DECT-2020 NR
5G industrial IoT radio for local networks

Jussi Numminen
Director Radio Strategy and IPR, Wirepas

Kristian Sæther
Product Director, Cellular IoT, Nordic Semiconductor

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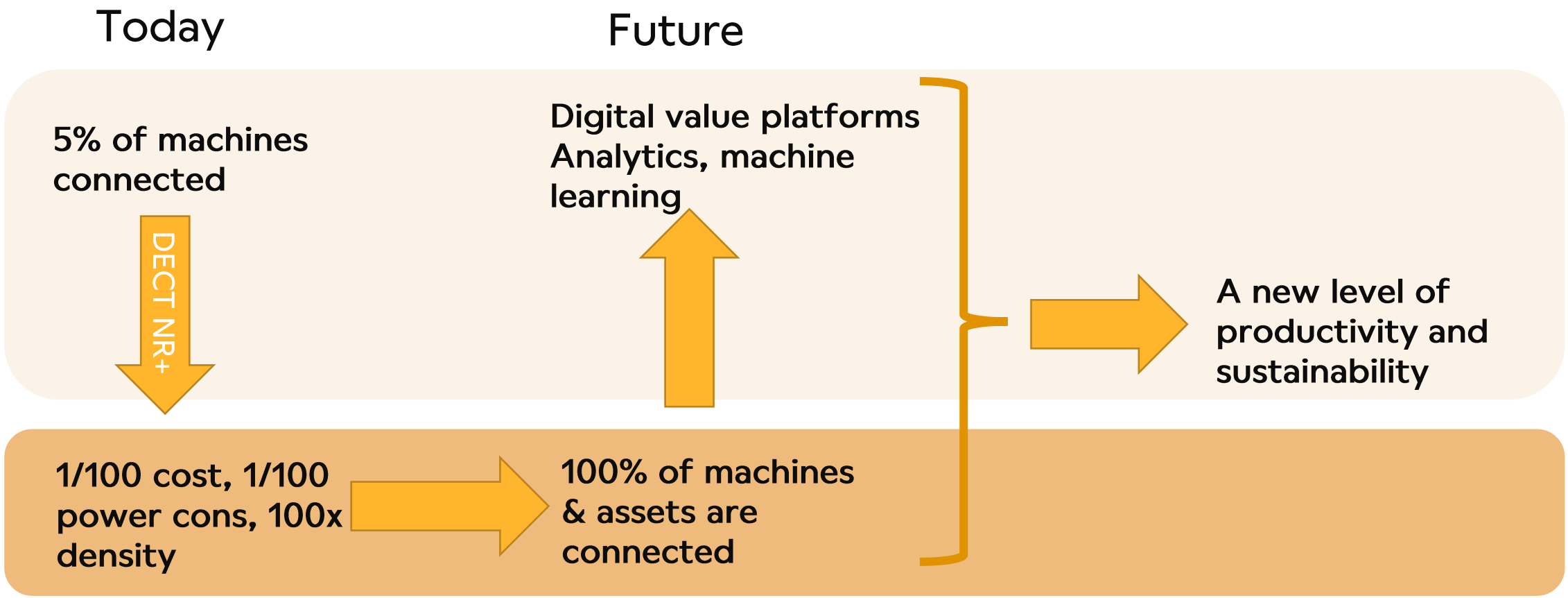
Outline

— Industry expectations for IoT connectivity- Wirepas

— Technology considerations - Nordic

— Use case discussion - Wirepas

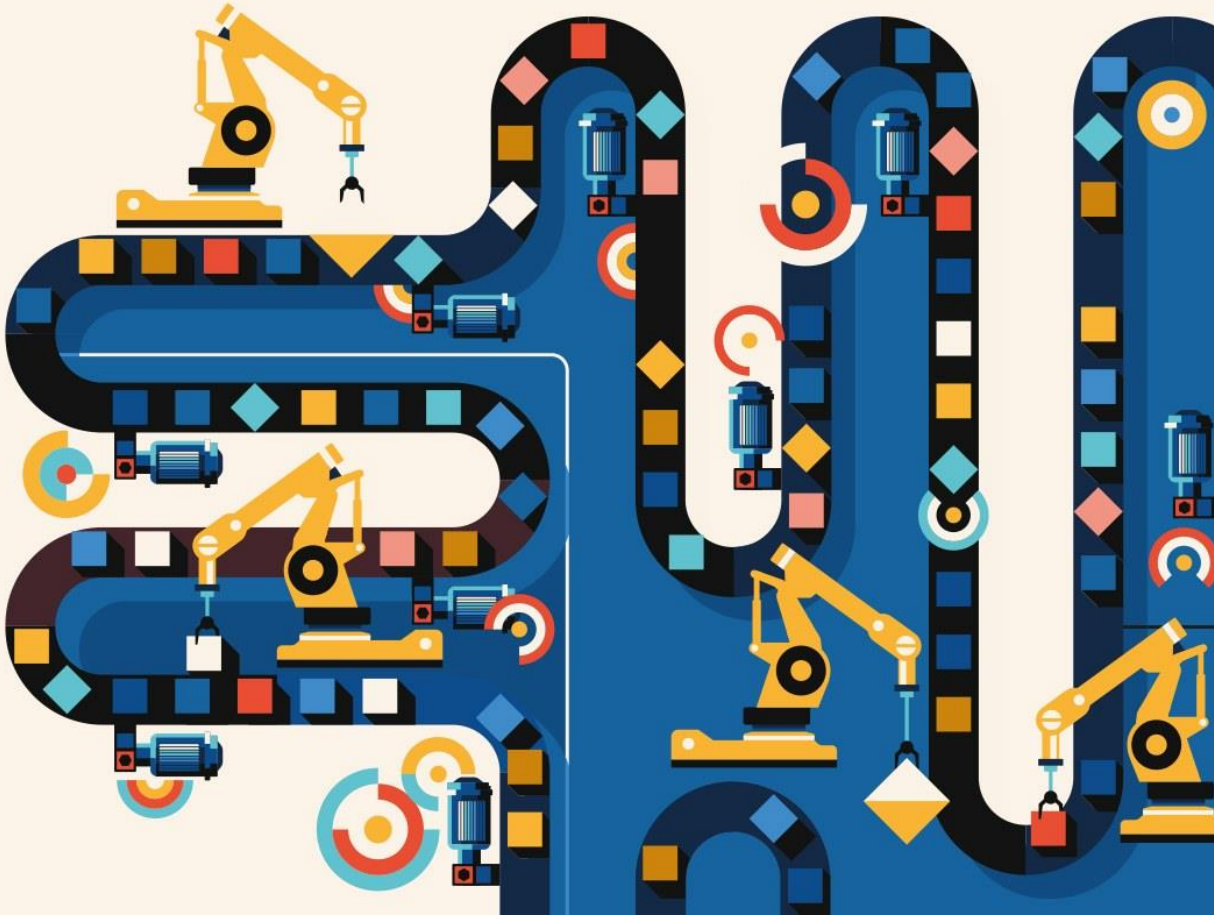
DECT-2020 NR opportunity for industry IoT



Simplicity of deployment

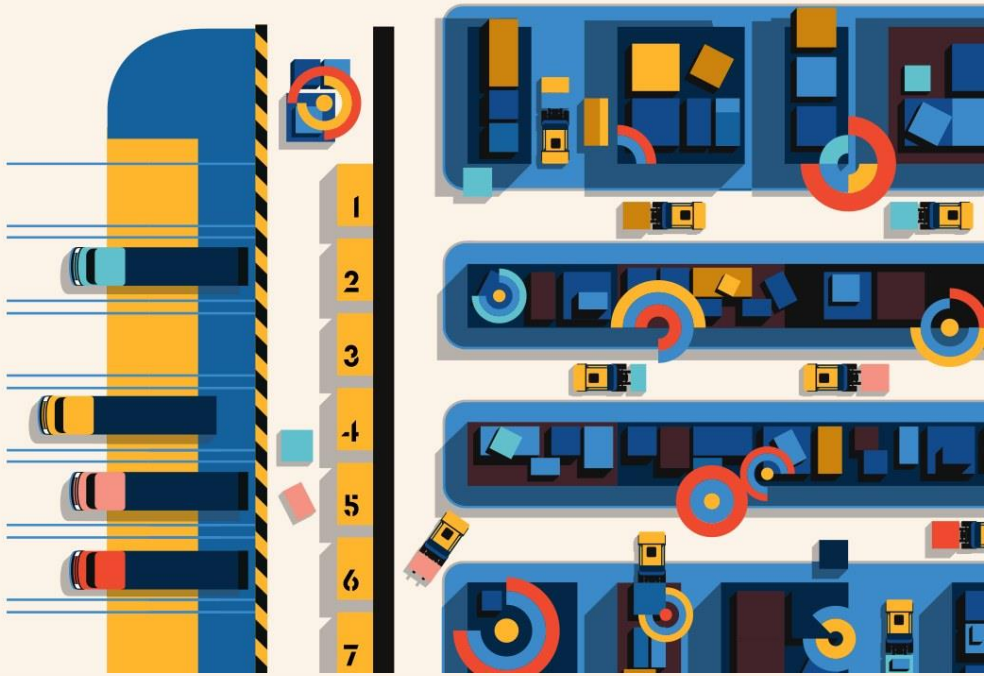
- No network planning
- No system configuration
- Avoid or minimize cabling needs
- Fitting to existing building structures
- Fit to existing IT infrastructure

- Bring new value to the industry by solving real problems.



Operational Sovereignty

- Freedom to operate and select the best option for application and business case
- Data to local cloud/servers or public cloud(s)
- Security and data sharing solutions
- Part of existing IT infrastructure or a separate system
- Internally managed or outsourced private networks
- Different data analytics and service solutions
- Scaling the solution in terms of spectrum and technologies



Access to spectrum

The vast majority:

— Will use license-exempt bands

➢ Dynamic spectrum sharing and coordination at the radio level

Local licenses on need bases:

— Simplicity and cost of licensing process

— Support of multiple overlapping local licenses

➢ Dynamic spectrum sharing and coordination at the radio level

ETSI DECT-2020 NR

- Lisence-exempt band at 1.9 GHz
- Dynamic spectrum sharing
- Support for licensed spectrum
- Mesh network architecture without network planning
- Deployed by anyone and can be integrated into existing IT systems
- Independent from system infrastructure
- ➢ Full operational sovereignty

Identities support large-scale networks

- **Network identification has** 24 bits Long NW ID and 8 bits Short NW ID.
  - 24-bit Long NW ID is used to associate to correct NW (approx. **16,77 M** globally unique networks IDs)
  - 8-bit Short NW ID is used for identifying own network traffic.
  - 8-bit Short NW ID allows 256 overlapping NWs in a radio area.

Identity concept is designed to support very large, dense and overlapping networks.
Short IDs are designed to support effective HARQ communication.

Radio device identification has 32 bits Long RD ID and 16 bits Short RD ID

- 32-bit Long RD ID supports more than **4 B** unique devices in a single network.
- 16-bit Short RD ID is used for local receiver–transmitter identification. This supports more than 65k equipment within a radio communication range.

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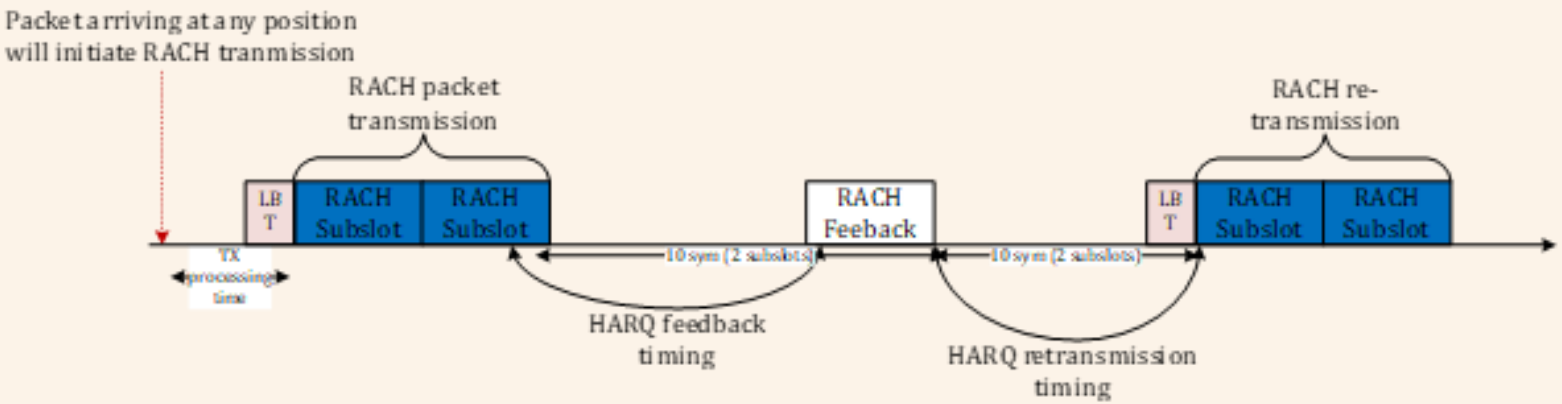
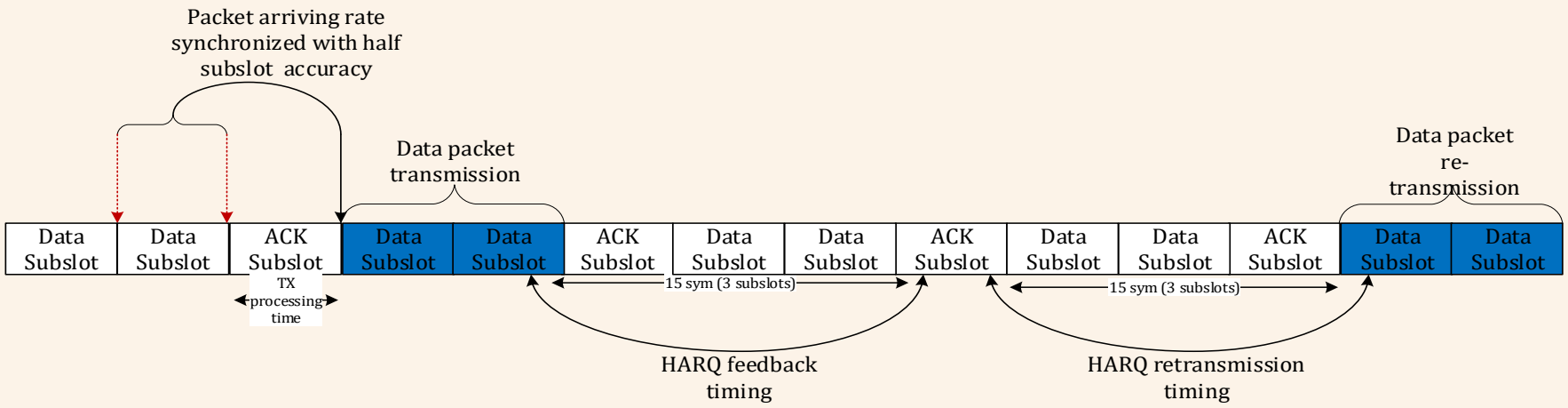
DECT-2020 NR latency performance



PHY layer numerology	TX duration	Subslot duration	Transport block size	Frameless Transmission mode (RACH)	Latency per hop
1,728 MHz @ 27 kHz	416,667 µs	208,333 µs	296 bits	No HARQ transmission	0,9 ms
				With HARQ	2,44 ms
3,456 MHz @ 54 kHz	208,333 µs	104,166 µs	368 bits	No HARQ transmission	0,45 ms
				With HARQ	1,22 ms

DECT-2020 NR latency performance



PHY layer numerology	TX duration	Subslot duration	Transport block size	Frameless Transmission mode (RACH)	Latency per hop
6.912 MHz @ 54 kHz	208.333 µs	104.166 µs	288 bits	No HARQ transmission	0,48 ms
				With HARQ	1,42 ms
13,824 MHz @ 108 kHz	104.166 µs	52.083 µs	288 bits	No HARQ transmission	0,24 ms
				With HARQ	0.71 ms

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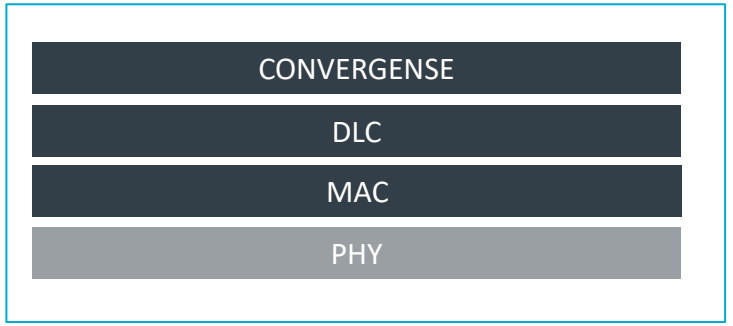
NR+ Network Protocol Layers

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



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NR+: Physical (PHY) layer

- Cycle prefix (OFDM) modulation for UL and DL (with MIMO support)
  - Resulting nominal bandwidth scaling from 1.728MHz to 221.184 MHz
- **Physical Data Channel (PDC) modulation supporting**

  BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM, 1024-QAM
  - With supporting “turbo coding rates”: ½, 2/3, 3/4, 5/6

- **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

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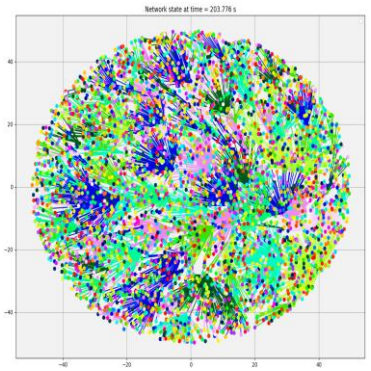
NR+: MAC layer

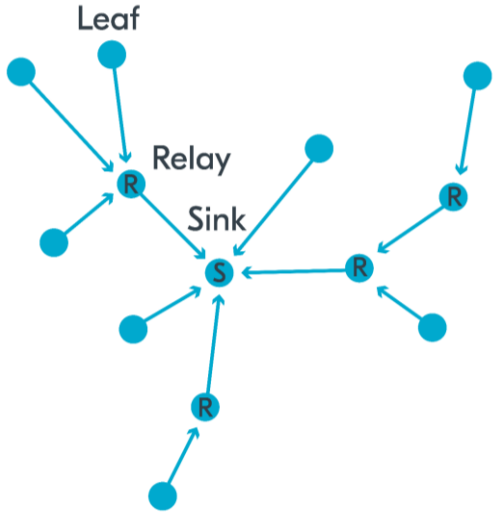
MAC



- 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



Simple NR+ Network

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Network Routing

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

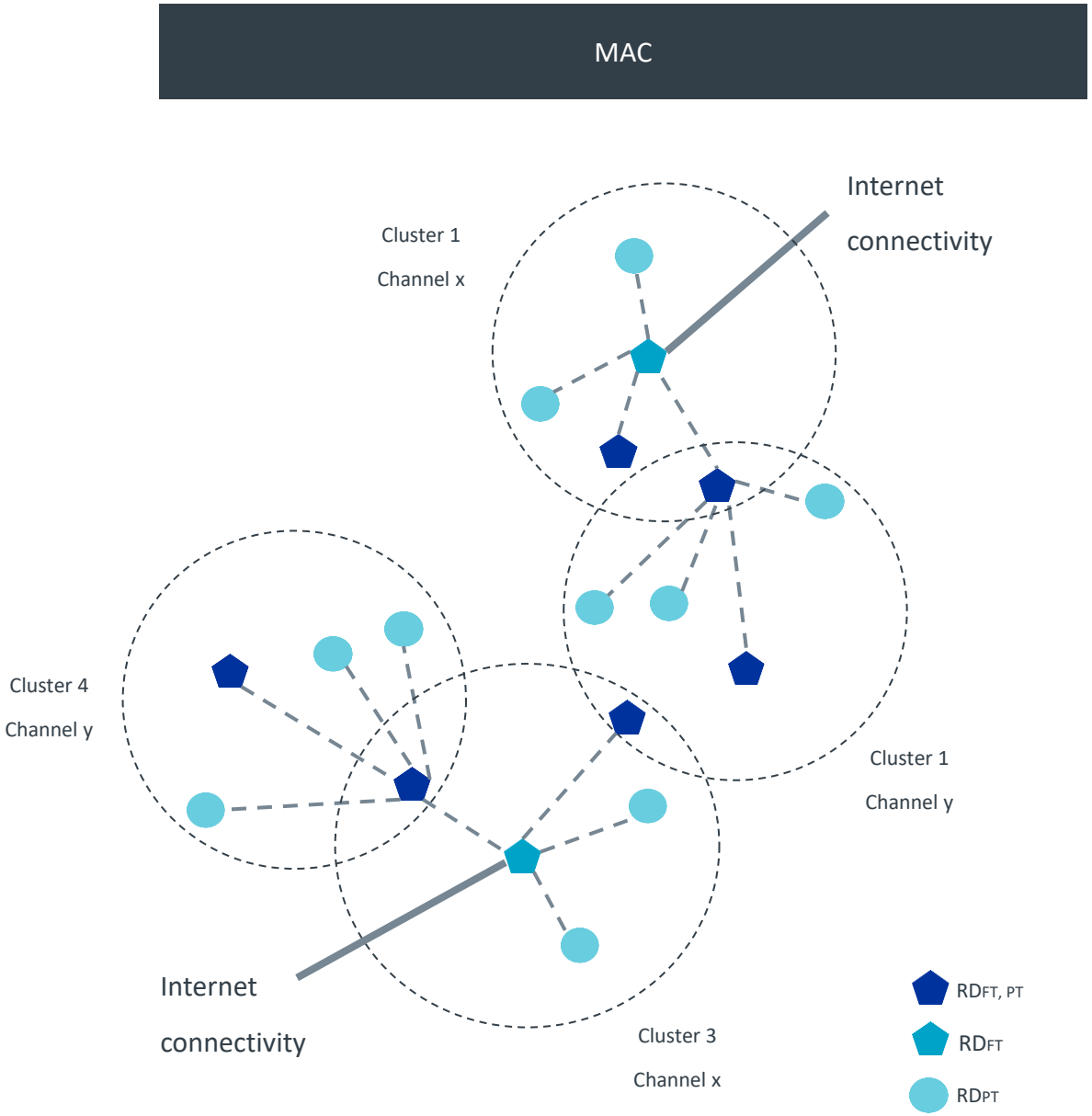
- An RD can be FT, PT or both

$RD_{FT, PT}$

RD_{FT}

RD_{PT}

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



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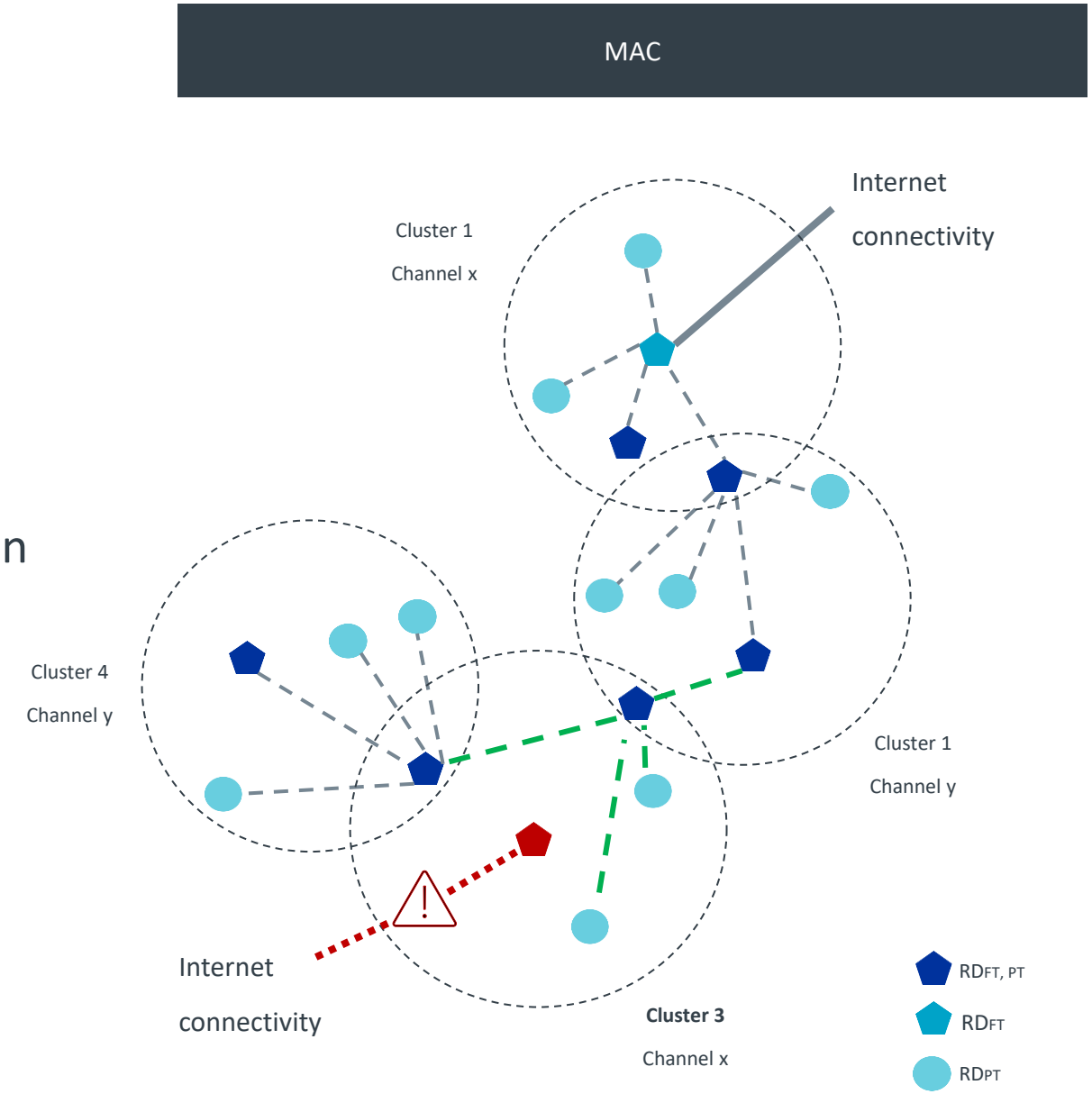
Network Routing

- 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



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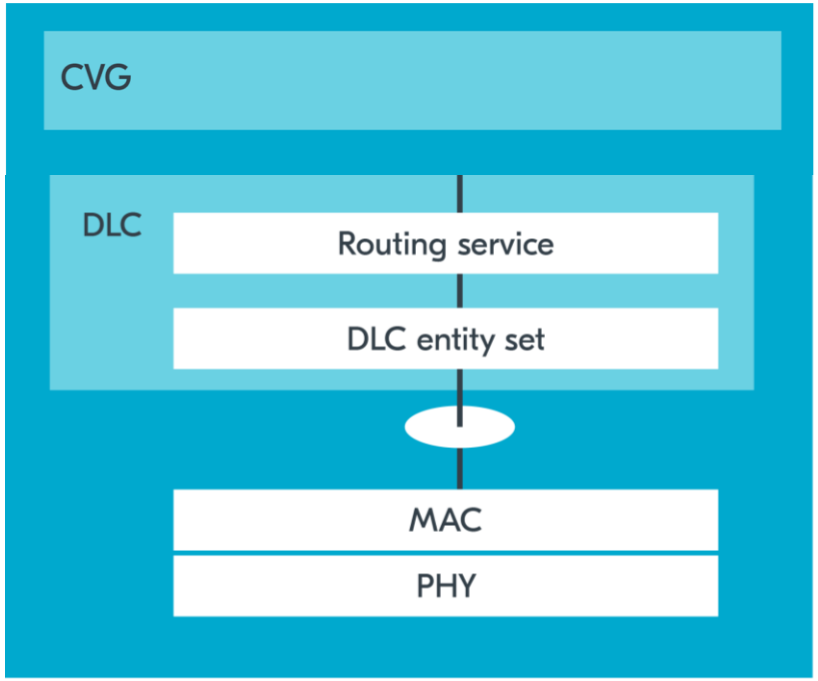
NR+: Data Link Control (DLC) layer

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



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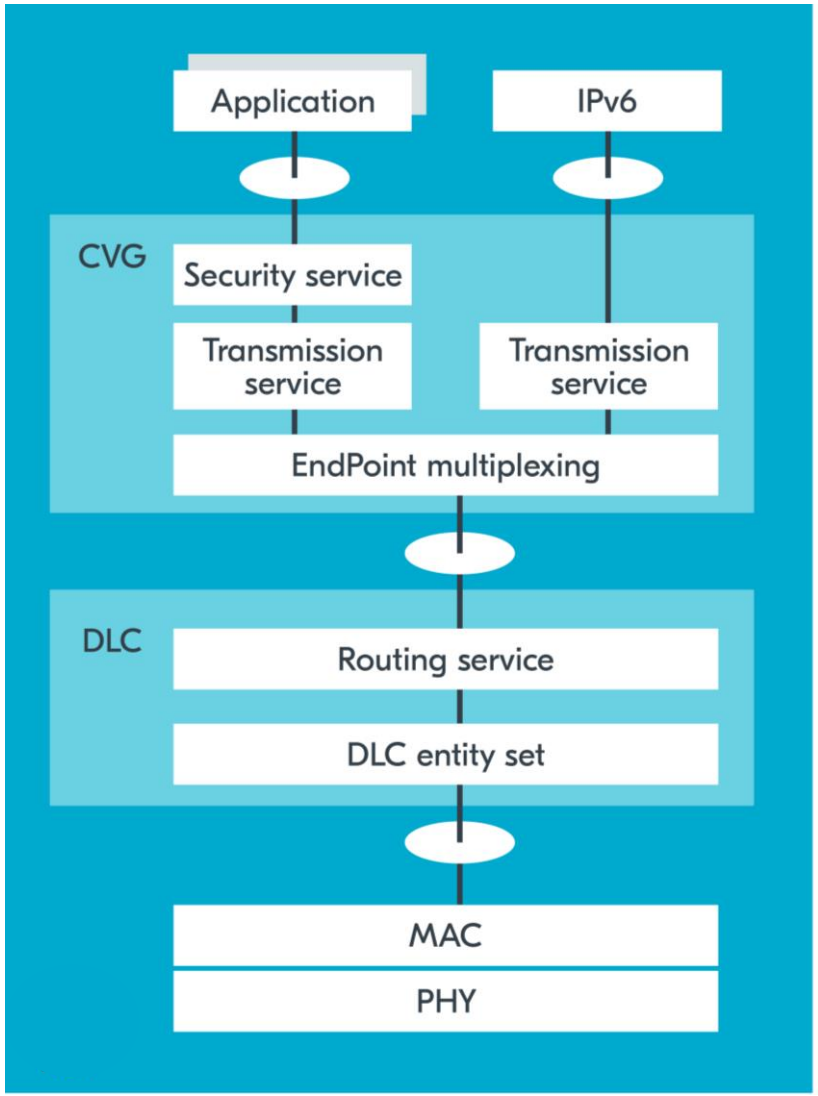
NR+: Convergence (CVG) layer

- 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



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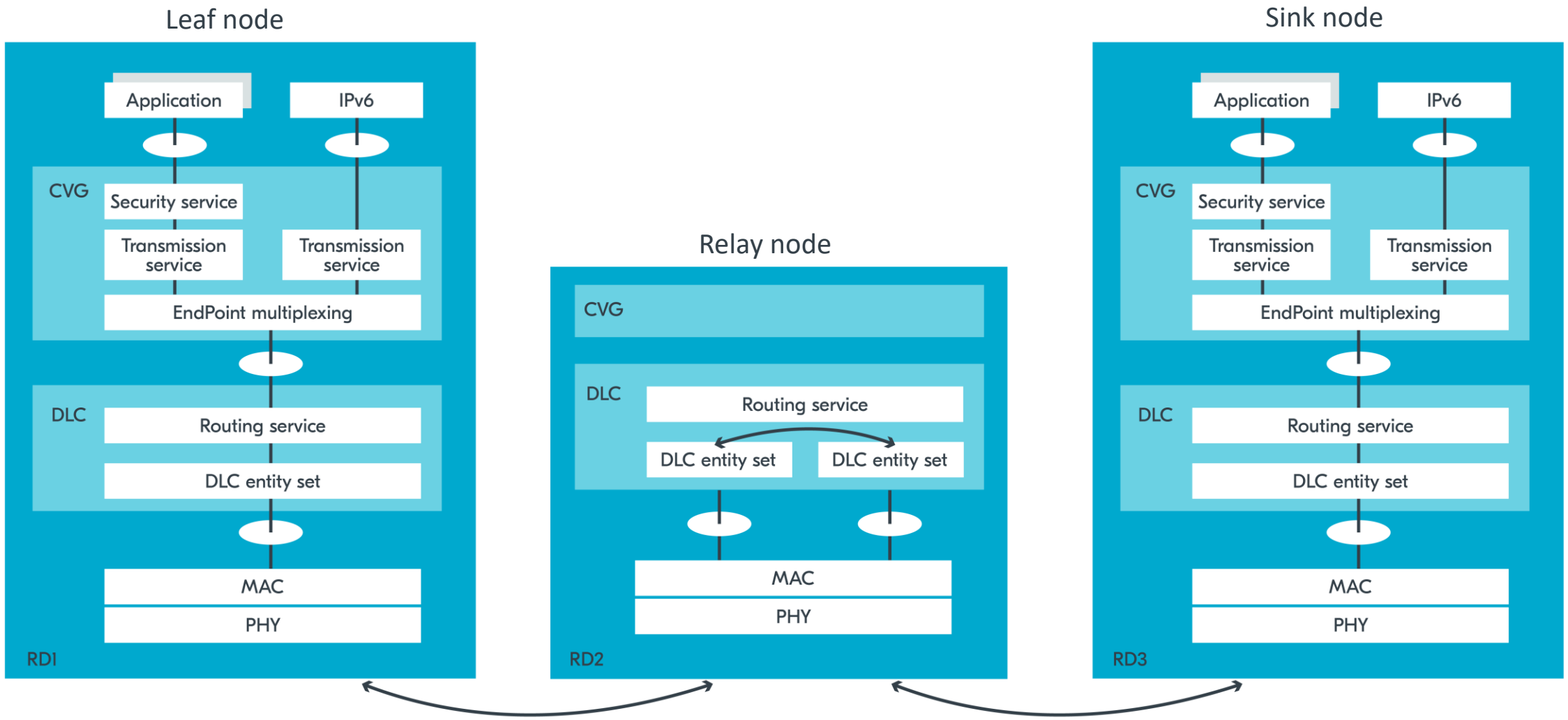
Network Architecture of a Mesh topology configuration



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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	MediumI
ISM RF	Low	Low	Medium	Low	Low

Source: ABI Research

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Key advantages

5G standard

Non-cellular 5G technology

Meets the ITU-R

mMTC and URLLC requirements

License-exempt

Operates on 1.9 GHz band

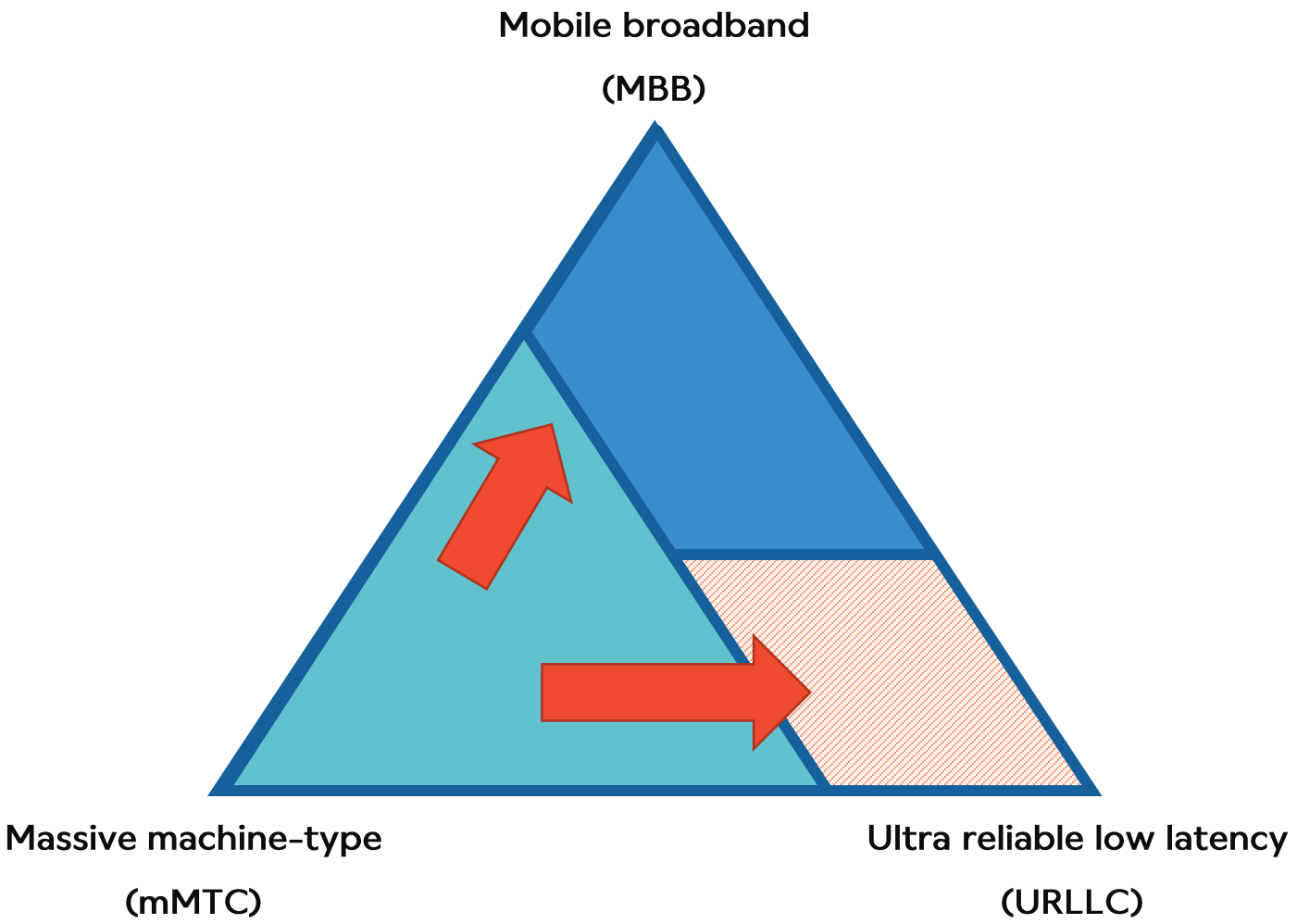
Global and license-exempt

Reliable

Scaling from 100 to 1M nodes per sq-km

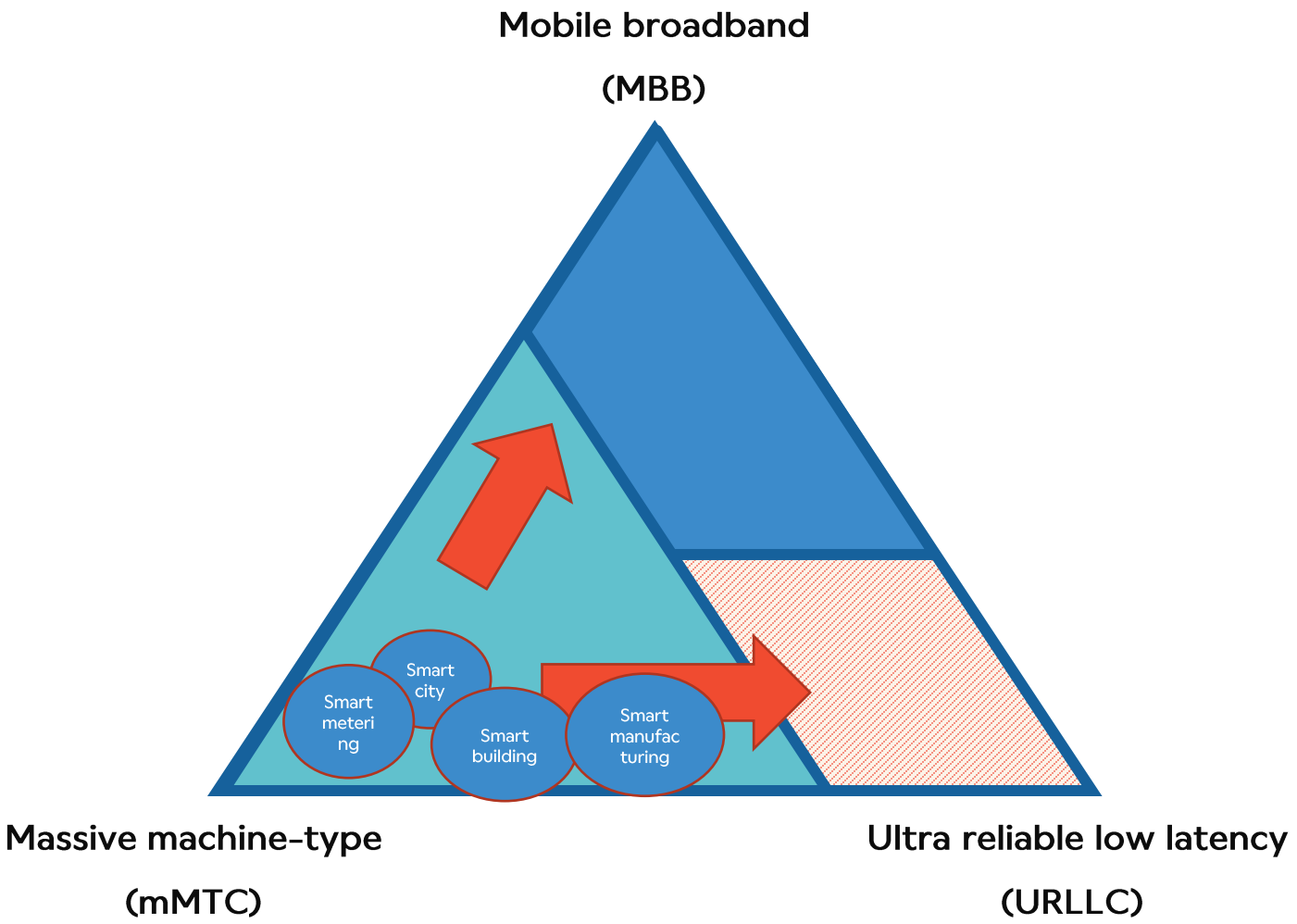
Ultra-high >99.99% reliability built into the lower layer to offload application layers

Application variety requires technology flexibility



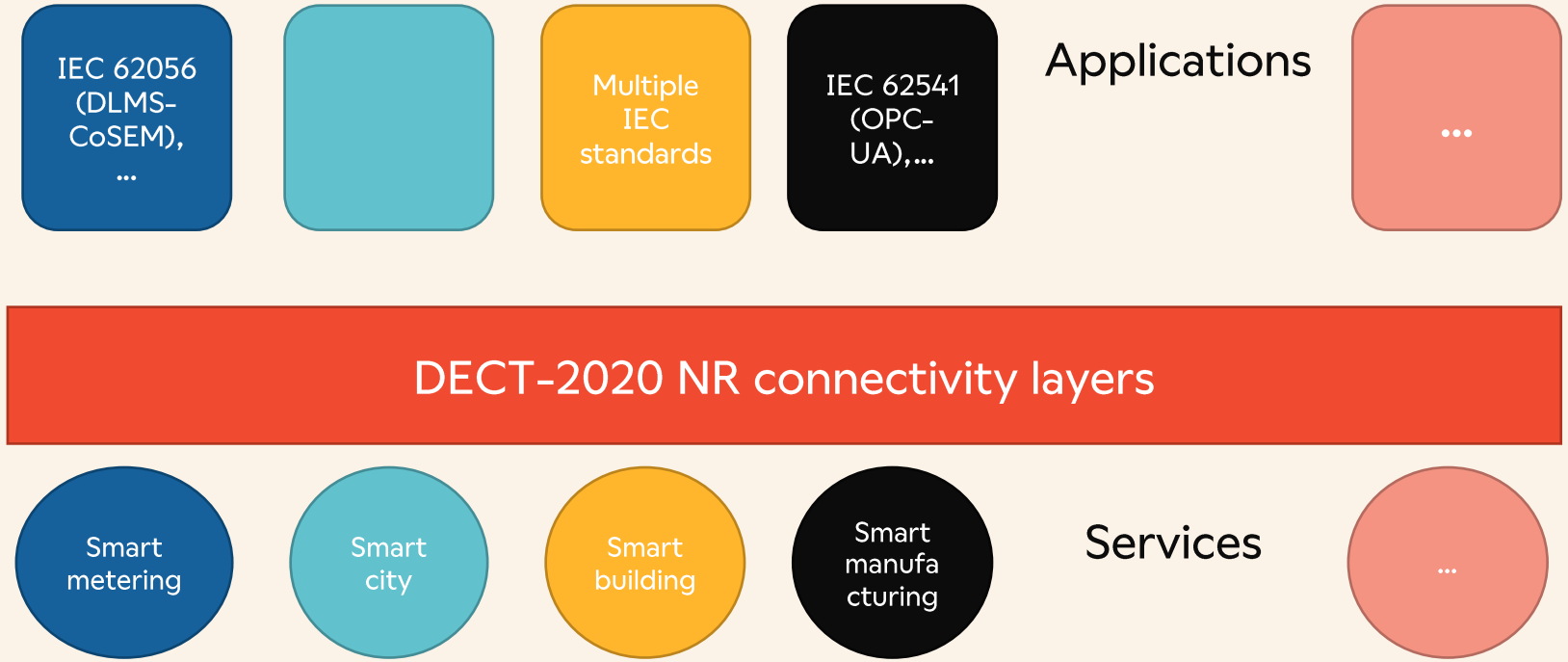
- New communication possibilities extend data consumption:
  - New use cases
  - New data formats
  - Security requirements
  - OTA software updates
- No clear classification between mMTC and URLLC:
  - Use case dependent

Industrial and utility use case examples



- Electricity Smart metering and submetering, grid monitoring
- Smart city applications: Streetlighting, water and gas metering
- Building automation
- Asset Tracking and positioning of e.g. Tools, Pallets, Containers
- Factory automation
- Preventing maintenance

Industrial and utility use case standards



- Existing standards define application characteristics and functionalities
- Both IP and Non-IP use is possible
- TS 103 874 standards series will define access profiles matching various use cases
- DECT-2020 NR connectivity layer is agnostic to applications

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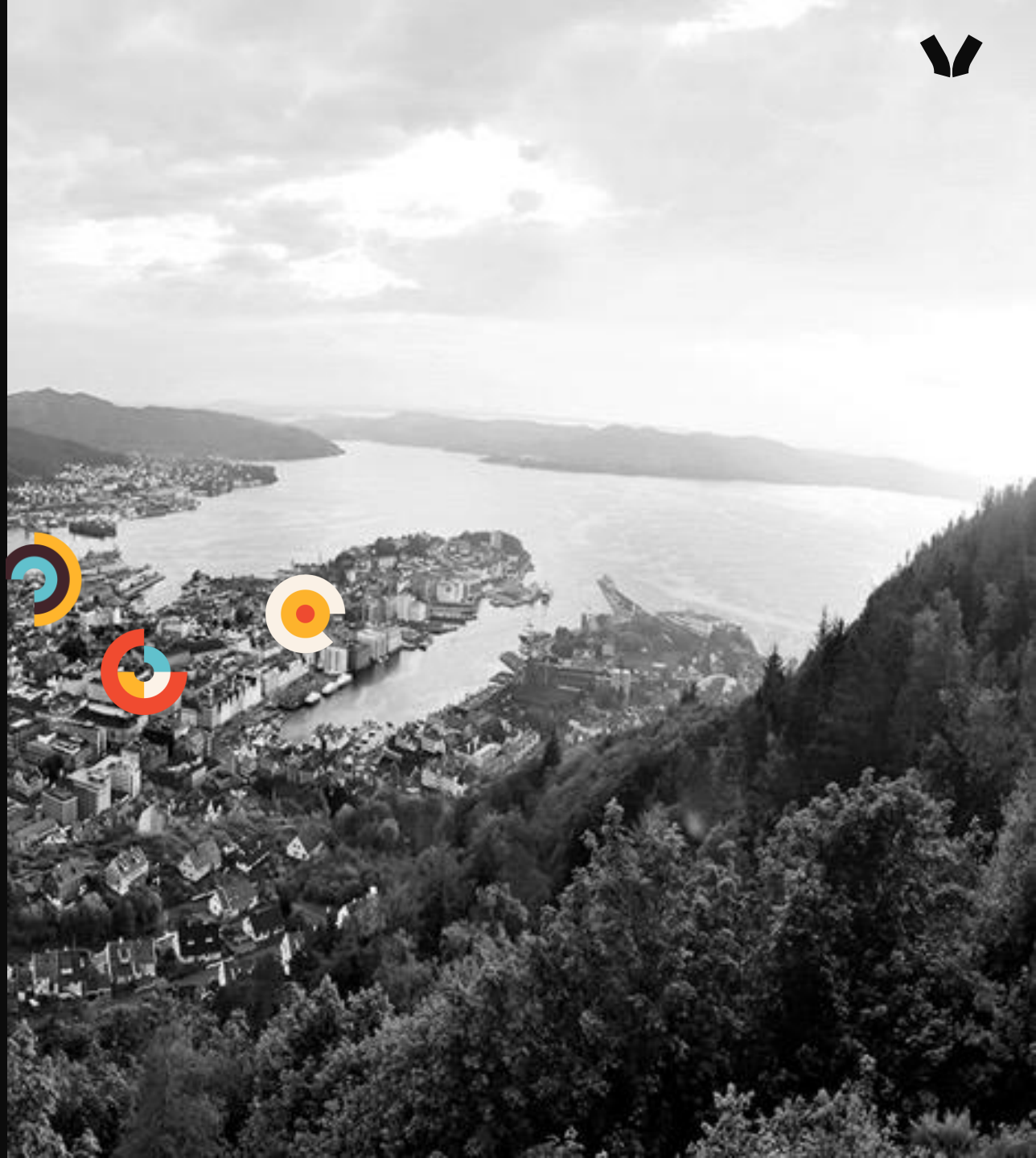
Smart meters

Electrification is a global trend to reduce CO2 emissions.
Europe is at the turning point preparing new actions for energy security

Benefits for the energy utility:

- Reliability SLA >99.9%.
- Cost for data and maintenance.
- Private network.

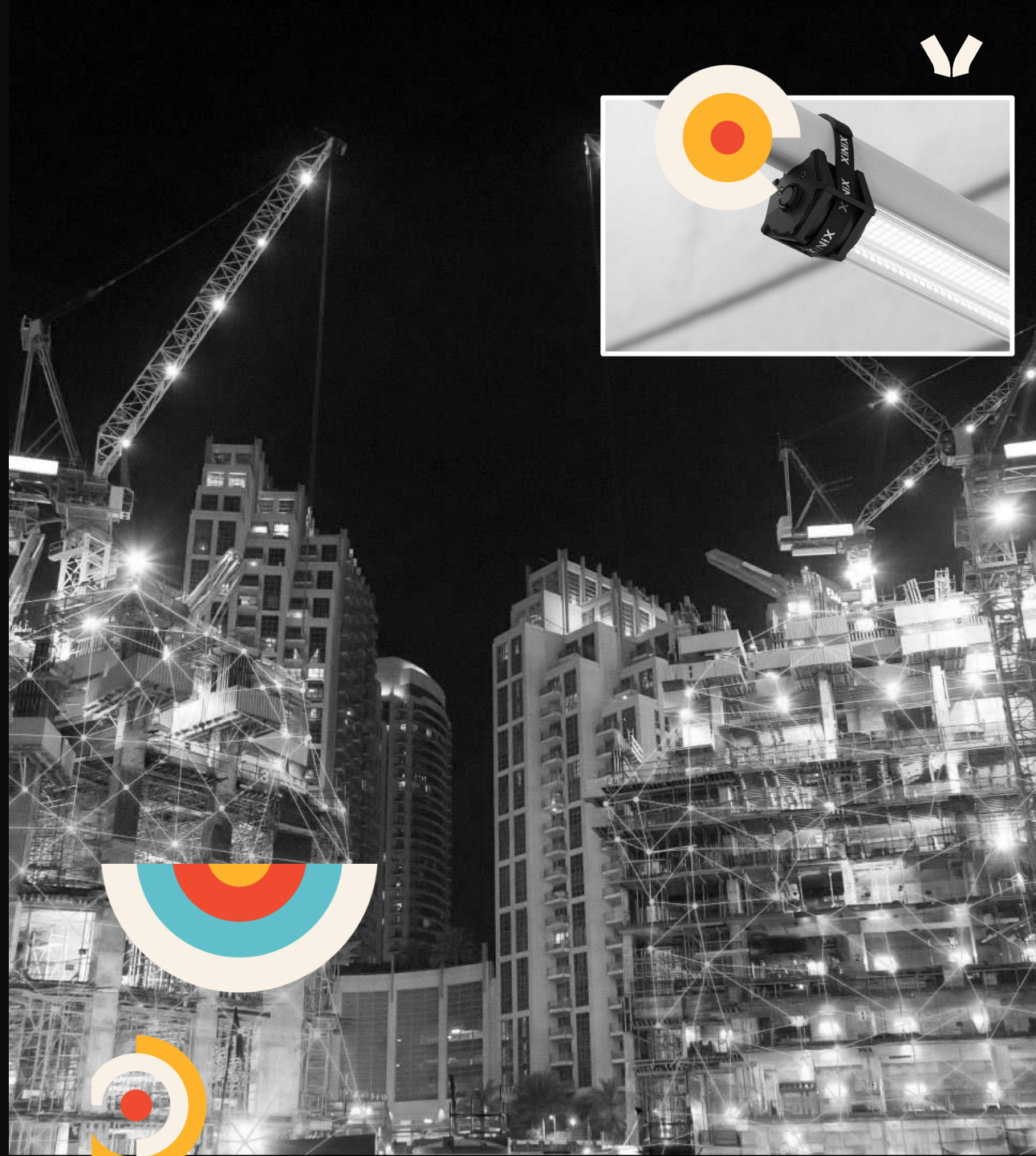


Smart Industrial sites

Combination of many:

- Industrial lighting solutions
- Asset/material tracking solution
- machine condition monitoring solution
- Real estate condition monitoring
- Security and evacuation solutions

- Example of one or multiple private network(s)



Smart city lighting

— Energy and maintenance savings

— Increasing the quality of light provided to users.

— At the same time the smart lighting infrastructure can extend the Internet of Things (IoT) smart city applications.

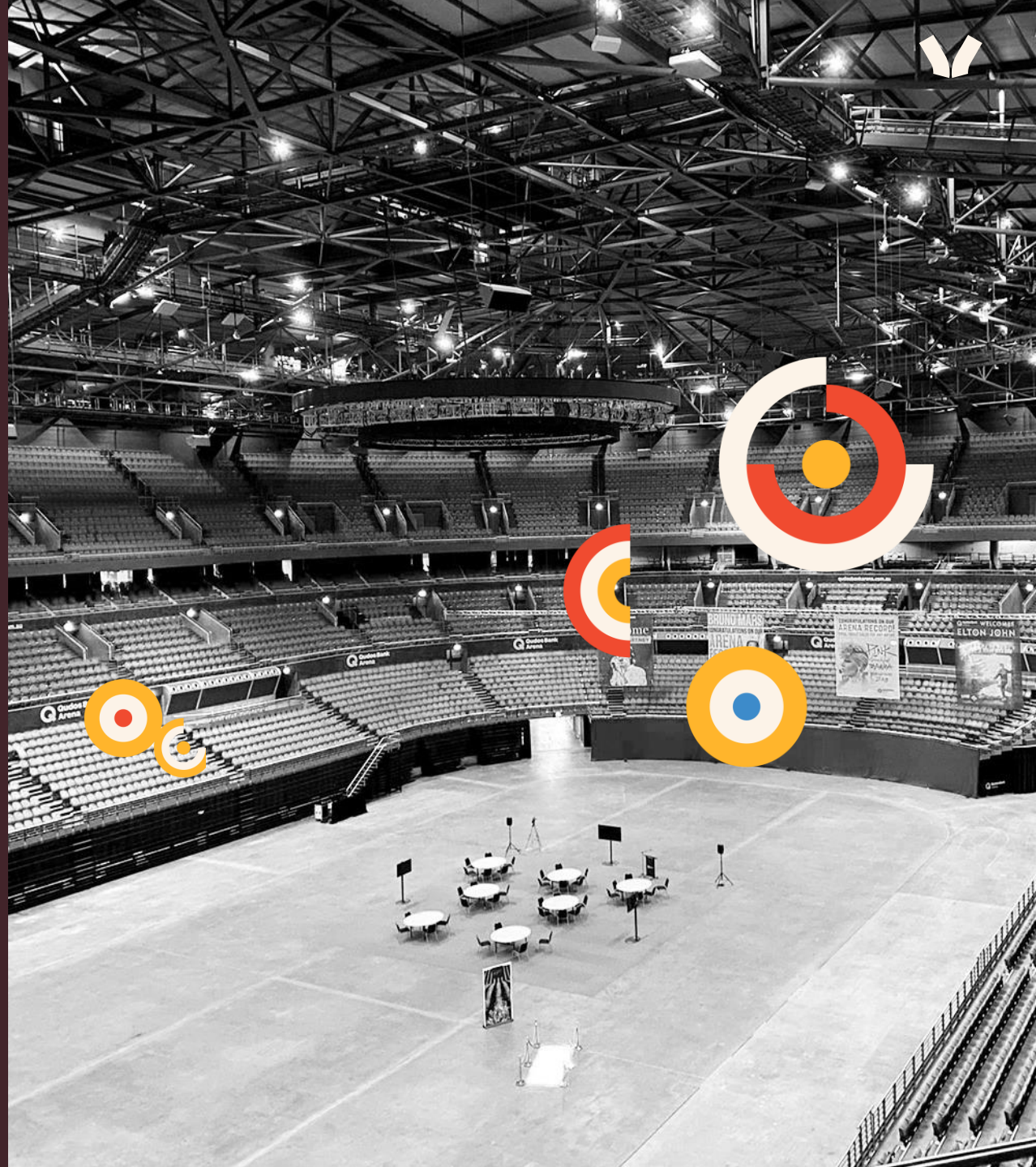
— Private network

Emergency Lighting

— Qudos Bank Arena in Sydney: 2500 upgraded emergency lighting luminaires now seamlessly communicate across a wireless dynamic self-managed mesh.

— Single push of the button to achieve complete site compliance.

— Private network



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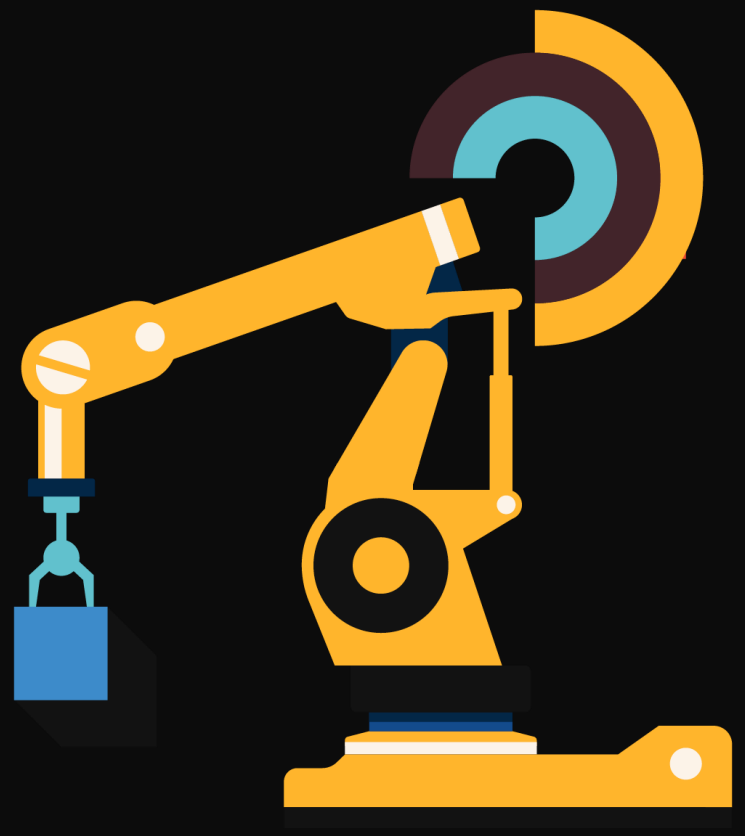

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