



STRATUM9
dect^{nr+}

Deterministic Wireless DECT-NR+ MAC Layer for Industrial Automation

STRATUM 9 GmbH
12.11.2025



Who we are?



25+ Years experience in Embedded Software Development (Bare Metal, Embedded Linux, Zephyr)

25+ Years experience in Hardware Development

15+ Years experience in Industrial Automation (especially the Automotive Industry)

- Development of PROFINET Devices
- Development of PROFINET Controller Stack
- Development of a Real-Time 802.11n-phy-based communication solution for the Automotive Industry



STRATUM 9 GmbH
Kufstein
Tyrol
AUSTRIA



STRATUM9

DECT NR+ Software Stack	IoT Modular IoT System	S9 Products Industrial Products
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Founded by Hubert Feurstein & Alfred della Torre jun.

Reliability & Robustness

Must operate consistently in harsh industrial environments (noise, interference, extreme temperatures).



Low Latency & Determinism

Critical for real-time control and automation to ensure timely data delivery and predictable system behavior.



Quality of Service (QoS)

The ability to prioritize different types of traffic (e.g., critical control signals over non-essential monitoring data) to ensure that the most important information is always delivered promptly and reliably, even under network load.



Scalability & Flexibility

Ability to easily expand the network and adapt to changing production needs and layouts.



Ease of Deployment & Maintenance

The system should be straightforward to install, configure, and troubleshoot. User-friendly interfaces, diagnostic tools, and over-the-air updates contribute to lower operational costs and reduced technical skill requirements.



Why Not Simply Use Wi-Fi for Industrial Automation?



Based on **IEEE 802.11** standards



Uses **Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA)**



Also known as **Listen-Before-Talk (LBT)** — devices check if channel is free before transmitting



Effective for **general-purpose networking** (offices, consumer devices)

Critical Issues in Industrial Contexts:

Non-Deterministic Latency

Transmission timing cannot be guaranteed — incompatible with time-critical systems



Performance Degradation under Load

More devices = increasing delays and reduced throughput

Lack of True Service Guarantees

No deterministic QoS — relies on probabilistic channel access (WMM)



Non-Deterministic Latency



Performance Degradation under Load



Lack of True Service Guarantees

Core Features for Industrial Automation:



Dedicated Clean Spectrum

1.9 GHz band — globally harmonized, protected spectrum with minimal interference (unlike congested 2.4/5 GHz Wi-Fi bands)



Hybrid MAC Layer

Combines **scheduled access** for critical deterministic traffic with **contention-based access** for bursty traffic — all managed by FT



Robust Scheduled Access

Key enabler of **determinism** for industrial control — solves LBT problems through coordinated transmission

Scheduled Access in DECT NR+



Centralized Control

Central base station (Fixed Termination Point) manages all communication within its cell



Dedicated Time Slots

Base station allocates recurring transmission opportunities to each device (Portable Termination Point)



Collision-Free Operation

Each device transmits only in assigned slots — results in **deterministic, predictable latency**



Scalability & Power Efficiency

Supports many devices efficiently — devices stay in low-power state until scheduled transmission



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MAC /DLC– Layer

Scheduling & Resource Handling

- Up to 32 Devices per FT (bidirectional)
- Pre-Defined Scheduling Plans
- Symmetric Up- and Downlink

Modes & Flow Management

- PT / FT / SCAN Mode
- 4 User Plane Flows

Timing & Synchronization

- Time-sync FT => PT (System Time)
- Sub-millisecond precision

Protocol Compliance & Messaging

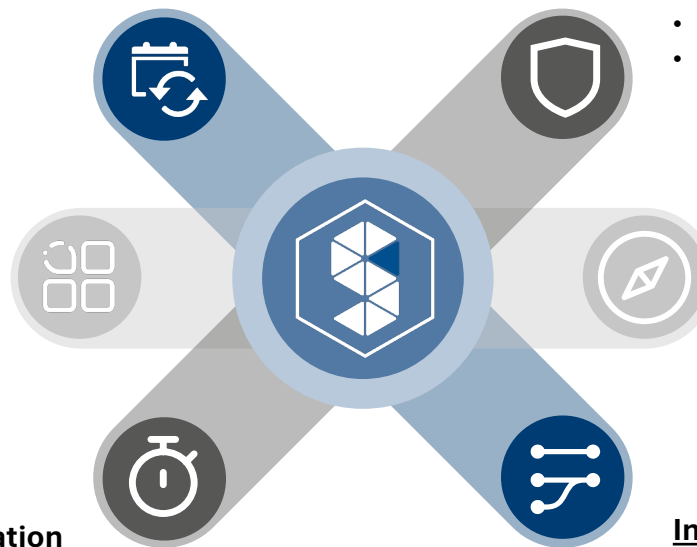
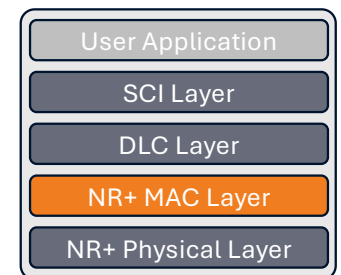
- Cluster Beacon Message
- Network Beacon Message
- Unicast Message
- Data Encryption

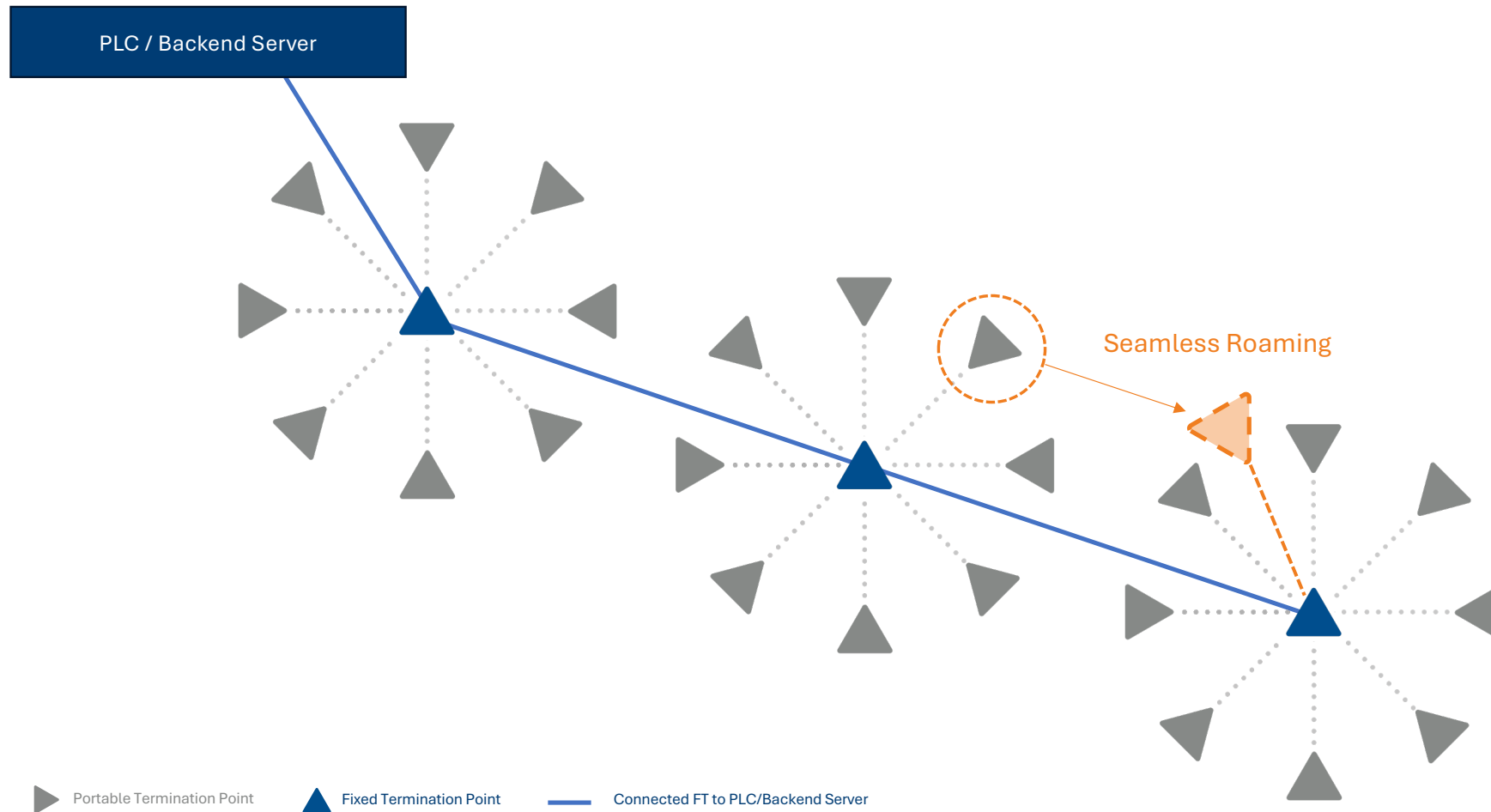
Mobility & Roaming

- Standard Roaming
- Seamless Roaming (no dataflow interruption)

Integration & Interfaces

- Optimized for instant associations
- Pre-Provisioned Devices (for simple device replacement)
- IP networking





Optimized for Industrial Protocols



STRATUM 9's DECT NR+ MAC layer provides native support for major industrial automation protocols, enabling seamless integration with existing automation infrastructure without protocol translation overhead.



PROFINET

Real-time Ethernet protocol for factory automation with deterministic cycle times



EtherNet/IP

Industrial protocol from Rockwell Automation with CIP (Common Industrial Protocol) for seamless device interoperability



Modbus TCP

Industry-standard protocol for connecting industrial electronic devices with widespread legacy system support



OPC UA

Platform-independent standard for secure and reliable data exchange in Industry 4.0 architectures



Protocol Efficiency Optimization



Our MAC layer minimizes protocol overhead through intelligent packet aggregation, header compression, and priority-based QoS, ensuring maximum throughput for time-critical industrial data.

DECT NR+ MAC Layer for Industrial Real-Time Communication



STRATUM 9 provides an optimized DECT MAC/DLC stack for **industrial use cases**

For a seamless user experience STRATUM 9 also provides higher layer services (SCI Command Layer, Network Layer-Adapter, PC side tooling, ...) which sit on top of the DECT MAC/DLC layer

TYPICAL USECASES:



AGV



Mobile Robotics



Wireless Safety Applications



Motion Control – Real Time



Machine-to-Machine Communication



Sorter Applications

... and many more

MAIN FEATURES

Deterministic communication

Low latency

Optimized for mobile applications

Industry-optimized reliability & safety

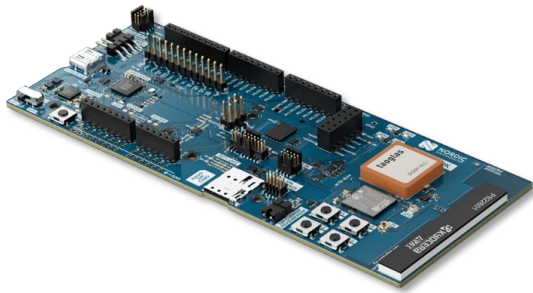
Variant 1 | Starter Kit

Variant 2 | Software Stack

Variant 3 | Firmware Image

Variant 4 | Development Package

Variant 5 | Ready-to-use Product



DECT-NR+ MAC Layer Firmware

- ▶ Nordic nRF9151DK
- ▶ FT-Mode
- ▶ PT-Mode
- ▶ RSSI-Scanner Mode



DECT-NR+ Tool

- ▶ Full configuration of the MAC Layer
- ▶ Status monitoring
- ▶ Firmware updates
- ▶ CLI-based tool (Command Line Interface)



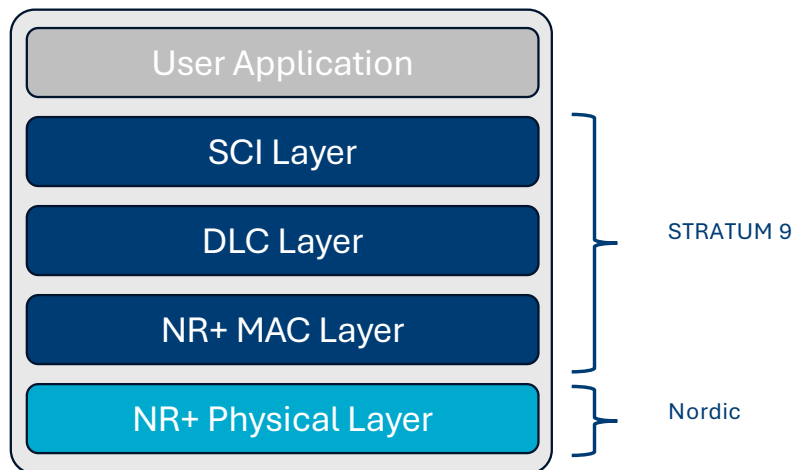
DECT-NR+ Gateway Service

- ▶ Linux System Service
- ▶ Net-Bridge Mode
- ▶ Audio-Bridge Mode
- ▶ API Server (REST or gRPC)
- ▶ Client-code in preferred language (e.g. Python)

- ▶ Runs on x64 (Windows, Linux) and ARM64 (Linux, Raspberry Pi)
- ▶ Communication via **UART** or **DECT NR+**
- ▶ Includes **0,5 hours of support per device** (valid for 1 year)
- ▶ Free lifetime updates

Download from our Website: st9.at/devkit

Variant 1	Starter Kit	Variant 2	Software Stack	Variant 3	Firmware Image	Variant 4	Development Package	Variant 5	Ready-to-use Product
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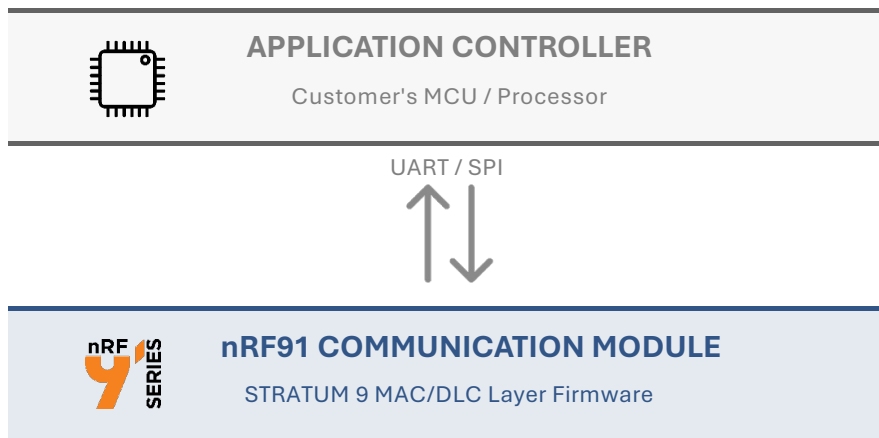


Software Development Kit

- Develop your DECT-NR+ application faster and more efficiently - with our powerful SDK
- Integrate our MAC layer directly into your nRF91 firmware project as a Zephyr module
- More functions, less effort: our add-on modules relieve you of the burden of implementation and create space for your core applications.

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SYSTEM ARCHITECTURE



Out of the box firmware

Ready-to-use firmware image with all functions for immediate use of DECT-NR+ on your hardware.



nRF91 as a ready-to-use communication module

Our tested firmware image for the nRF91 allows you to focus on developing your application on your application controller.



Own application controller

Your application runs on a controller of your choice and communicates with the nRF91 via defined interfaces.

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Hardware Design & Engineering

- ▶ Hardware design & optimization
- ▶ Rapid prototyping & testing
- ▶ EMC/EMI compliance
- ▶ Certification support (CE, FCC)



Firmware & Software Development

- ▶ Bare Metal & RTOS (Zephyr)
- ▶ Embedded Linux systems
- ▶ MAC/DLC layer customization
- ▶ Industrial protocol integration
- ▶ OTA update mechanisms
- ▶ Security implementation



Backend & Cloud Services

- ▶ Cloud infrastructure setup
- ▶ Device management platforms
- ▶ Data analytics & visualization
- ▶ Dashboard & UI creation
- ▶ Integration with existing systems



Concept to Production Partnership



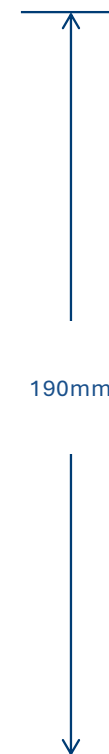
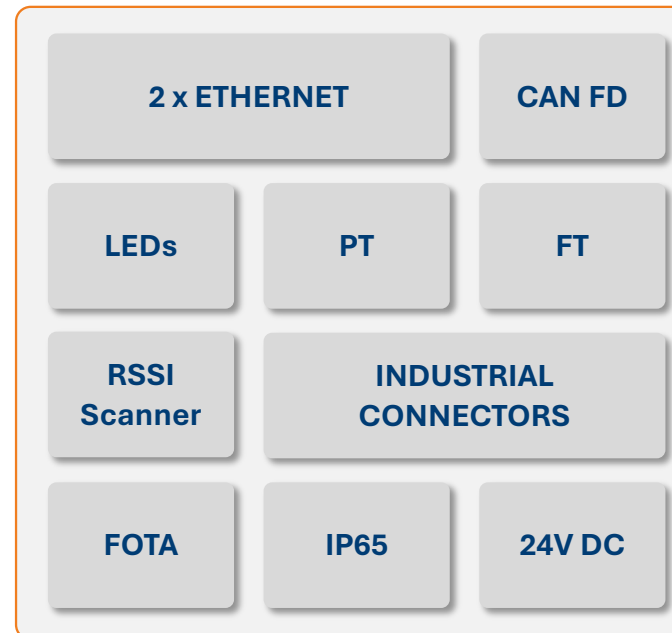
With 25+ years of embedded systems expertise, STRATUM 9 delivers complete solutions from initial concept through production deployment. We handle the complexity so you can focus on your core business, accelerating time-to-market and reducing development risk.

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Smart Antenna

- ▶ Industrial use cases in harsh environments
- ▶ Fully integrated MAC / DLC / SCI Layer
 - ▶ Wireless PROFINET
 - ▶ Wireless CAN
 - ▶ Wireless



Kickstart your DECT NR+ project with us

Consulting • Prototyping • Integration • Support



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THANK YOU