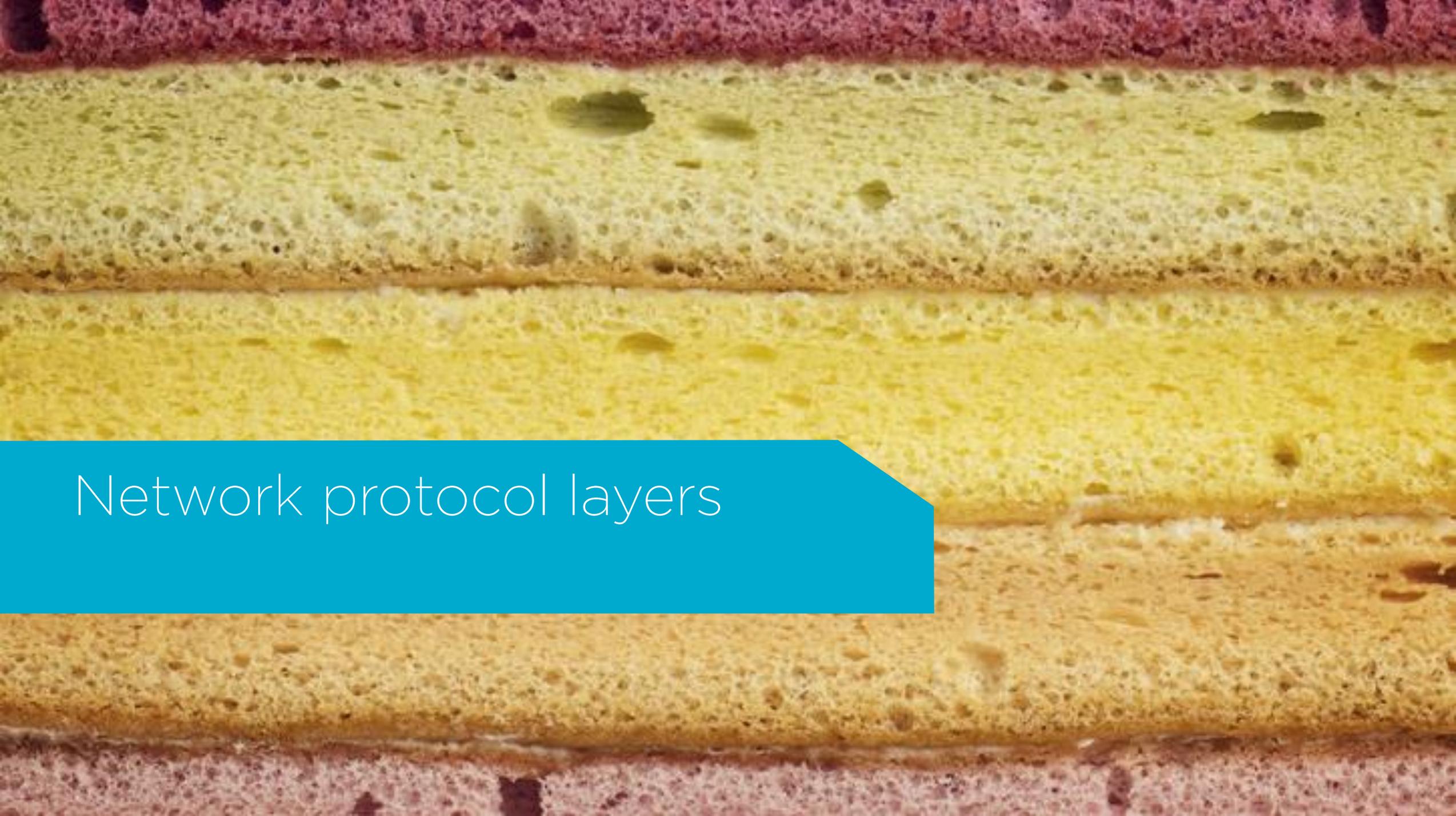


NR+ for Smart City

Smart Street Lights

- Scale city-wide using same network infrastructure

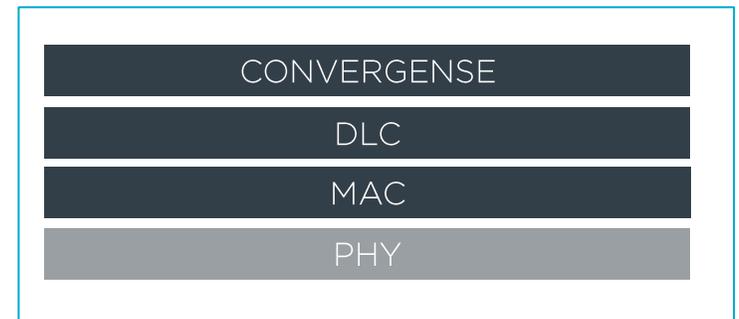




Network protocol layers

NR+ Network Protocol Layers

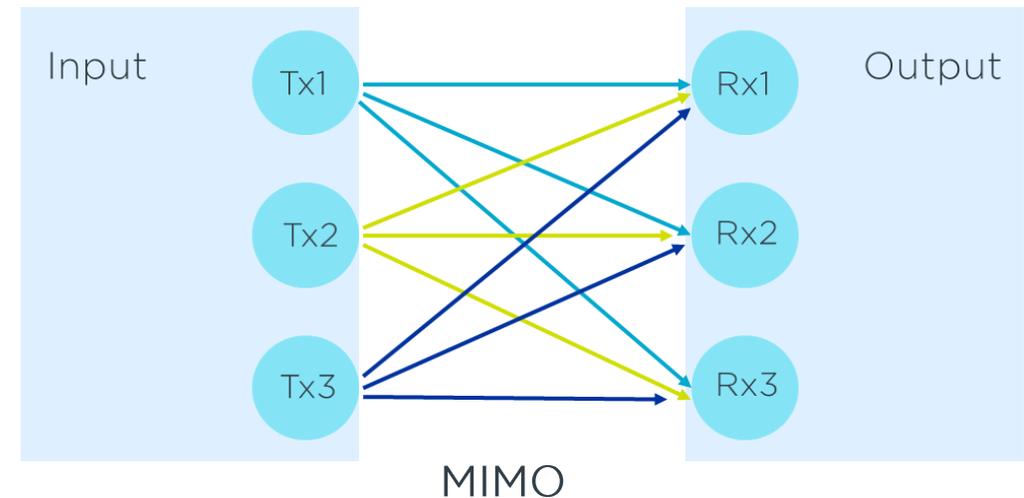
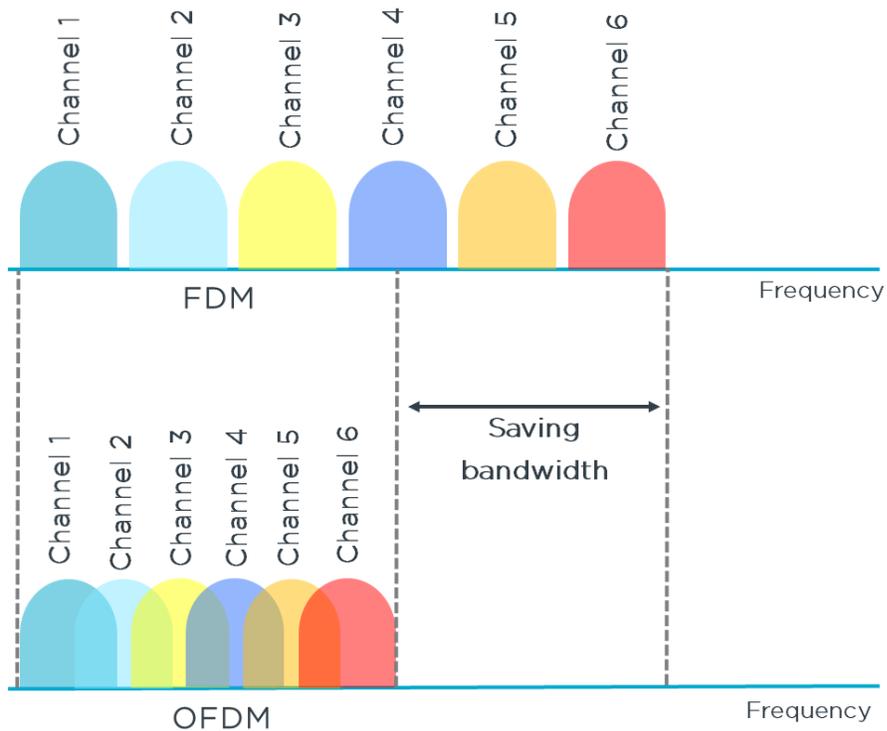
- Physical (PHY) layer
- Medium Access Control (MAC) layer
- Data Link Control (DLC) layer
- Convergence (CVG) layer



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

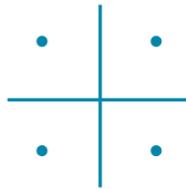
PHY

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

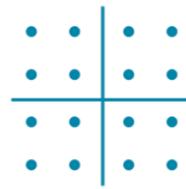
BPSK
1 bits/symbol



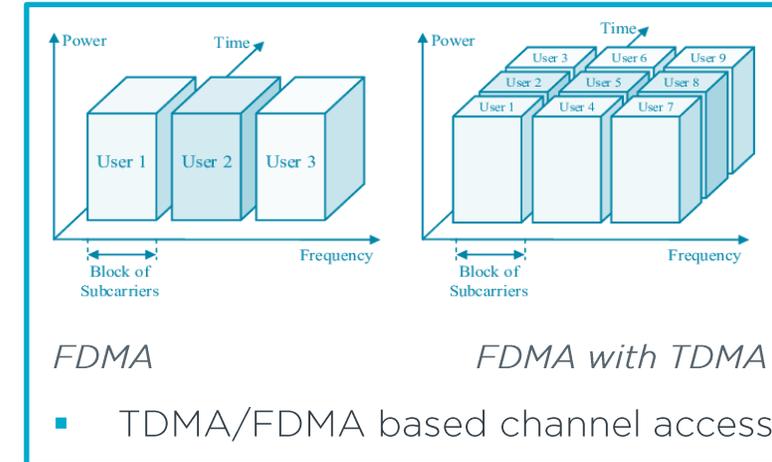
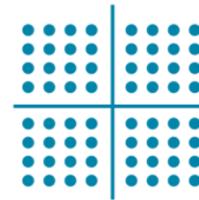
QPSK
2 bits/symbol



16QAM
4 bits/symbol



64QAM
6 bits/symbol



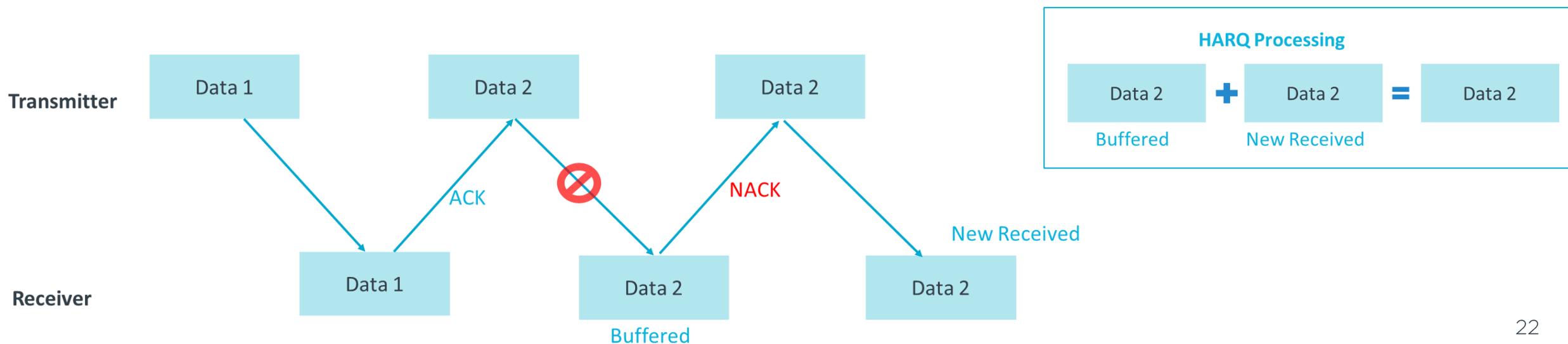
- High data rate scalability
 - Spec. scales up to 9Gbit/s data rate
 - Nordic's Initial plan is 3Mbit/s and optimized for low power devices



NR+: Physical (PHY) layer

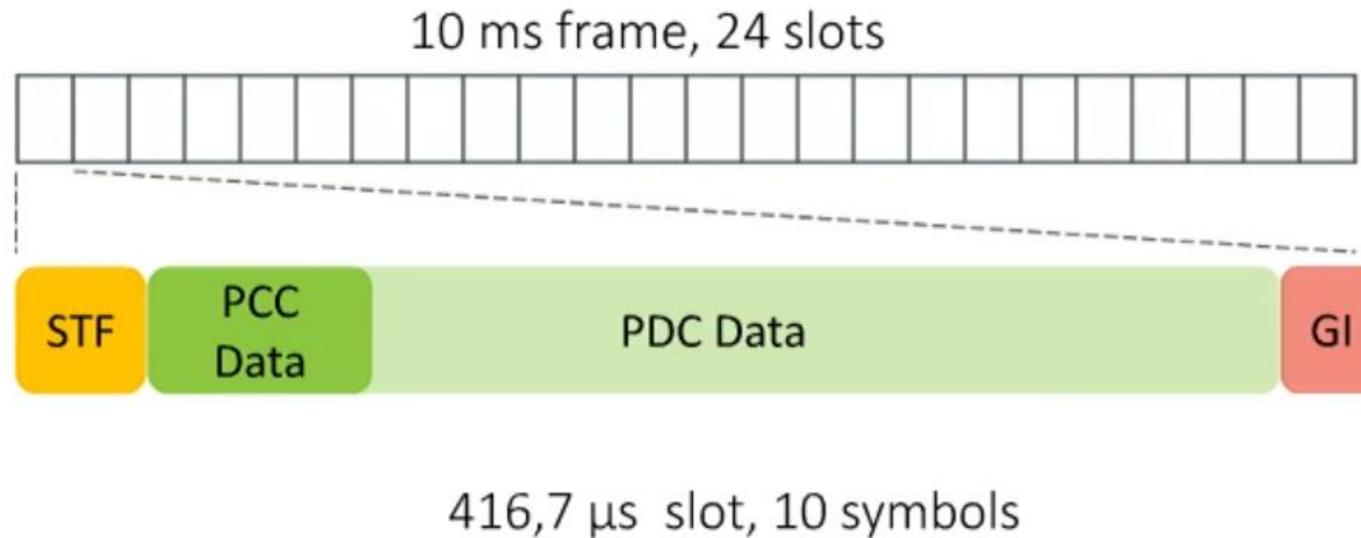
PHY

- 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

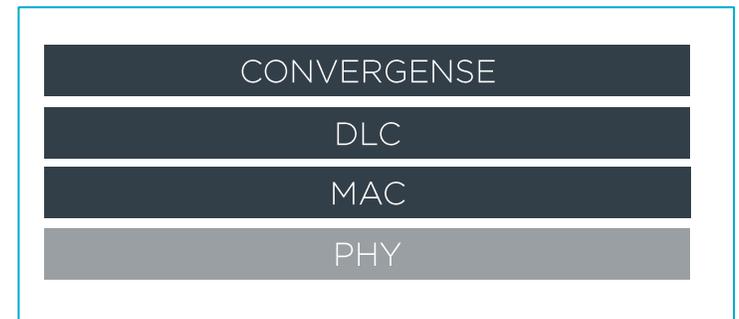
PHY



- 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

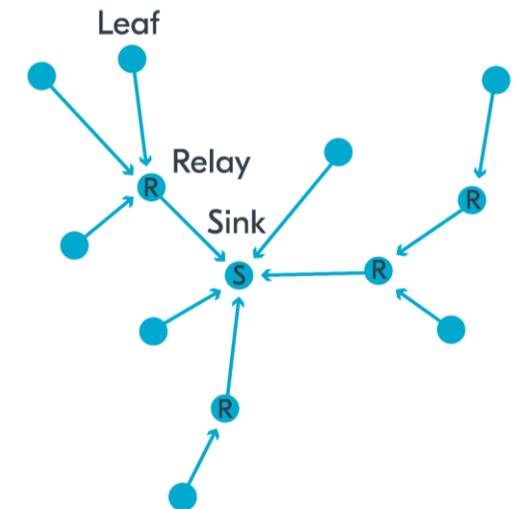
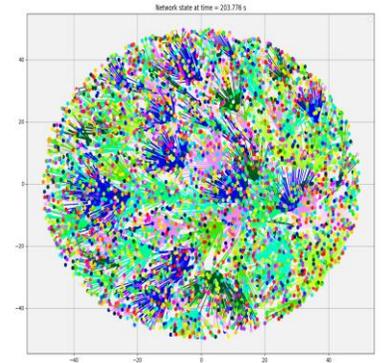
- Physical (PHY) layer
- Medium Access Control (MAC) layer
- Data Link Control (DLC) layer
- Convergence (CVG) layer



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

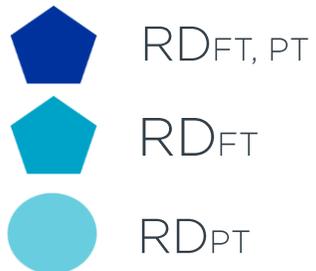


Simple NR+ Network

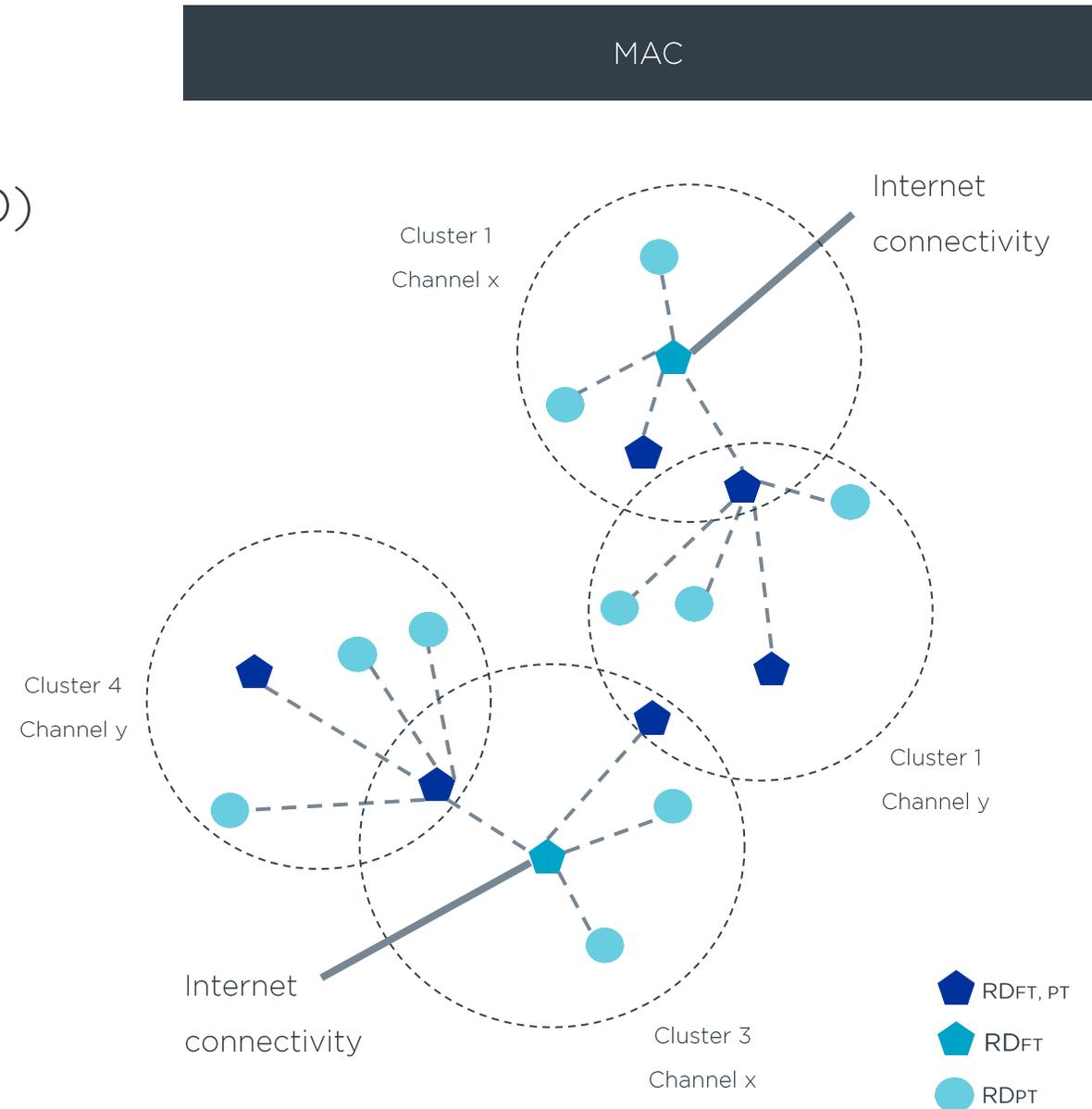
Network Routing

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

- An RD can be FT, PT or both

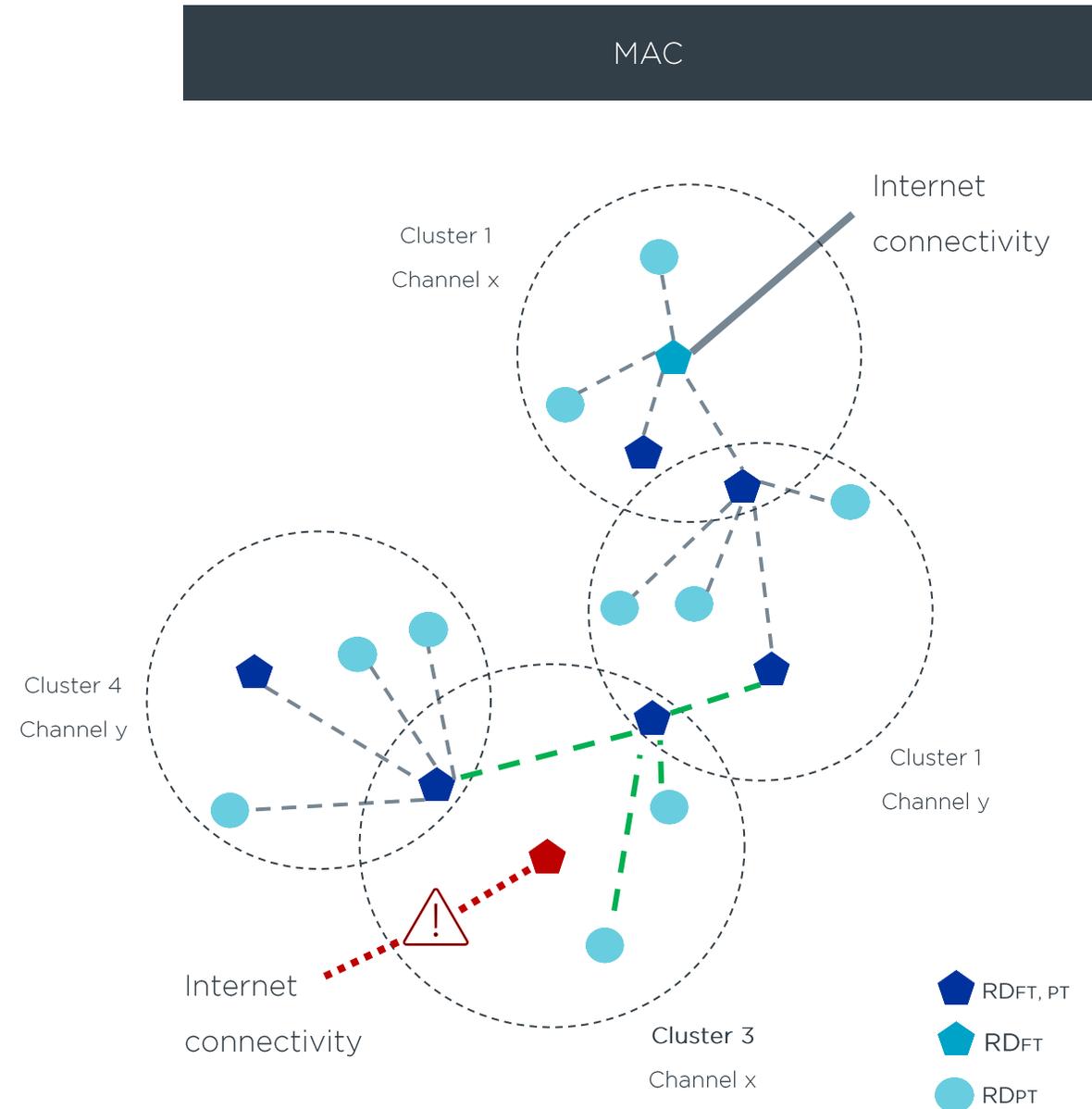


- FT = Fixed termination point
- PT = Portable termination point



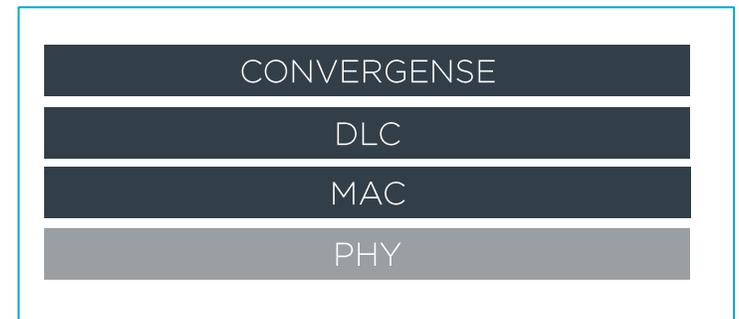
Network Routing

- 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



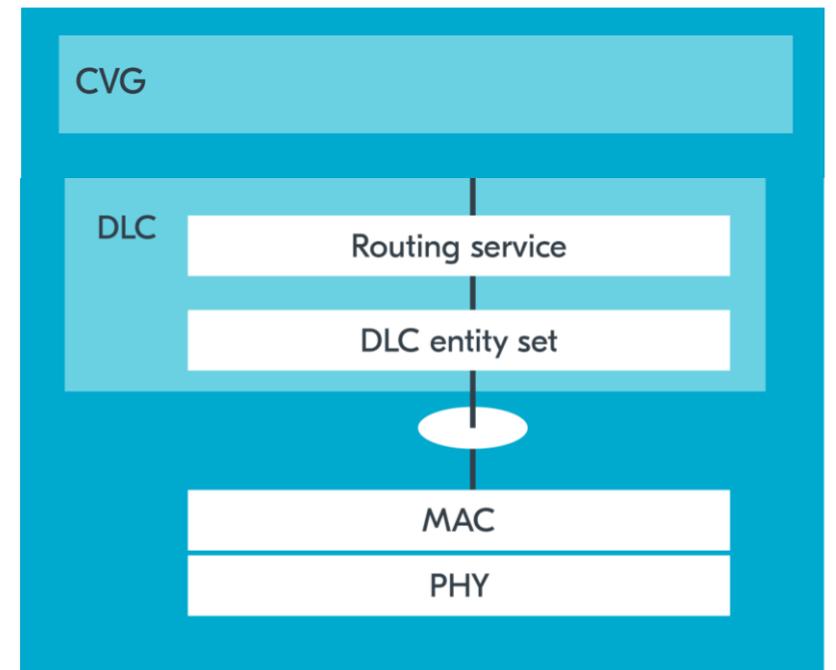
NR+ Network Protocol Layers

- Physical (PHY) layer
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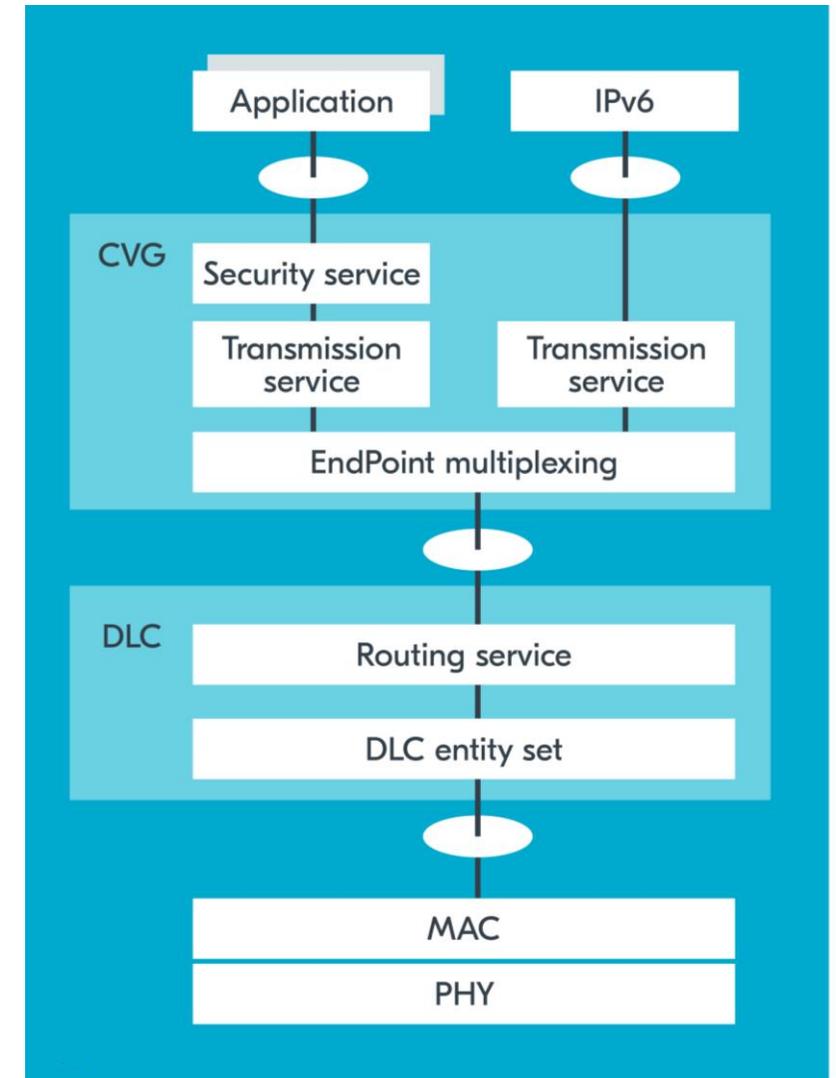
NR+: Data Link Control (DLC) layer

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

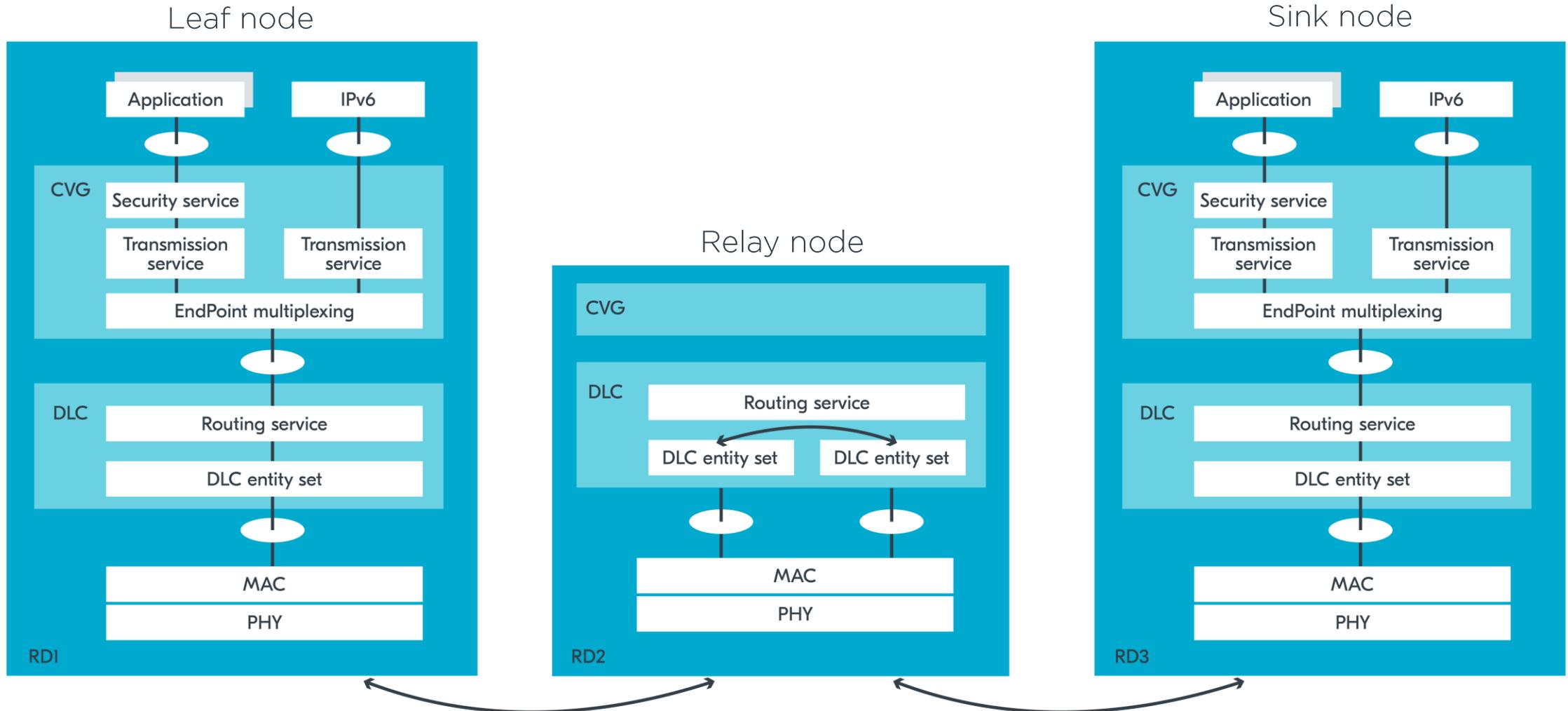


NR+: Convergence (CVG) layer

- 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)

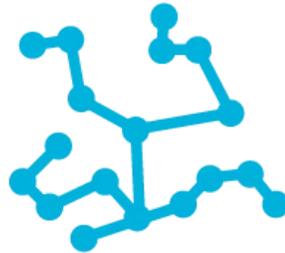
- [Part 1: Overview](#)
- [Part 2: Radio reception and transmission requirements](#)
- [Part 3: Physical layer](#)
- [Part 4: MAC layer](#)
- [Part 5: DLC and Convergence layers](#)

- [Final Evaluation report on DECT-2020 NR](#)

Key advantages



Self-healing



Decentralized



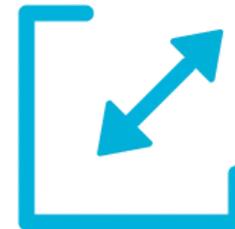
License-exempt



Global spectrum



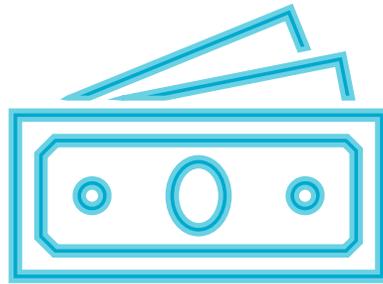
Ultra-low latency



Highly scalable

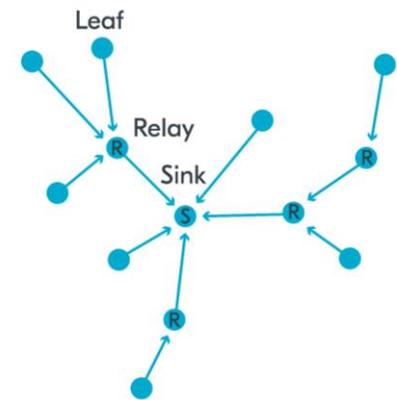
Benefits

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](#)