

# Small Cell Portfolio Update

October 2023

Mobile Networks

# Agenda

1. Nokia Small Cell portfolio overview and updates
2. Femto Solution
3. Indoor solution
  - AirScale Indoor (ASiR) solution
  - Multi-operator Indoor solution
  - Direct Connect pRRH solution
  - .
4. Outdoor Micro - for street coverage

# The best Small Cell portfolio for high performance densification

Outdoor - street level deployments

In-building deployments

## Strand Mount All-in-One\*



- 5G SA, CBRS
- 4T4R, 42 dBm EIRP
- Integrated DOCSIS & power

## micro RRH with compact size



- Street site densification
- 4G and 5G, FDD/TDD
- Up to 200 MHz oBW
- Integrated antenna option

## AirScale Indoor Radio (ASiR)



- Easy to deploy, scalable ASiR
- Wide range of compact pRRH
- 4G and 5G, multi-band
- Support hybrid fiber cable

## Indoor All-in-Ones



- Cell Boosters
- Smart node 4G+ 5G, multi-band
- 5G AiO single band\*
- Low Cost, flexible, self-Install
- All-in-One Radio

## DAS Drivers

CPRI Digital Donor (CDD)



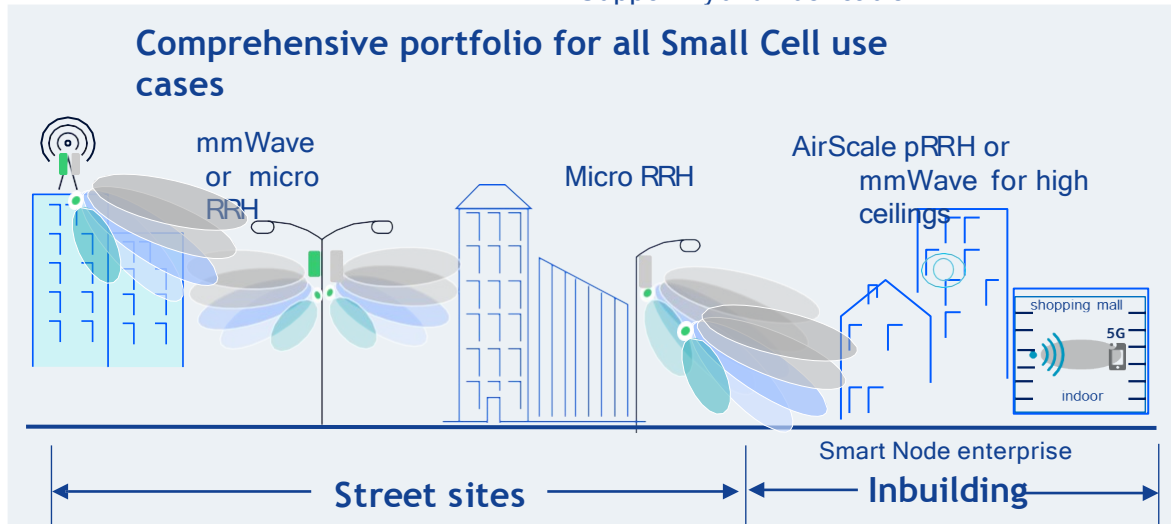
- Powering Active and Passive DAS
- Digital connectivity to Active DAS
- 4G and 5G

## 360° mmWave coverage with extension modules



Unique mmWave solution

- TCO optimized flexible deployments
- Main radio unit and 1-2 extension units
- 24/26/28/39 Ghz



## AirScale baseband

### Compact BBU ASOE/ASOF\*

- For base and medium capacity
- Compact 7-liter unit, 4G/5G support
- Versatile Small Cell deployments



### AirScale System Module

- High-capacity modular BB for all RATs
- Efficient deployment of macro and small cell BB processing in the same unit



# Femtocell Solution



# Indoor Network Drivers & Market Segments need to be considered

Indoor Network Drivers

Public Spaces  
(CSPs operated)

Private Spaces  
(Private Owned - CSP/Enterprise)

Time-to-market

Reliability

Control

Cost

Ease of Depl.

Security

Latency

Coverage

Capacity

Mobility



Museum



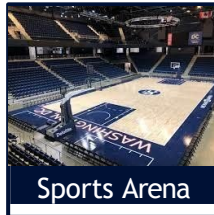
Library



City Hall



Shopping Mall

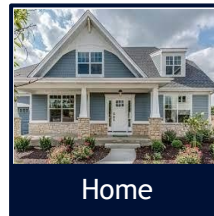


Sports Arena

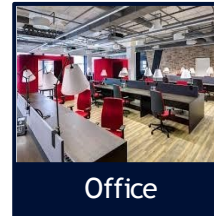


Concert Hall

Requires support for **multi-operator environment** and vendor agnostic to ensure that all end-users receive the same quality of service



Home



Office



Factory



Hospital



University



Requires **high availability, security with low latency network** to support key use-cases of critical-care & Industry4.0. Served by private networks (aka NPN, non-public

- Deep indoor coverage from outdoor Macro sites not reliable with new 5G mid and high bands
- Many countries are opening **spectrum for private wireless use**-Fast introduction of frequency variants required
- Enterprise are more aware of the benefits of using Cellular vs. traditional Wi-Fi
- New use cases emerging that require **better QoS compared to Wi-Fi**
- Public cloud providers are more actively seeking to partner with Private Enterprises & CSPs
- Ability to **scale capacity** from very small (single cell) to large coverage area- pay as you grow
- **Ease of deployment and operation**- Plug-n-Play, remote troubleshooting and monitoring required

# Recent Femto use-case discussions



Differentiated business travel



Temporary event service



Café / restaurants



Shopping and retail



Operator shops



Hospital and healthcare



Small / Medium enterprises



First responder sites



Hospitality venues

eMBB  
B2B  
Public

# Nokia Femtocells Portfolio

SOHO

Residential

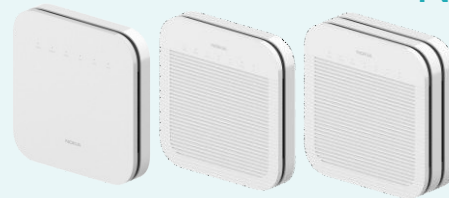
## Multi-standard SOHO



- 4G dual-band
- 32+32 users
- 125mW
- CAT-M, NB-IoT,
  - VoLTE, coverage and data offload

## Smart Node Family

New



- 4G + 5G NSA, SA
- 64 LTE +32 NR users
- 125mW-250mW
- CAT-M, NB-IoT
- 4G/4G + 5G/5G SA deployment options

## Multi-Standard residential



- 4G dual-band
- 8+8 users
- 50mW
- CAT-M, NB-IOT
- VoLTE, coverage and data offload

## LTE residential



- 16 users
- 50mW
- VoLTE, coverage and data offload

## Virtual Femtocell Gateway





- SW only delivery
- AiO for easy and cost-effective gateway
- Flexible: suits small and large deployments



## Cloud-based femtocell management (cOAM)

- Cloud-native network functions CNF for centralized deployment
- Scalable to support >1M access point, 4G and 5G Smart Nodes
- Simplified provisioning and Geo-redundant

# Femtocell product family

	Femtocell LTE Residential*	Femtocell Multi-band Residential	SOHO Express	SOHO
Bands	B7	B1/B7, B1/B3, B2/B4	B1/B7, B2/B4, B1/B3	B1/B7, B2/B4, B1/B3
RF Output Power	2x50mW	2x50mW	2x125mW	2x125mW
RF BW	20MHz	20MHz	20MHz	20MHz
Carrier BW	5, 10, 15, 20MHz	5, 10, 15, 20MHz	5, 10, 15, 20MHz	5, 10, 15, 20MHz
Users	8 LTE connected users	8 W-CDMA + 8 LTE connected users	Upto 16 W-CDMA + 16 LTE	32 W-CDMA + upto 64 LTE
Peak Rate	150 Mb/s DL 70 Mb/s UL	360 Mb/s DL 120 Mb/s UL	360 Mb/s DL 120 Mb/s UL	360 Mb/s DL 120 Mb/s UL
Physical Size	0.5L/0.6kg	1.4L/0.9kg	1.4L/0.9kg	1.4L/0.9kg
Power consumption	15W	23W	23W	23W
Synchronization	NTP	NTP; GPS for B2/B4, OTA	NTP; GPS for B2/B4, OTA	NTP; GPS for B2/B4.OTA
Backhaul	Eth. RJ45	Eth. RJ45	Eth. RJ45	Eth. RJ45
Mounting	Desktop	Desktop, Wall	Desktop, Wall	Desktop, Wall
Regulatory	CE	FCC/CE	FCC/CE	FCC/CE
Form Factor				

# Nokia Smart

## Node

Specification	Details
Access / RF output power	LTE 2x2; 125 mW per Tx (B3/B7, B2/B25/B66) n77(3.7 to 3.98 MHz),n41+)*
Coverage	Residential: 50m; Enterprise: 100m
Bandwidth	LTE: Two Carrier; up to 20+20 MHz, 2xCA 5G: Single Carrier; up to 100 MHz Carrier BW*
User capacity	LTE: up to 32/carrier (64 total) 5G: up to 32
Peak throughput	LTE 2xCA: Scalable up to 360 Mbps DL/120 Mbps UL; 5G: scalable up to 800 Mbps DL/40 Mbps UL*
IoT	NB-IoT, Cat-M (LTE layer)
Physical size	Volume: 3.5 L, Weight: 1.6/1.7 kg
Synchronization	GPS, PTP
Backhaul	2.5 GB Ethernet port
Antenna types	Omnidirectional
Input power	12V DC Input via AC adapter
3GPP Specification	TS25.104 home range, TS36.104 home range, TS38.104

\*5G Access requires easy to install clip-on module

+planned, not in first wave

Confidential

## 4G with easy upgrade to 5G Services Enablement

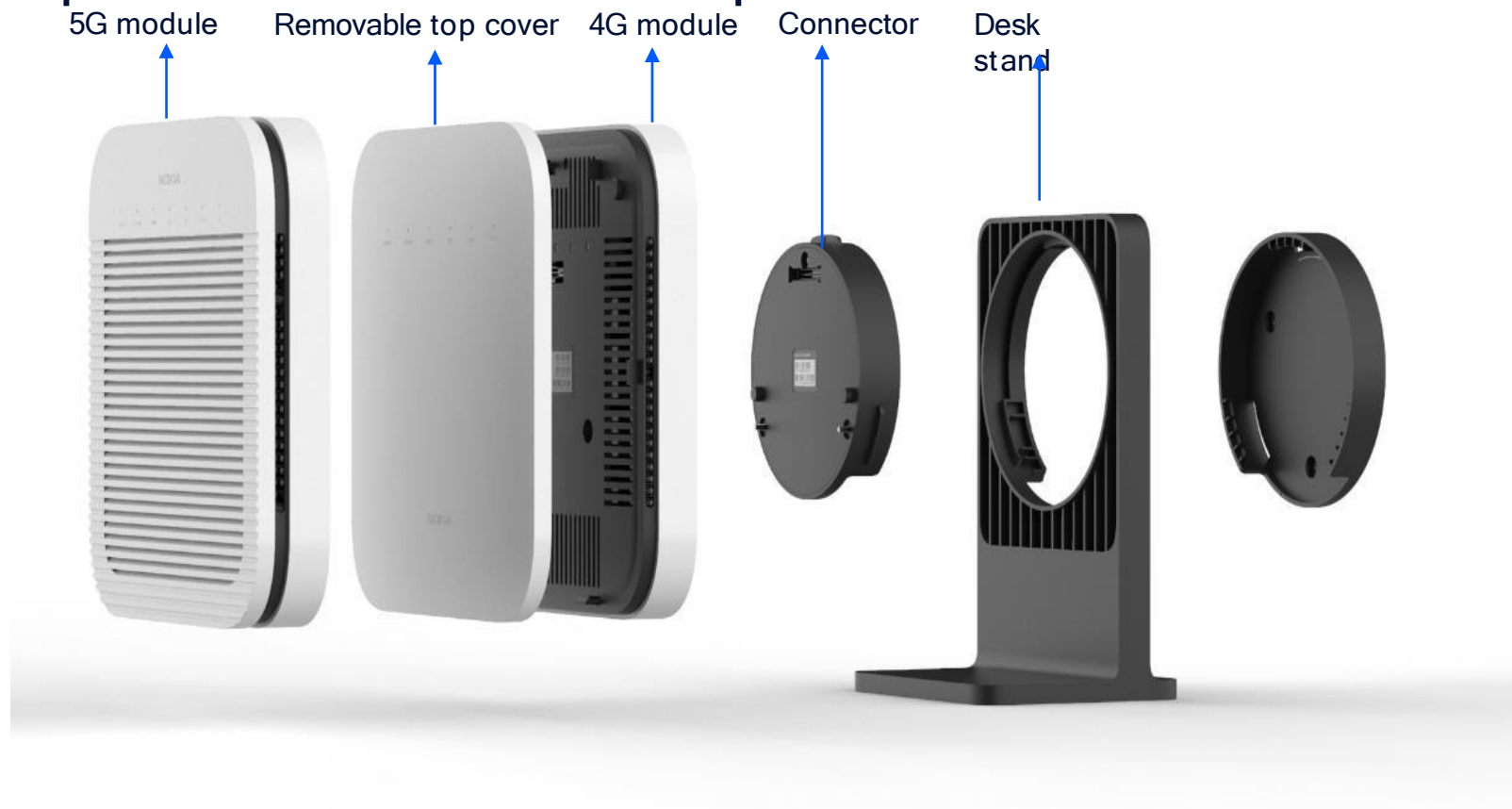
- Award winning design
- Provides ubiquitous coverage from macro network evolving to high capacity indoor 5G solution
- Supports 5G with flexible frequency band and power options - No hardware swap
- Flexible output power and user count options
- Secure plug and play (self install)
- Suitable for small enterprise and residential applications
- NB-IoT and CAT-M ready
- LBO Functionality
- Compact form-factor enables desktop/ wall/ ceiling mount



Image representative only

# Smart Node All-in-One 4G / 5G

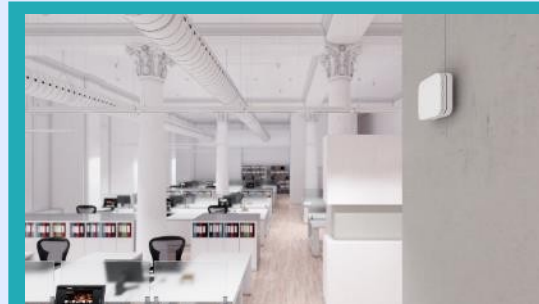
Shape individual customer experiences



## Flexible mount options



Ceiling mount



Wall mount

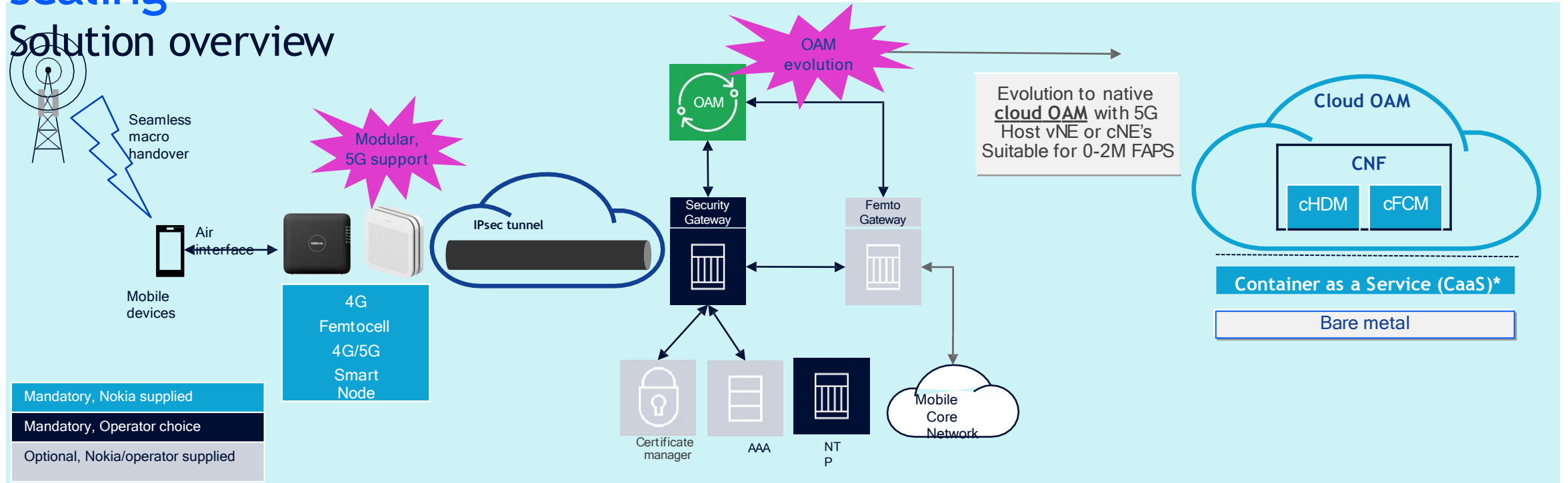


Desktop mount

**NOKIA**

# Cloud evolution enables easy scaling

## Solution overview



### Cloud OAM layer (cOAM)

- Cloud native FCAPs support
- Management of TR-069 devices
- Easy north bound OSS integration
- Orchestration of pre-provisioning and activation workflows.

### 5G FAP and gateway management

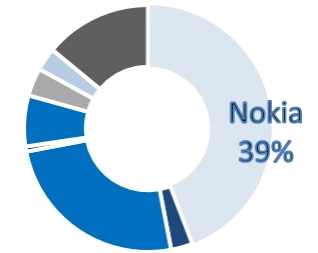
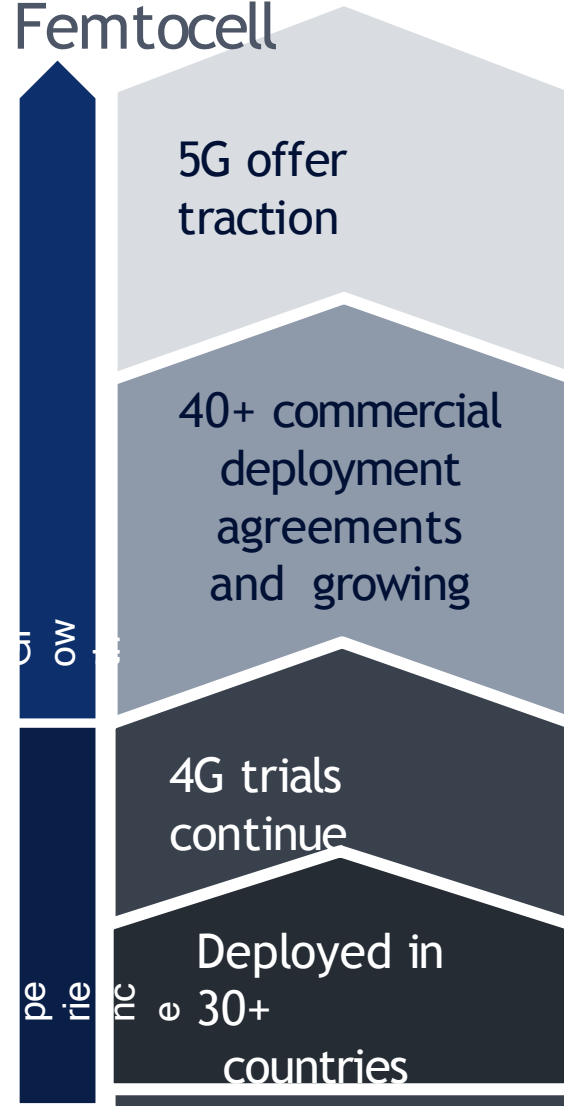
- Supports management of the new 5G/4G Smart Nodes
- Continued support for legacy 4G only access points
- Integrated 4G Femto gateway management

### Security layer (vSeGW+vAAA)

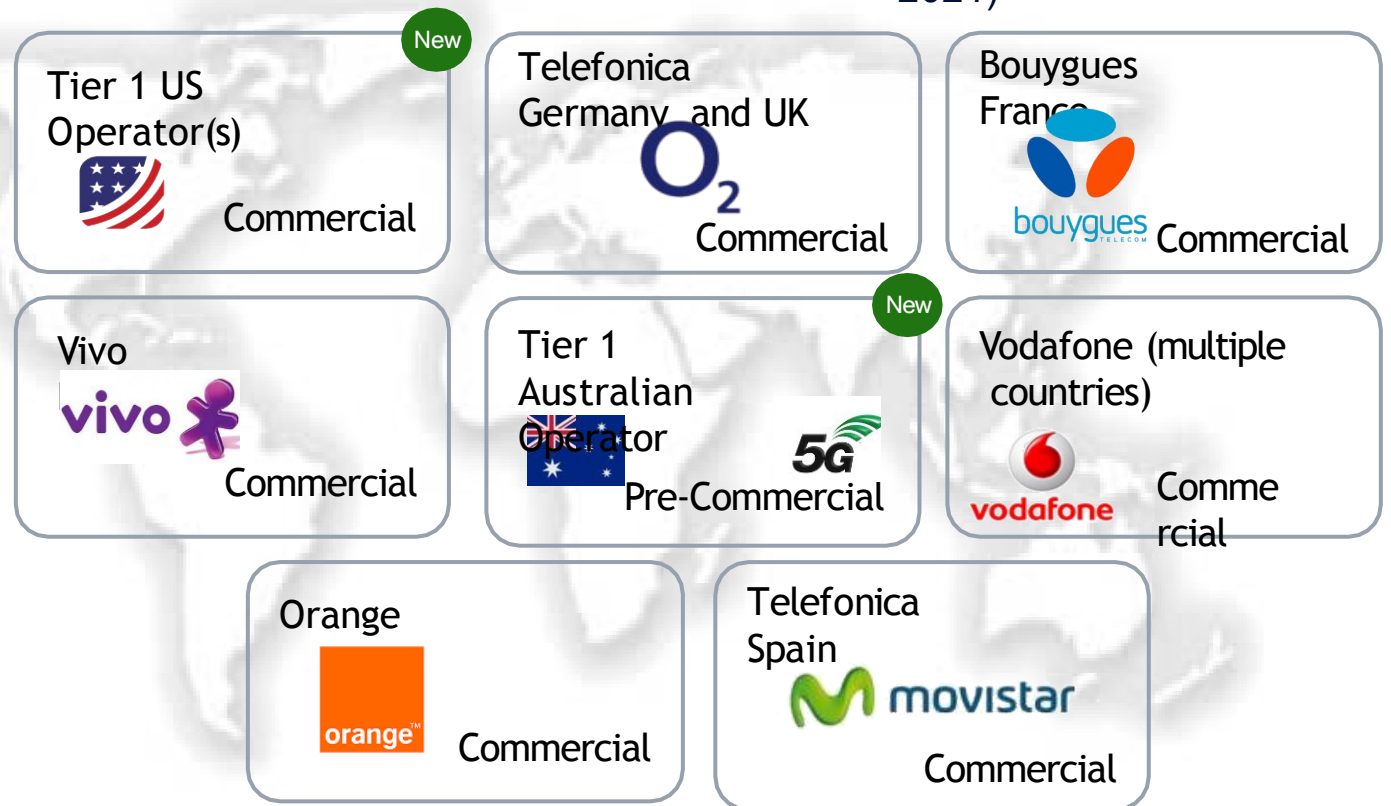
- AP IPsec tunnels of Operators' choice.
- NCM PKI secure identity (digital certificates) for device authentication.
- Optional AAA server for authorization of access (must be NOKIA if Nokia 775x SeGW).

# Success stories and references

## Residential and Enterprise Femtocell



#1 Residential Market Share  
(Source: Mobile experts 2021)



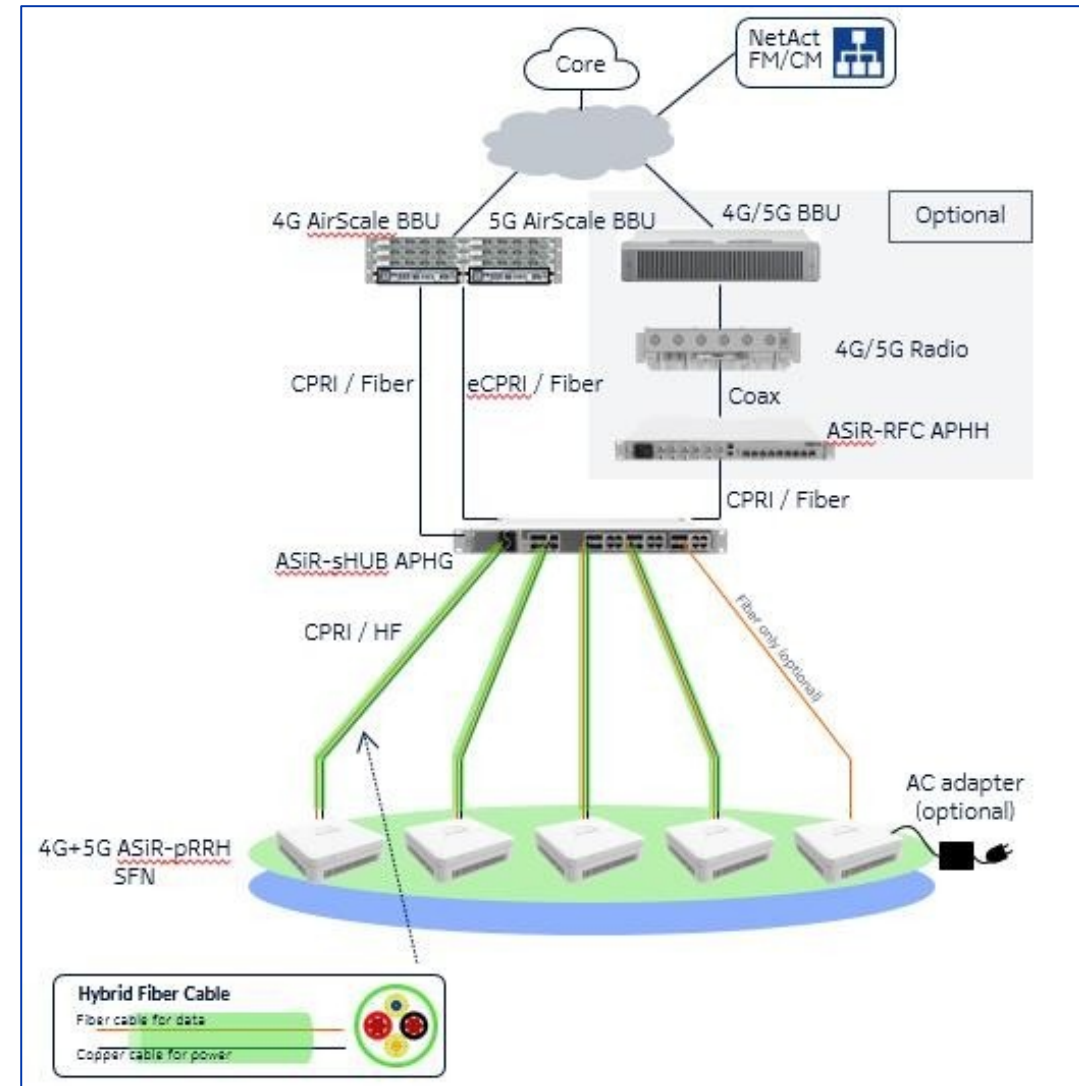
# AirScale Indoor Radio (ASiR)

# AirScale Indoor: Unique and flexible

## Designed with 5G evolution in mind

- Baseband sees sHUB and pRRH as a 4T4R radio unit
- Same feature set and SW, same macro BBU and O&M
- (NetAct) Simple evolution to 5G for already deployed 4G
- Highly scalable indoor solution from small office to very large enterprise
- Standalone or non-standalone architecture
- Low power consumption (~75W) enabling PoE
  - Single frequency network (SFN) (virtual cell) simplifies planning and optimization
  - Integrated / external antenna options offer flexible deployment
- ETH CAT 6 copper or hybrid fiber transport between ShUB and
- pRRHs Capability to support neutral hosting solution

## Architecture



# 5G solution with legacy radio technology support

## AirScale Indoor Radio System

(ASiR)

### 4G+5G Indoor Solution

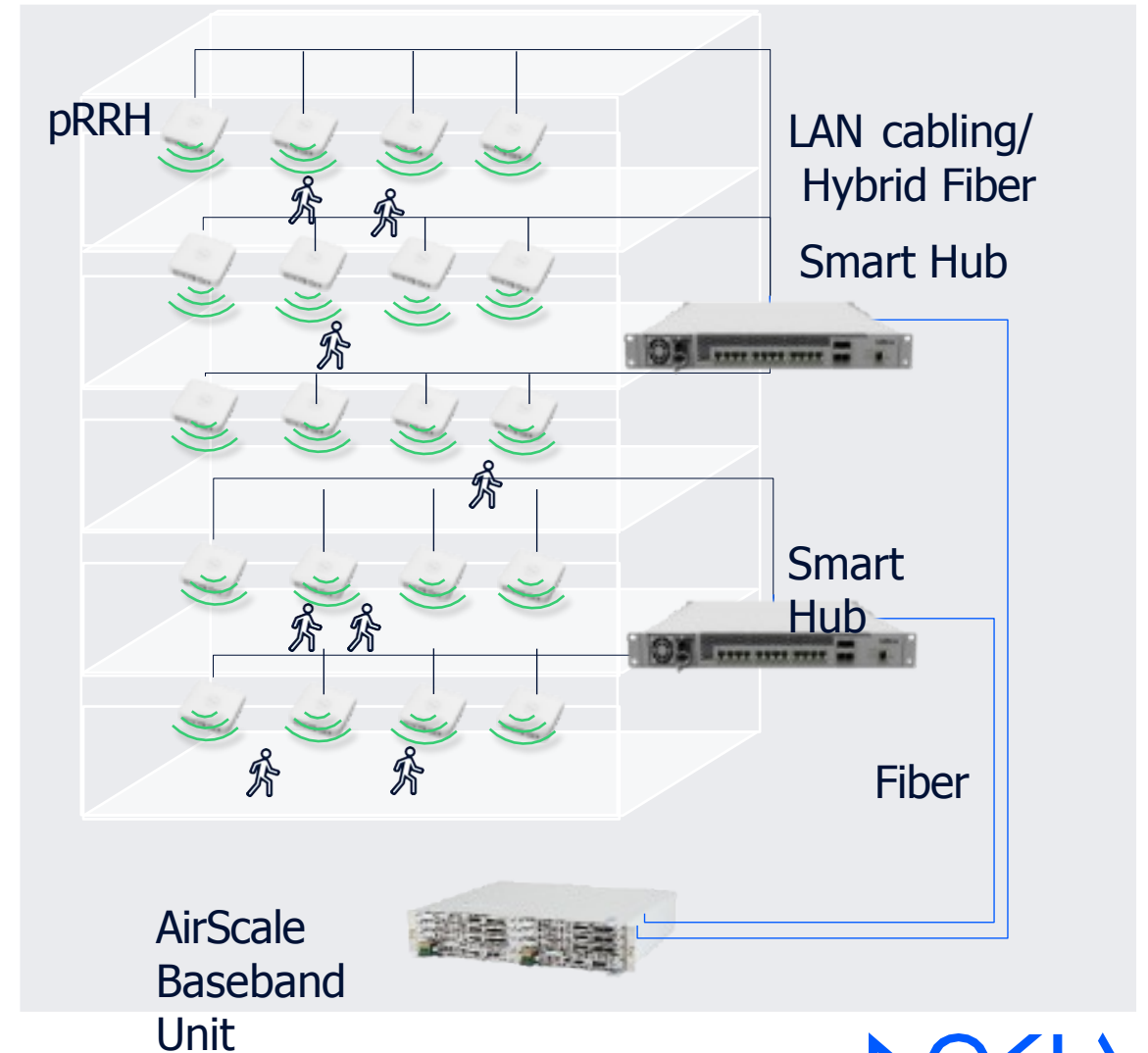
- High capacity with deep indoor coverage

### All Radio Technologies

- 2G, 3G also supported

### Optimized TCO

- 100% macro parity, shares AirScale Baseband Unit with macro
- Single Frequency Network for fast & easy planning; neighbor cell interference mitigation
- Flexible Indoor cabling



# Designed to minimize indoor 5G Total Cost of

5G deployment options with AirScale Indoor

Radio

4G Entry

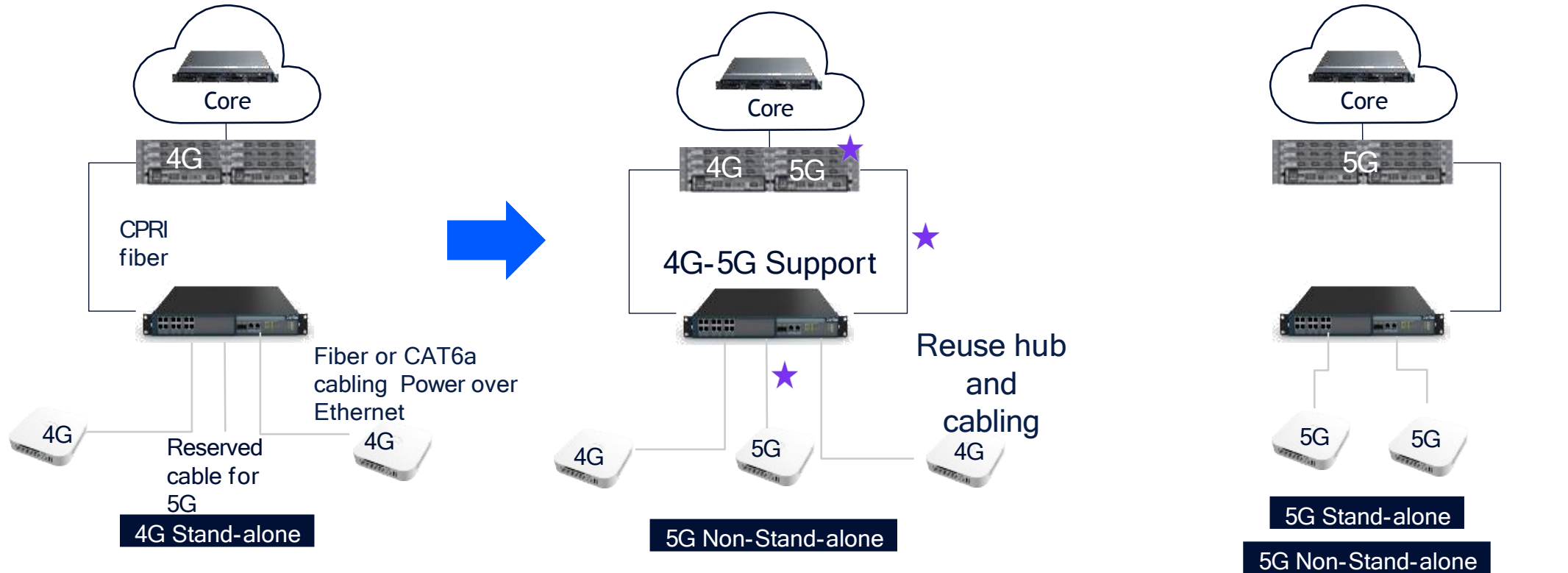
4G and 5G

5G Overlay

AirScale  
Baseband

Smart Hub

Pico  
RRH



4G Stand-alone

5G Non-Stand-alone

5G Stand-alone

5G Non-Stand-alone

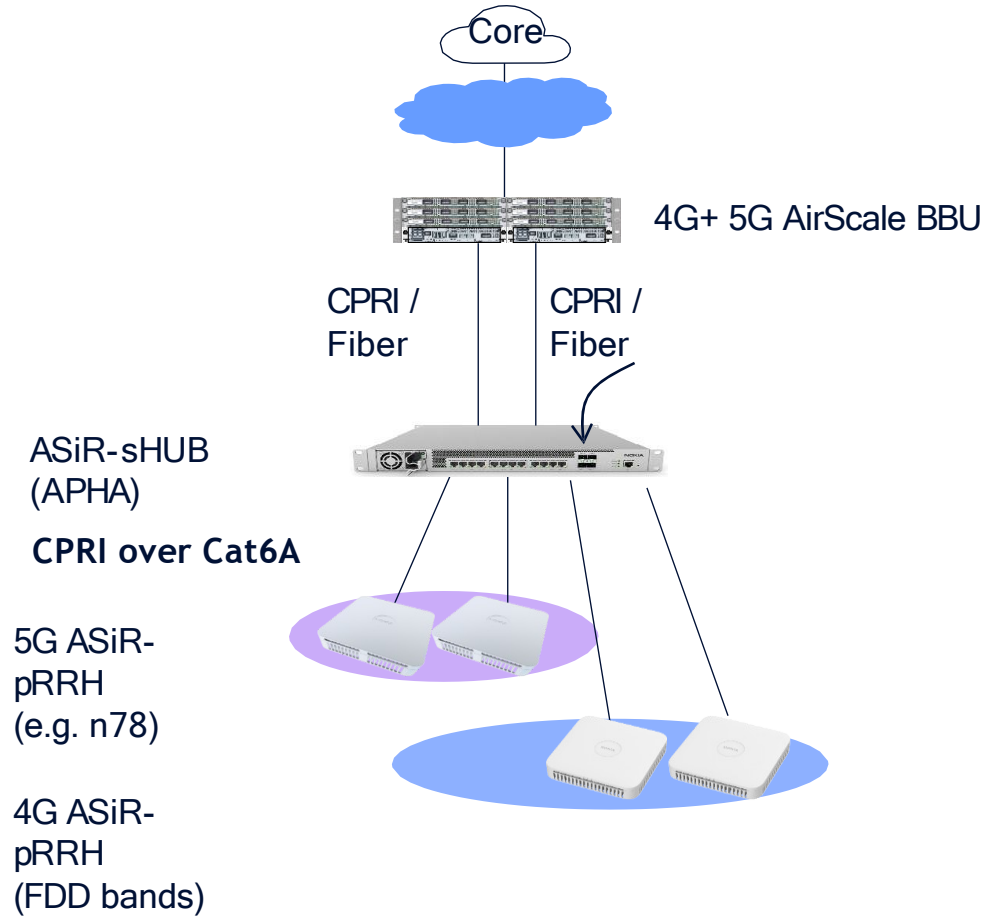
+2G ,3G, 5G FDD  
4G pRRH HW ready for 5G NR  
(FDD bands,  
1800/2100/2600)

★ Limited Components  
added to enable 5G

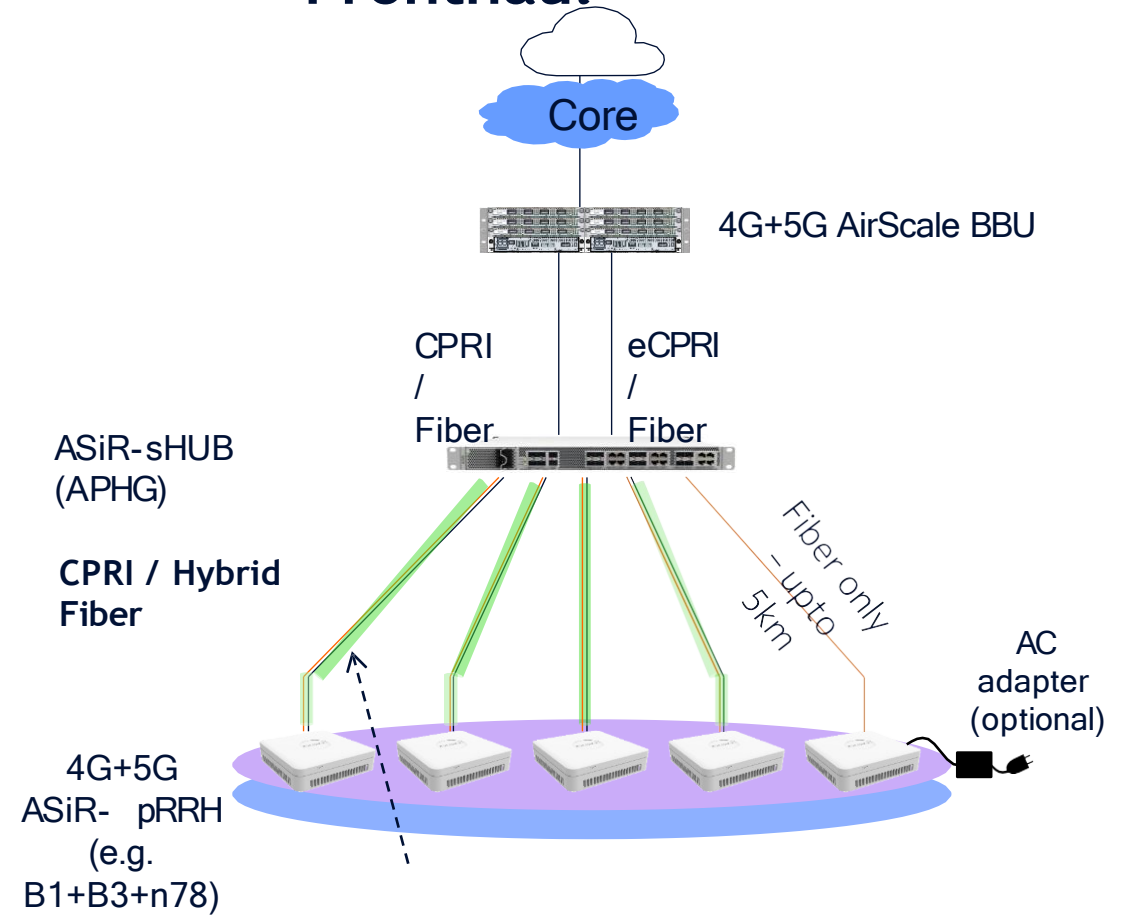
2G/3G/4G DAS or macro  
to provide LTE anchor

# AirScale Indoor Radio System - Copper and Fiber

## Fronthaul Copper Fronthaul



## Fiber Fronthaul



# ASiR-pRRH (pico RRH) - AHGEDA LTE

Specification	Details						
LTE Access Band Frequency	Band 1 + Band 3 + Band 8 (three RF bands)						
	1 <sup>st</sup> band		2 <sup>nd</sup> band		3 <sup>rd</sup> band		
	Band 1 (Full Band) UL: 1920-1980MHz DL: 2110-2170MHz		Band 3 (Full Band) UL: 1710-1785MHz DL: 1805-1880MHz		Band 8 (Full Band) UL: 880-915MHz DL: 925-960MHz		
RF Output Power Carriers	50 to 200mW per Tx Path Up to four LTE carriers per unit;		50 to 200mW per Tx Path Up to two carriers <sup>2</sup> per band		50 to 200mW per Tx Path <sup>1</sup>		
	4G LTE: Up to two 20MHz	3G UMTS: Up to one 15 MHz DAS carrier <sup>3</sup>	4G LTE: Up to two 20MHz	No 2G/3G support	4G LTE: Up to two 10MHz	2G GSM / 3G UMTS: Up to one 15 MHz DAS carrier <sup>3</sup>	
Carrier Bandwidth	5, 10, 15, 20MHz	Up to 15MHz	5, 10, 15, 20MHz	N/A	5, 10MHz	Up to 10MHz for GSM Up to 15MHz for UMTS	
Physical Size	Dimensions: 210mm x 210mm x 50mm; Volume: 2.2L, Weight: 2kg						
Synchronization	CPRI timing recovery						
Fronthaul port <sup>4</sup>	One 5GBASE-T Copper (CPRI over 5GBASE-T)						
Antenna	Configuration: 2 Tx/2 Rx (per band); Types: Integrated Omni; Nominal Gain: -0dBi						
Power Input	PoE++ (802.3bt type 3), DC input via AC adapter is not supported						
Power Consumption	Max (design): 50W						
Regulator	@ ETSI						

## AirScale Indoor Radio System Solution ASiR-pRRH Benefits

- Centralized flexible architecture enabling graceful 5G insertion
- 2G/3G support via RF converter
- Best performance vs. size (up to two 2x200mW bands)
- High capacity
- 256QAM, Carrier Aggregation
- Carrier-grade software quality
- Proven plug & play for light touch install
- Enhanced scaling via SFN



AHGEDA:  
475175A

# AWHENHC ASiR-pRRH

## 2T2R/4T4R

### B3+B40/n40+B41/n41 2.6W

Specification	Details
Standard	3GPP / SRRC / MIIT
Band / Frequency Range	3GPP Band B3 TX 1805-1830MHz, RX 1710-1735MHz, B40/n40 TX 2320-2370MHz, RX 2320-2370MHz, B41/n41 TX 2515-2675MHz, RX 2515-2675MHz,
Max. Supported Modulation	256QAM
Number of TX/RX Paths	B3: 2T2R, B40/n40: 2T2R, B41/n41: 4T4R
Instantaneous Bandwidth IBW	B3: 25MHz, B40/n40: 50MHz, B41/n41: 160MHz
Occupied Bandwidth OBW	B3: 25MHz, B40/n40: 50MHz, B41/n41: 160MHz
Max. Output Power per TRX	AWHENHC: 2T2R 250mW, 4T4R: 400mW, AWHENHD: 2T2R 200mW, 4T4R: 300mW
Dimensions	222mm x 222mm x 67mm
Volume	3.3L
Weight	2.9kg
Supply Voltage / Connector Type	PoE++/RJ45; 1) DC cable pair with "RJ45-to-DC" adapter, 2) External AC adapter
Power Consumption	67 W (Full power, 100% throughput, typical)
Antenna Ports, Calibration Port	AWHENHC: Integrated antenna, AWHENHD: 8x SMA female
ALD Control Interfaces	N/A
Optical Ports	1x SFP28 for CPRI rate 10
Other Interfaces / Connector Type <sup>1</sup>	1x RJ45 for power input
Operational Temperature Range	0°C to 40°C
Cooling	Convection cooling (without fans)
Installation Options	Wall, ceiling
Ingress	IP20

<sup>1</sup> There is no dedicated local maintenance port. Local maintenance will be done via console port on ASiR-shUB.

## AirScale Indoor Radio System Solution ASiR-pRRH benefits

- Compact solution for 4G+5G multi-RAT & multi-band indoor deployment
- Centralized flexible architecture
- Best performance vs. size
- Hybrid fiber fronthaul for longer distance between ASiR-shUB and ASiR-pRRH
- Enhanced scaling via SFN
- Integrated / external antenna option for deployment



AWHENHC:  
476210A

NOKIA

# AWPNA/AWPNB AirScale Indoor pRRH 4T4R B40/n40 1W

## AirScale Indoor pRRH benefits

- Optimal solution for industrial IoT or enterprise use cases
- Cost-effective and reliable indoor solution
- Direct fronthaul eCPRI connection to BBU
- Best performance vs. size
- 4x250mW Tx output power
- 100MHz BW carrier, 256QAM support
- Carrier-grade software quality
- Proven plug & play for light touch install



Product Specifications	
Standard	3GPP / ETSI / ANATEL, TDD
Supported RAT	4G/5G
Band / Frequency range	RX 2300 MHz - 2400 MHz, TX 2300 MHz - 2400 MHz
Max. supported modulation*	256QAM
Number of TRX paths	4T4R
Instantaneous bandwidth (IBW)	100MHz
Occupied bandwidth (OBW)	100MHz
Max. output power per TRX and total	250mW / TRX (1 W total), SW settable up to 7dB down
Dimensions (H×W×D)	250 x 250 x 63.2 mm
Volume	4L
Weight (excluding mounting bracket)	3.1kg
Supply voltage / Connector type	PoE++ 43-57V / RJ45
Antenna ports	AWPNA: Integrated antenna AWPNB: 4x SMA female
Optical ports*	1 x SFP28 Port eCPRI up to 25GE
Other interfaces / Connector type*	1 x RJ45 Port eCPRI up to 10GE and power input
Operational temperature range	-20 °C ... +40 °C
Cooling	Convection cooling (without fans)
Installation options	Wall, ceiling
Ingress / Surge protection	IP20, PoE++ Power Port: 0.5kV/0.25kA 1.2/50µs & 8/20µs

AWPNA 476361A / AWPNB 476362A

**NOKIA**

# ASiR-pRRH B1/n1+B3/n3+B7/n7

Supporting 2G, 3G, 4G, 5G - tri-band/ four carriers

Specification	Details					
LTE Access Band Frequency	Band 1 + Band 3 + Band 7 (Three RF bands)					
	1 <sup>st</sup> band		2 <sup>nd</sup> band		3 <sup>rd</sup> band	
	Band 1 (Full Band) UL: 1920-1980MHz DL: 2110-2170MHz		Band 3 (Full Band) UL: 1710-1785MHz DL: 1805-1880MHz		Band 7 (Full Band) UL: 2500-2570MHz DL: 2620-2690MHz	
RF Output Power	50 to 200mW per Tx Path		50 to 200mW per Tx Path		50 to 200mW per Tx Path	
Carriers	Up to four LTE carriers per unit; Up to three LTE carriers + one 2G/3G DAS carrier <sup>1</sup> per unit; Up to two carriers <sup>2</sup> per band					
	4G LTE: Up to two 20MHz	3G UMTS: Up to one 15 MHz DAS carrier <sup>2</sup>	4G LTE: Up to two 20MHz	2G GSM: upto 10MHz DAS Carrier	4G LTE: Up to two 20MHz	5G FDD one 20MHz carrier
Carrier Bandwidth	5, 10, 15, 20MHz	Up to 15MHz	5, 10, 15, 20MHz	N/A	5, 10, 15, 20MHz	N/A
Physical Size	Dimensions: 210mm x 210mm x 50mm; Volume: ~2L, Weight: ~2kg					
Synchronization	CPRI timing recovery					
Fronthaul port	One 5GBASE-T Copper (CPRI over 5GBASE-T)					
Antenna	Configuration: 2 Tx/2 Rx (per band); Types: Integrated Omni; Nominal Gain: ~0dBi					
Input Power	PoE++ (802.3bt type 3), DC input via AC adapter is not supported					
Regulatory	ETS					

1. One DAS carrier may contain multiple 3G carriers  
2. Contiguous carriers

## AirScale Indoor Radio System Solution ASiR-pRRH Benefits

- Centralized flexible architecture enabling graceful 5G insertion
- 5G FDD and DSS support
- 2G and 3G support via RF converter
- Best performance vs. size (up to three 2x200mW bands)
- High capacity
- 256 QAM, Carrier Aggregation
- Carrier-grade software quality
- Proven plug & play for light touch install
- Enhanced scaling via SFN



AHGEHA

# AirScale Indoor Radio 5G pico RRH

Specification	Details
RF Output Power	50mW to 250mW per Tx path
RF Bandwidth	OBW: 100MHz; IBW: 100MHz
Carriers	one 5G NR carrier
Carrier bandwidth	20,40,60,80,100MHz
Physical Size	Dimensions: 210mm x 210mm x 54mm Volume: 2.3L, Weight: 2.1kg
Synchronization	CPRI timing recovery
Fronthaul port	Two 5G/10GBASE-T Copper; Port Type: RJ45 Ethernet; (Support 9.8Gbps CPRI over 10GBASE-T with and without IQ compression.)
Antenna	Configuration: 4 Tx/4 Rx (per band) Types: Integrated Omni Nominal Gain: ~0dBi
Power Supply	PoE++ (802.3bt compliant PoE interface); Type 4 as PD, Type 3 as PSE for daisy-chaining with 4G ASiR-pRRH; DC input via AC adapter is not supported

Band	Frequency	Product
n78	3.4-3.6 GHz	AWHQA
	3.6-3.8 GHz	AWHQB
	3.3-3.6 GHz	AWHQC
	3.45-3.7 GHz	AWHQQ
n41	2.496-2.69 GHz	AWHHA

## AirScale Indoor Solution 5G ASiR-pRRH benefits

- Centralized flexible architecture
- Best performance vs. size
- Up to 4x250mW Tx output power
- 100MHz BW carrier, 256QAM support
- Carrier-grade software quality
- Proven plug & play for light touch install
- Enhanced scaling via SFN



AWHQA

# AirScale Indoor pico RRH: B1/n1+B3/n3+n78

Supports up to 100+100 MHz or n78 spectrum

Specification	Details		
Access	LTE/5G NR; B1/n1 + B3/n3 + n78 (Three RF bands)		
Band Frequency	1 <sup>st</sup> Band (B1/n1)	2 <sup>nd</sup> Band (B3/n3)	3 <sup>rd</sup> Band (n78)
	UL: 1920-1980MHz DL: 2110-2170MHz	UL: 1710-1785MHz DL: 1805-1880MHz	<b>UL: 3420-3800MHz DL: 3420-3800MHz</b>
RF Output Power per Tx Path	50 to 200mW	50 to 200mW	<b>50 to 250mW</b>
Number of carriers	Up to two (LTE/NR/DSS) + additional NB-IoT carrier	Up to two (LTE/NR/DSS) + additional NB-IoT carrier	<b>Up to two (NR)</b>
Carrier Bandwidth	5, 10, 15, 20MHz	5, 10, 15, 20MHz	<b>20, 30, 40, 50, 60, 70, 80, 90, 100MHz</b>
IBW / Total OBW Physical Size <sup>3</sup>	60MHz / 40MHz Dimensions: 222x222x67mm; Volume: 3.3L, Weight: 2.9kg	75MHz / 40MHz	<b>200MHz / 200MHz</b>
Synchronization	CPRI timing recovery		
Fronthaul port <sup>4</sup>	One SFP28 for CPRI rate 10; Two RJ45 for power input and 10GBASE-T		
Input Power	(1) DC cable pair with "RJ45-to-DC" adapter, (2) External AC adapter		
Antenna	Configuration: 2T2R for B1/n1 and B3/n3, 4T4R for n78; AWHGEQJ: Integrated omni, ~0dBi nominal gain; AWHGEQK: External antenna (SMA female connector interface)		
Regulatory	ETS		

## ASiR-Gen3 pRRH benefits

- Compact solution for 4G+5G multi-RAT & multi-band indoor deployment
- NEW: 2G (B3) and 3G (B1) support in 23R2
- Centralized flexible architecture
- Best performance vs. size
- Hybrid fiber fronthaul for longer distance between ASiR-sHUB and ASiR-pRRH
- Enhanced scaling via SFN
- Integrated / external antenna option for deployment flexibility



AWHGEQJ

# Live Site / Abu Dhabi / 5G NSA 2x100MHZ n78 Data

5G NSA FR1 TDD CA n78c n78+n78 100Mhz+100Mhz Configuration (3GPP 38.101)

\* Overall Throughput limited to 2 Gbps per subscription in Core

RF Measurement Battery Temperature 38.50 (°C)

	PCell	SCell1
Serving PCI	469	
EARFCN	1850	
Band	3	
RSRP(dBm)	-78.79	
RSRQ(dB)	-4.27	
SINR(dB)	25.84	
DL TP(Mbps)	0.01	
UL TP(Mbps)	0.01	
<b>LTE</b>		
Serving PCI	930	930
Serving Tx Beam ID	0	0
NR-ARFCN(Band)	643296(78)	649920(78)
Duplex Mode	TDD	TDD
SCS(kHz)	30kHz	
SS-RSRP(dBm)	-64.19	-66.30
SS-RSRQ(dB)	-10.36	-10.32
SINR(dB)	35.41	36.61
DL TP(Mbps)	0.00	0.00
UL TP(Mbps)	0.01	
<b>5G NR</b>		

F1=3.6..3.7 GHz F2=3.7..3.8 GHz



# Selecting right sHUB depending on requirements and

## Cat6a Ethernet vs. Hybrid Fiber sHUB

Cat6A (copper) cabling,  
CPRI: sHUB APHA



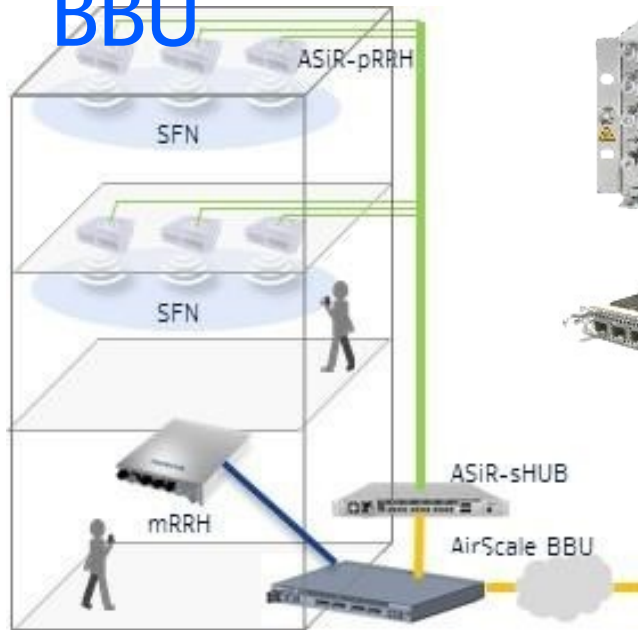
Optical/Hybrid fiber, CPRI/  
eCPRI: sHUB APHG



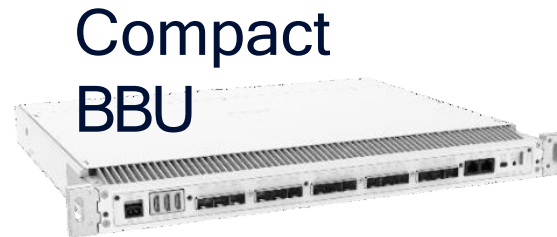
- Capacity :  
100MHz 4T4R TDD + 4x20 MHz 2T2R FDD
- Single Cat6a cable supports 10G- CPRI  
1x 100MHz 4T4R - no need to invest in fiber unless more capacity is needed.
- Connect through Cat6a cable (2G/3G/4G/5G) FDD pRRH and 5G TDD pRRHs with RJ45 port
- 4x9.8Gbps CPRI towards BBU
- No hybrid fiber connectivity to pRRH

- Enhanced HW Capacity supporting 5G evolution
  - HW ready 4 x 100 MHz 4T4R (1600MHz)
  - Support 4G+5G pRRH full capacity  
200 Mhz 4T4R TDD + 4x20MHz 2T2R FDD
- Hybrid fiber support 25G CPRI for 4G+5G pRRH
- 2x 25GbE eCPRI + 4x9.8Gbps CPRI towards BBU - enhanced fronthaul capacity
- 4G or 5G pRRH with RJ45 port (copper) connected using Hybrid Fiber Converter

# High Capacity AirScale Indoor BBU



ABIO  
plug-in



Compact  
BBU

## ABIO capacity card

support with hybrid fiber (APHG sHub)  
(5G21B)

- 5G with Cat6A (APHA sHub) (22R3)
- 4G with hybrid fiber and Cat6A (22R3)
- Concurrent 4G+5G (23R1)

ASIB common card support (SRAN20C,  
5G20A) ASIL common card support (22R2)

## ASOE support:

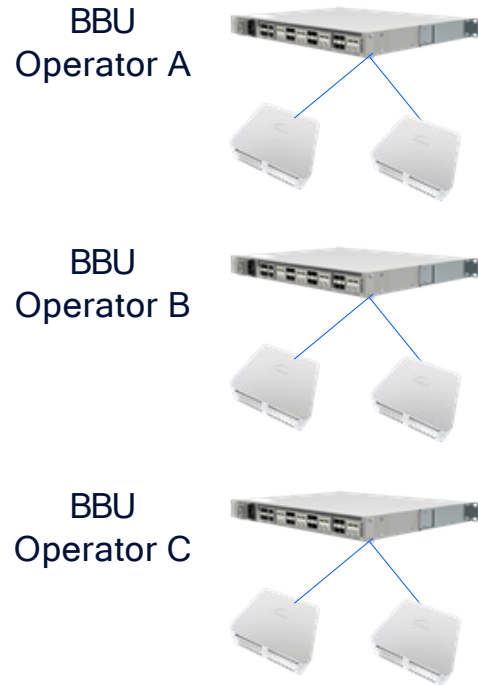
- 5G with hybrid fiber (APHG sHub)  
(22R3)
- 5G with Cat6A (APHA sHub) (22R4)
- 4G FDD (22R4)
- Concurrent 4G+5G (23R1)

# Multi-Operator Indoor Solution

# Three ways to implement a multi-operator indoor architecture

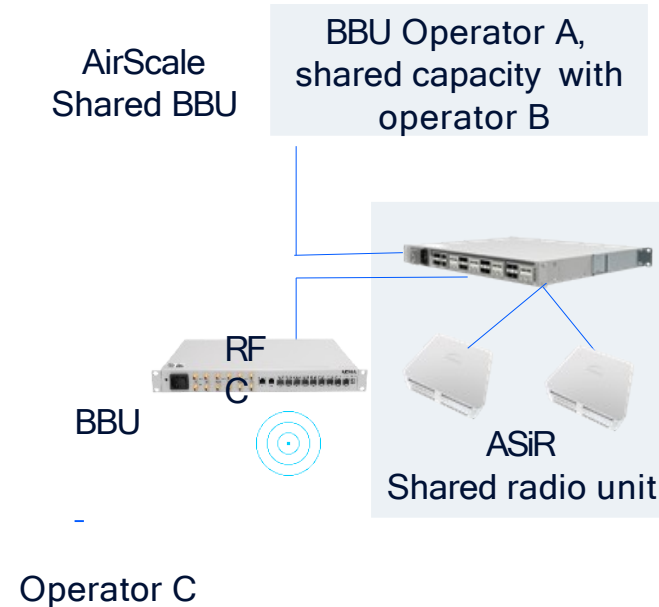
ASiR can address all scenarios

Each operator runs own network



No optimization

Lead operator

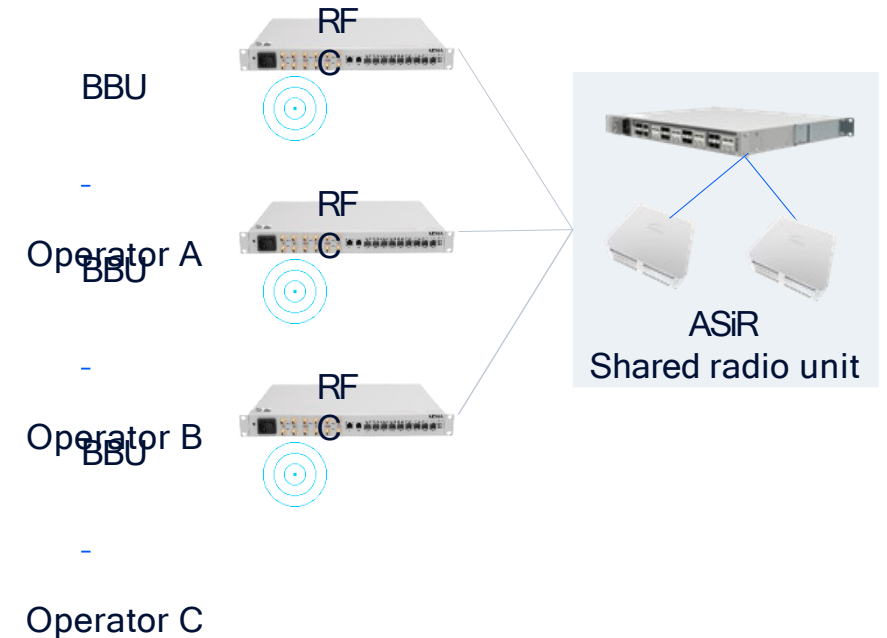


Sweet spot for CSPs

- Fully digitized RF
- Less equipment (BBU, RU)
- Energy saving

Attenuated RF

Neutral host

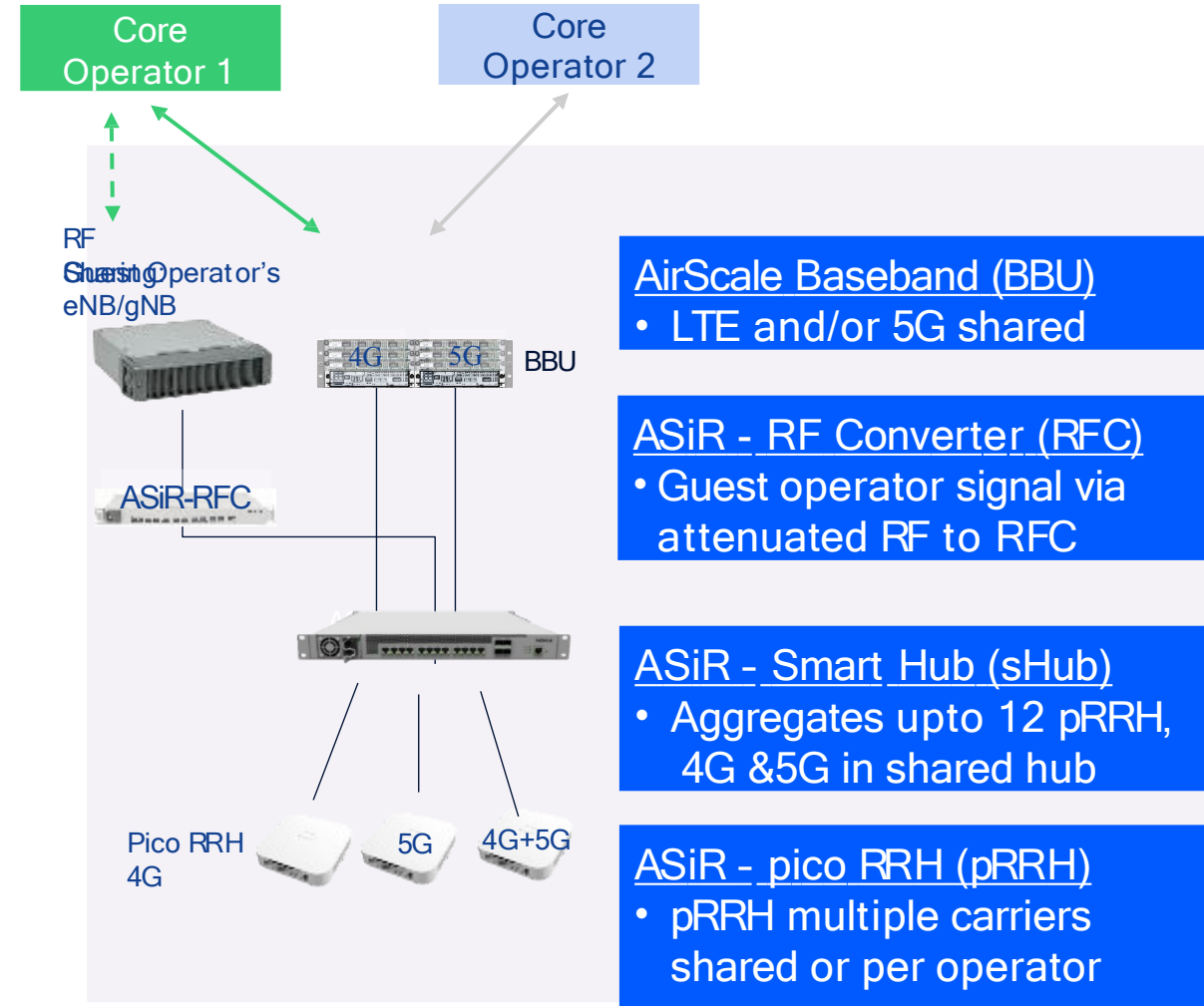


Active DAS-like, multi-vendor

# Flexible Multi-Operator Indoor sharing

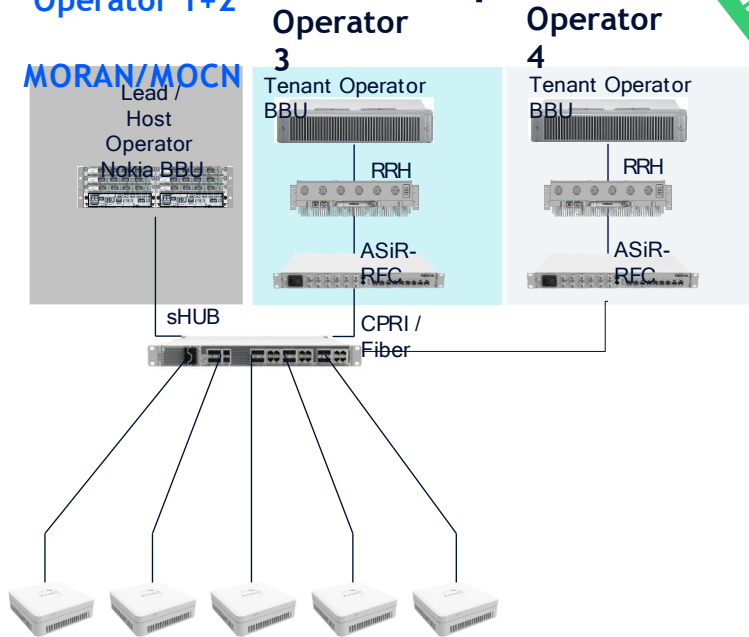
## AirScale Indoor Radio (ASiR)

- AirScale Indoor connects to AirScale Baseband Unit using CPRI via AirScale Indoor Smart Hub
- **MOCN** supported - 6 operators
- MORAN supported with 2 flavors:
  - **MORAN with shared Baseband Unit**
    - Operators have shared baseband, sHub and pRRH
  - **MORAN with RF Converter (RFC)**
    - All operators have dedicated baseband, but pRRH and sHub shared
    - Guest operator's eNB/gNB connected through RFC
- Dedicated or shared cells can be implemented in same ASiR solution

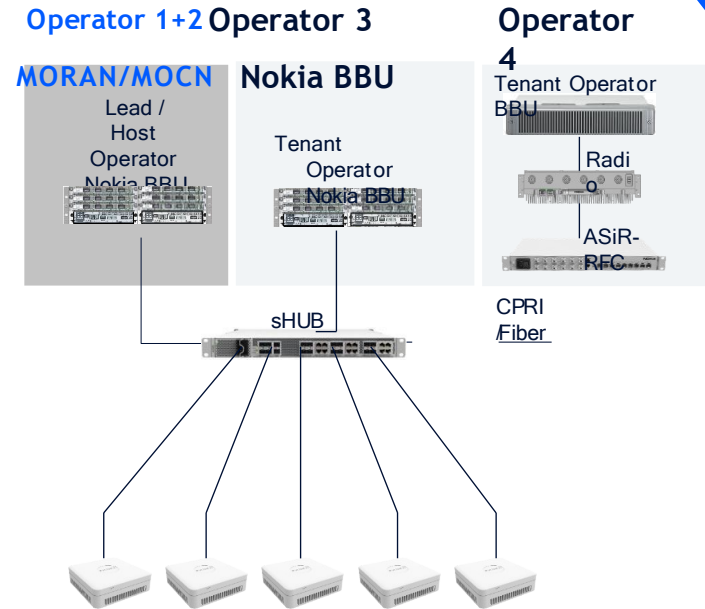


# Multi-Operator Deployment

## Scenario : Lead Operator Model



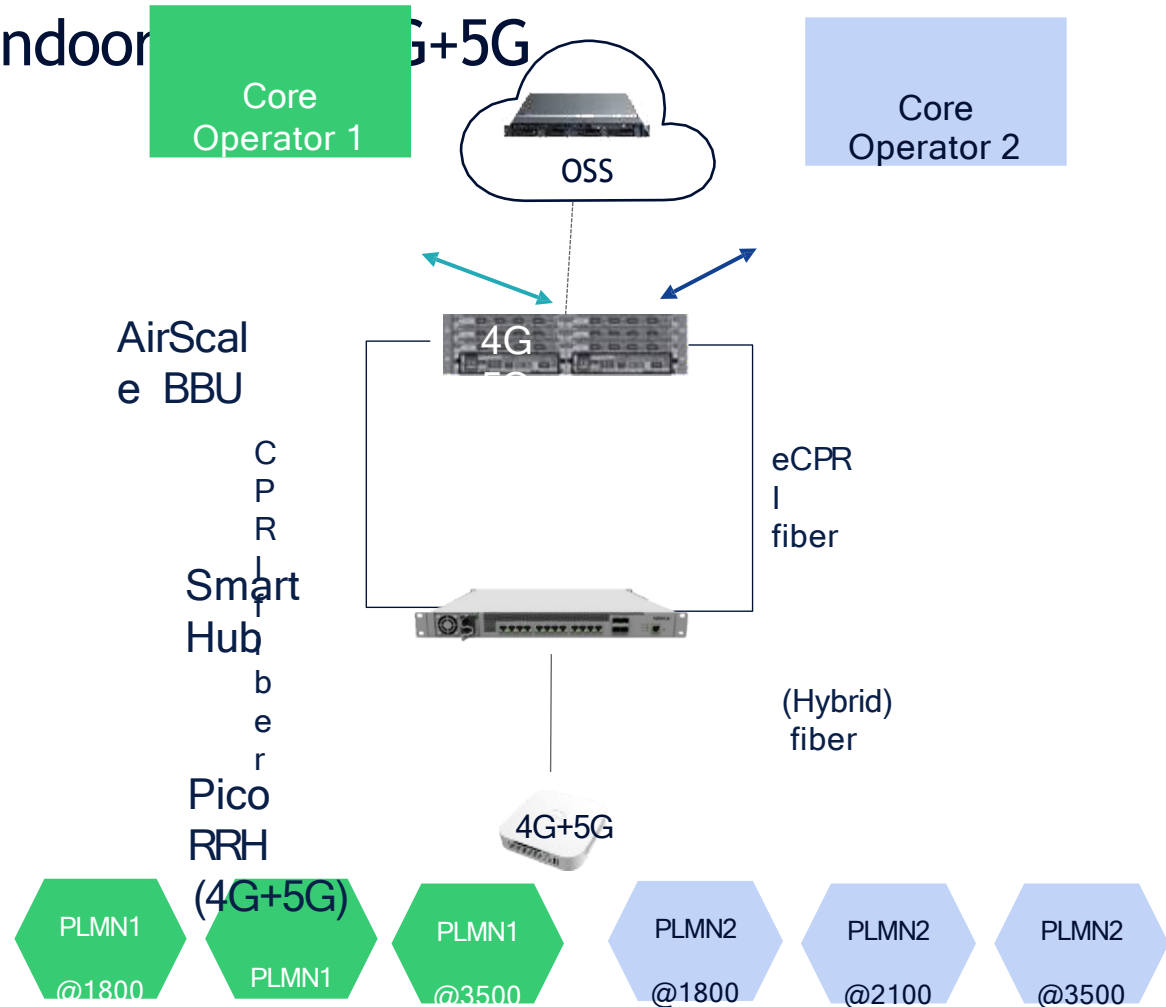
- Two operators share AirScale BBU (MORAN/MOCN) - one host operator, e.g. TTN
- Two tenant operators connected through RFC with own Nokia or non-Nokia BTS



- Two operators share AirScale BBU (MORAN/MOCN) - one host operator, e.g. TTN
- One Tenant Operator with Nokia BBU direct CPRI/eCPRI connection to sHub
- One tenant Operator connected through RFC with own Nokia or non-Nokia BTS

# Two operator ASiR solution - MORAN/MOCN

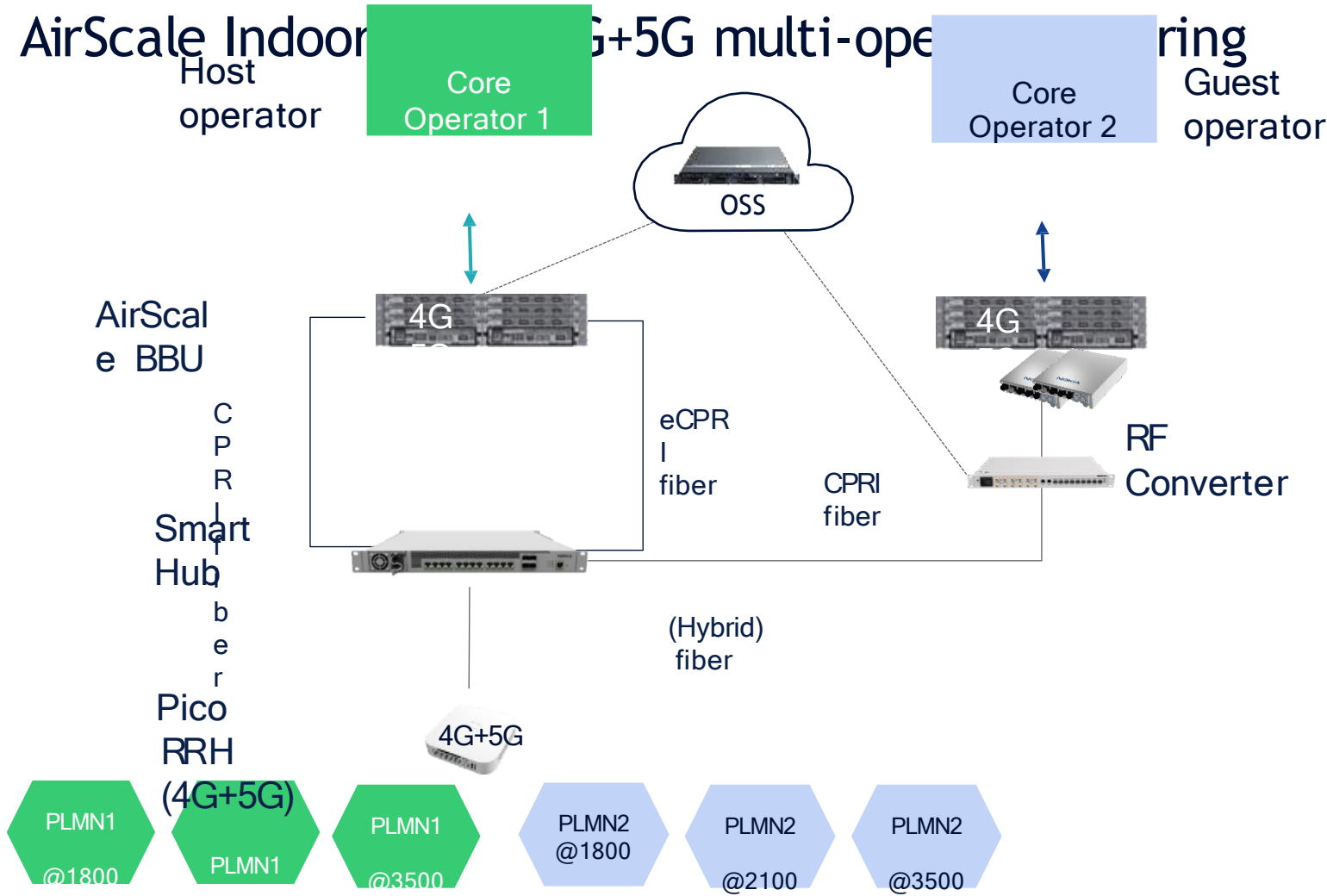
AirScale Indoor



- Operators use their own dedicated spectrum
- Shared AirScale BBU
- Smart Hubs, cabling and Pico RRH are shared
- Single entity to operate - either one of the operators or neutral entity (like N!)
- 5G TDD n78 carriers on same band in a single pRRH within 200MHz oBW&iBW

# Guest operator using dedicated eNB/gNB through RF Converter

AirScale Indoor Host operator **Core Operator 1** 4G+5G multi-operator **Core Operator 2** Ring Guest operator



- Operators use their own dedicated spectrum with own baseband unit
- Smart Hubs, cabling and Pico RRH are shared, but operated by Host Operator
- Host Operator's baseband connected using CPRI/fiber to Smart Hub
- Guest operators' 4G and 5G base station (BBU+RF) connected through 5G RF Converter similar to DAS connection
- 5G carriers on same band in a single pRRH within 200MHz to BW & iBW

# AirScale Indoor RF Converter

## (RFC) Technical Data - APHH

Specification	Details
Supported RAT	2G, 3G, 4G, 5G
RF signal feed port	Twelve SMA connectors with Simplex/Duplex Tx/Rx ports: <ul style="list-style-type: none"><li>– Two sets of 4T4R RF feed ports for NR FR1 TDD</li><li>– Two sets of 2T2R RF feed ports for FDD.</li></ul>
ASiR-sHub Interface Port	Eight SFP ports with 24.3Gbps CPRI interface
Maintenance ports	Two 100BASE-T interface with RJ-45 connector
Bands	2300-4200 MHz (TDD) 1710-2690 MHz (FDD) Supported band is dependent on ASiR-pRRH capability
Temperature range	Operational 0...+40C, storage -40...+70C
Dimension	440mm(W) × 420mm(D) × 44mm(H)
Weight	8.5kg
Input power	100 - 240VAC, 50/60Hz
Synchronization	CPRI timing

## AirScale Indoor Radio System solution

### ASiR-RFC Benefits

- Inject GSM, WCDMA, LTE and 5G FR1 signal from external BTS
- Physical connectivity with up to eight ASiR-sHubs
- CPRI interface to ASiR-HUB
- Multi-Tech RF conversion (RF analog to CPRI digital data)



APHH

# AirScale Indoor Solution

## summary

### Copper Fronthaul

- Indoor distributed architecture
- 4G + 5G with smooth upgrade path
- All key bands covered - also 2G,3G support
- Multi-operator 4G

### Fiber

- Fibre based platform for higher capacity and longer range
- NR/DSS for 4G pRRH

### 4G+5G Multi-operator

- 4G+5G pRRH (gen3 pRRH)
- Multi-operator 4G+5G
- Compact baseband

AirScale Indoor

#### 4G dual-band pRRHs

- B1+B3
- B3+B40



#### 4G tri-band pRRHs

- B1+B3+B7
- B1+B3+B8



#### 5G pRRHs

- n78 (B42) AWHQA
- n78 (B43) AWHQB



#### 5G pRRHs

- n78 mid-band AWHQQ
- n41 AWHHA

#### Ethernet sHUB APHA

- CAT 6A cabling
- 100MHz NR+4x20MHz LTE



CPRI

#### RF-Converter

- APHB RF ports for 2/3/4G RF access



#### Ethernet Extender

- APHD Dual-port ethernet extender



#### SW features:

- 5G FDD FR1 support on 4G pRRH
- DSS in ASiR
- GSM (B3) support
- BBU: High Capacity ABIO support for ASiR hybrid fiber solution (5G)

#### Optical/HF sHUB APHG

- Upto 4x100MHz NR
- Hybrid fiber

#### CPRI/eCPRI



#### Hybrid Fiber Converter APHF

- Hybrid Fiber to PoE++



#### Tri-band 4G+5G pRRH (HF)- 22R3

- 200MHz oBW/iBW
- B1+B3+n78
- Other band combinations



#### 5G pRRH (HF) - 22R3

- n77
- Other bands

#### RF-Converter 5G (22R3)

- APHH 5G Signal feeding upto 4.2GHZ



#### Baseband (22R3... 23R1)

- Compact BBU ASOE
- High capacity ABIO support



# Direct Connect pRRH

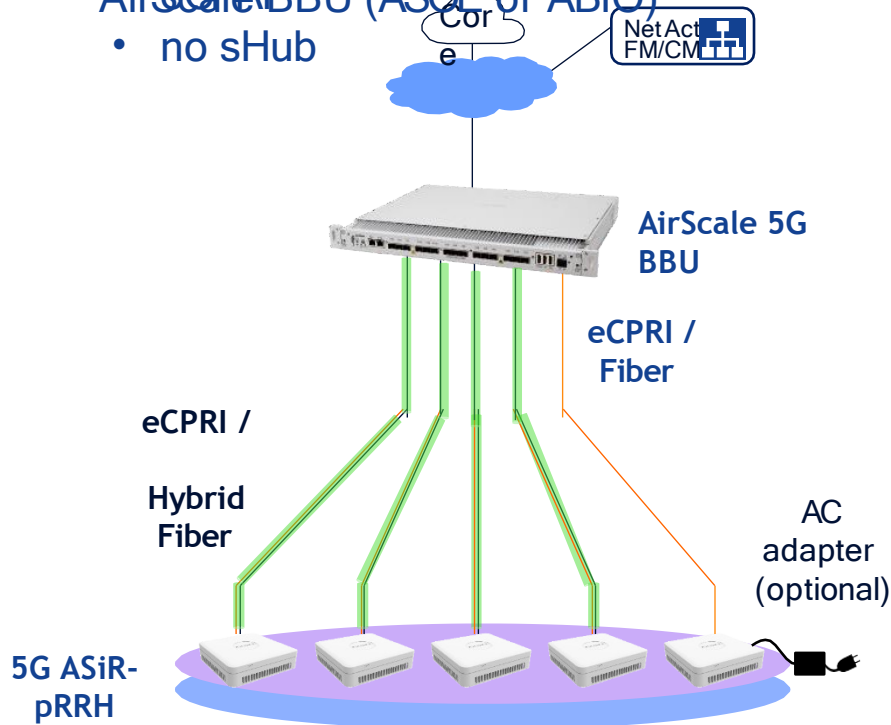
# Direct Connect 5G AirScale pRRH Solution

5G Stand-Alone n77 (3.8-4.2 GHz) available

New Direct Connect variants planned in 24R1

- B38/n38
- B40/n40

- Direct connect pico RRH with AirScale BBU (ASOE or ABIO)
- no sHub



## AirScale Indoor pico RRH Solution Benefits

- Optimal solution for industrial IoT or enterprise use cases
- Cost-effective and reliable indoor solution
- Direct eCPRI fronthaul connection to BBU
- Best performance v.s. size
- 4x250mW Tx output power
- 100MHz BW carrier, 256QAM support
- Carrier-grade software quality
- Proven plug & play, no touch install

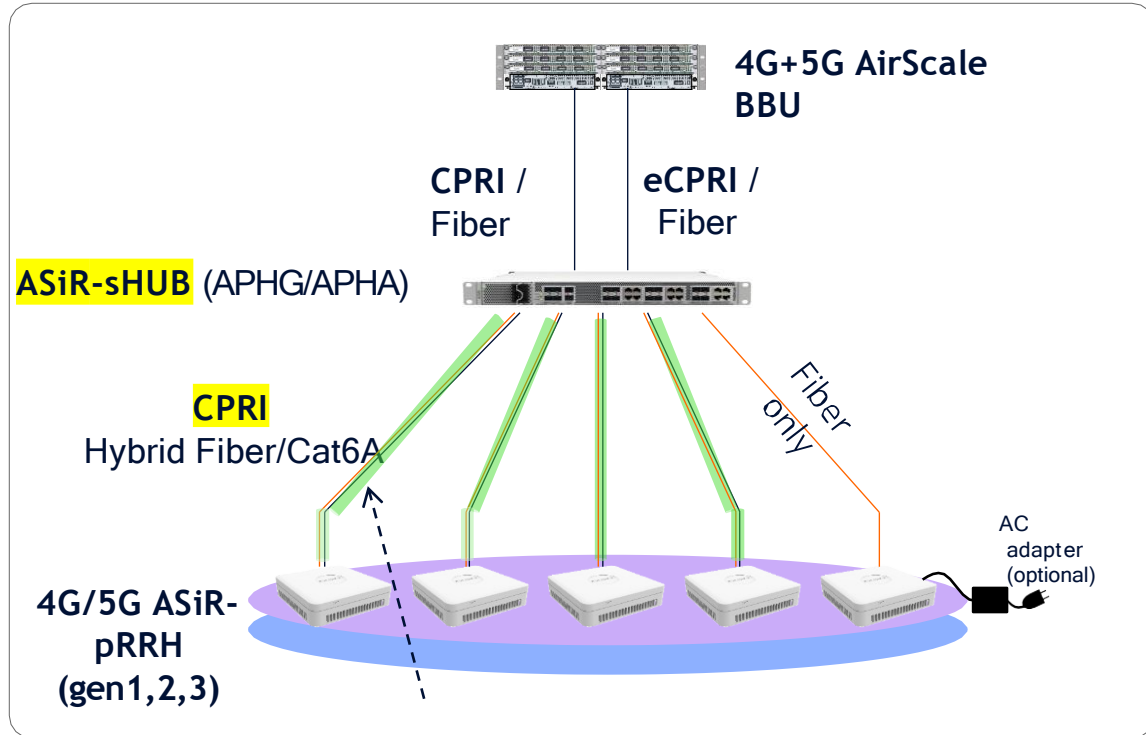


※ Physical design is subject to change

# AirScale Indoor Radio System vs Direct Connect

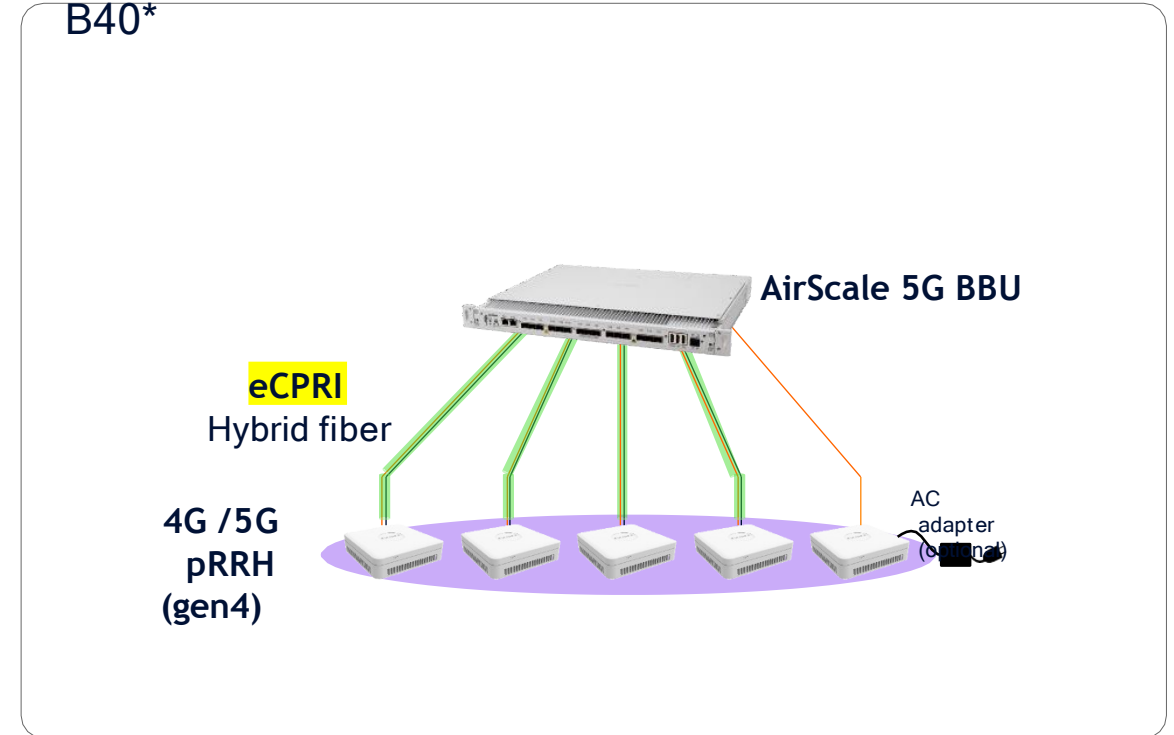
## ASiR - always with sHub

- Medium to large deployments, multi-operator support
- Multi-band - supports also 4G and 5G FDD, 2G and 3G
- CPRI between pRRH and sHub



## Direct Connect pRRH - without sHub only

- Small to medium deployments, private networks
  - eCPRI, based on Reefshark 6602
  - 5G Stand-alone - single band (n77, n79, CBRS, n38\*, n40\*)
  - 4G supported on CBRS, B38\* and B40\*
- \*planned in 24R1



# Outdoor Micro for Street or Hotspot Coverage

# AHGB AirScale Micro RRH 4T4R n1/B1 20W

## Technical data

	Product Specifications
Standard	3GPP/ETSI
Supported RAT*	3G/4G/5G, IoT (IB,GB), FDD
Band / Frequency range	Band-1 (RX: 1920-1980MHz; TX:2110-2170MHz)
Max. supported modulation*	256QAM (TX), 64QAM (RX)
Number of TX/RX paths	4T4R
Instantaneous bandwidth (IBW)	60MHz
Occupied bandwidth (OBW)	60MHz
Max. RF output power	20W
Dimensions (H×W×D)	DC: 295mm x 245mm x 55mm; AC: 295mm x 270mm x 55mm;
Volume	DC: 4.0L; AC: 4.5L
Weight (excluding mounting bracket)	DC: 5.4Kg; AC: 6.5kg
Supply voltage / Connector type	DC: -40.5V to -57V/OCTIS Plug Kit DC Power AC: 80V to 276V (via external AC/DC converter) /OCTIS Plug Kit AC Power
Antenna ports	Nex-10
Optical ports	2x SFP+ Ports CPRI 9.8 Gbps (Rate 7)
Other interfaces / Connector type	One EAC port, supporting two external alarms
Operational temperature range	-40 °C ... +55 °C
Cooling	Convection
Installation options	Pole, Wall, Bookshelf, Stacked, Shroud
Ingress / Surge protection	IP65, AC/DC Power Port: ±6 kV pulse 1.2/50 μs, RS=2Ω

## AirScale Micro RRH benefits

- Manages cell site costs with right size radio for the right purpose.
- Reduces OPEX with common management system for Macro and Micro cells
- Provides deployment flexibility for different use cases with versatile installation scenarios
- Tunable Output Power



AHGB -474514A

# Band 3 AirScale Micro RRH 4T/4R 20W

(AHEU) AirScale Micro Remote Radio Head (RRH): Compact and remote multicarrier solution: 474513A

Specification	Details
LTE access	Band 3 UL: 1710 - 1785 MHz / DL: 1805 - 1880 MHz
RF output power	Up to 4x5W per TX path (0.5 dB steps down to 50mW)
Capacity/bandwidth	Up to 4 carriers IBW: 75 MHz; OBW: up to 75 MHz;
Physical size	DC: ~4L/ ~5.4Kg; AC: ~4.5L / ~6.1Kg
Dimensions	DC: 295 x 245 x 55mm AC: 295 x 273 x 55mm
Interfaces	2 CPRI ports for Fronthaul (2x 9.8Gbps) 1 port for External Alarm
Mounting Options	Wall, Pole, Strand, Enclosure, Bookshelf
Antenna	Configuration: 4T4R or 2T2R MIMO Types: Integrated Directional or External Connector: Nex10
Power Consumption	110W (Typ.); 150W (Max)
Input power	DC: -40.5V to -57V AC: 80V to 276V (via external AC/DC converter)
Regulatory	ETSI

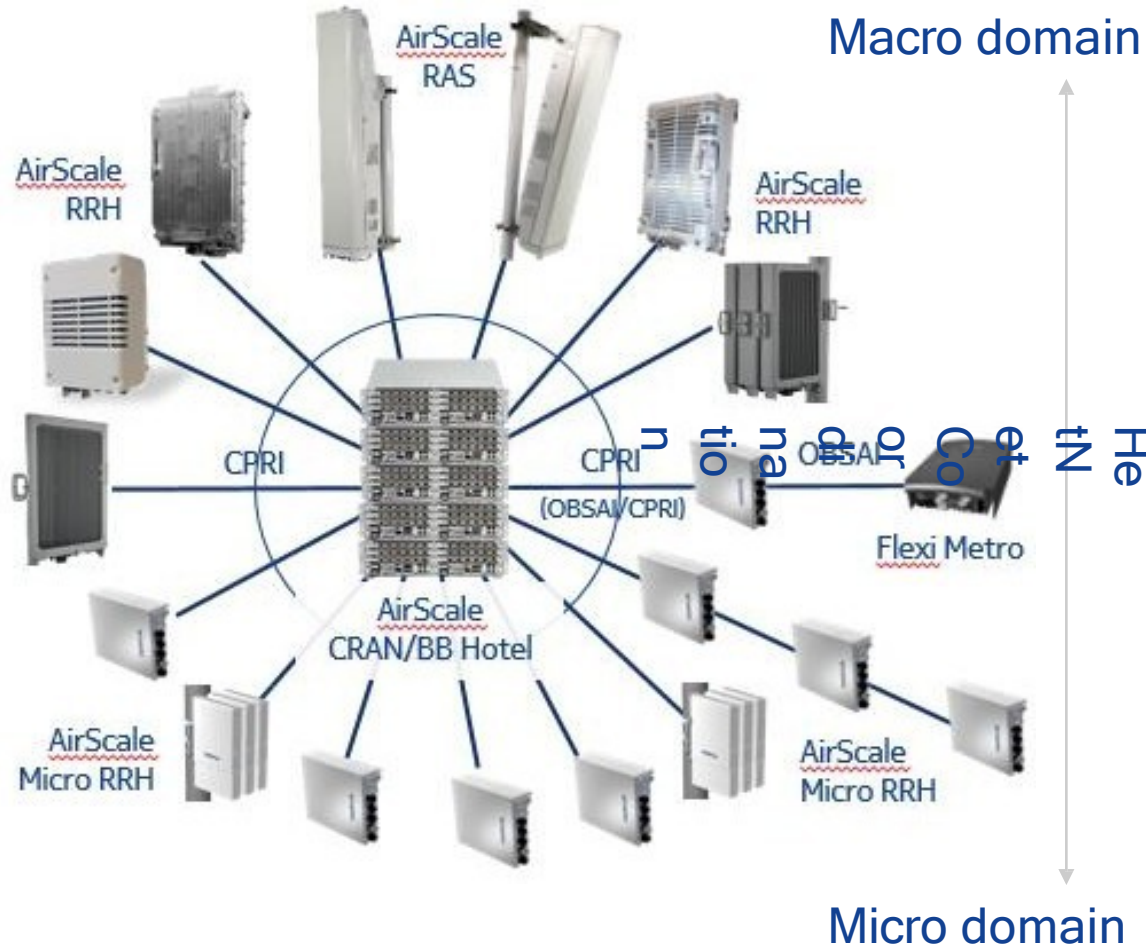
## AirScale Micro Remote Radio Head benefits

- Manages cell site costs with right size radio for the right purpose.
- Reduces OPEX with common management system for Macro and Micro cells
- Provides deployment flexibility for different use cases with versatile installation scenarios
- Tunable Output Power



# Nokia AirScale Micro RRH Benefits

## Seamless HetNet Coordination @ all levels



Optimum macro & micro cell mix btw. high & low power RRH's & RAS with common baseband unit

Manage cell costs with right size radio for right purpose

Reduced OPEX with common management

Optimized cell size with right pwr level per location/use case

Seamless HetNet micro-macro coordination as one single system

AirScale baseband HW & SW driving all radios

Macro/micro feature parity across all RRH's

Full support of 4,5G/4,5G Pro:  
Multi-CCA, CoMP

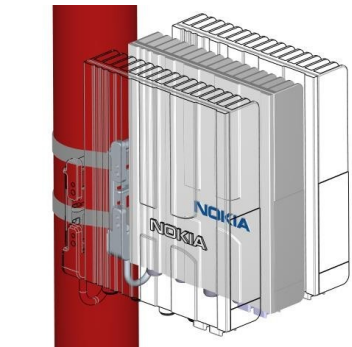
# AirScale Micro RRH - versatile installation

## scenarios

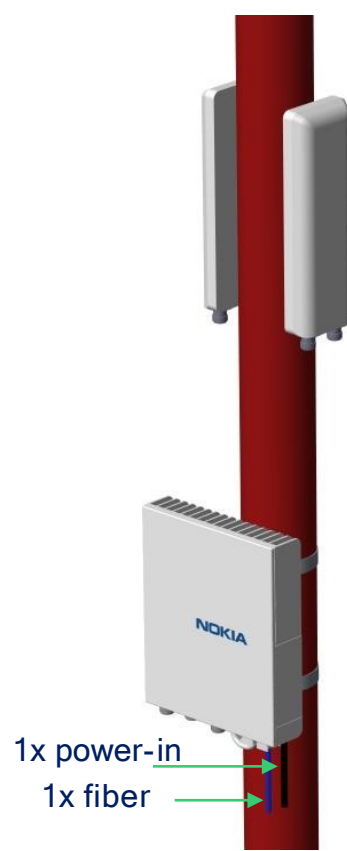
Pole mount - flat



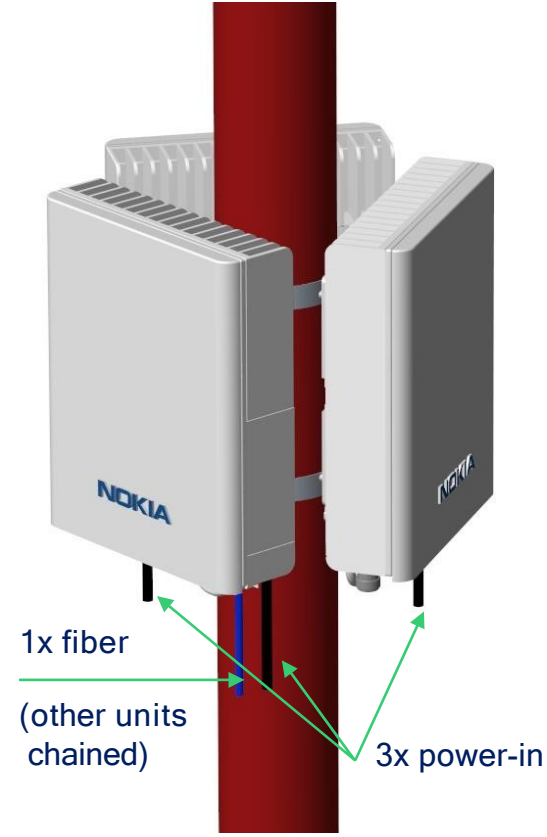
Pole book-mount



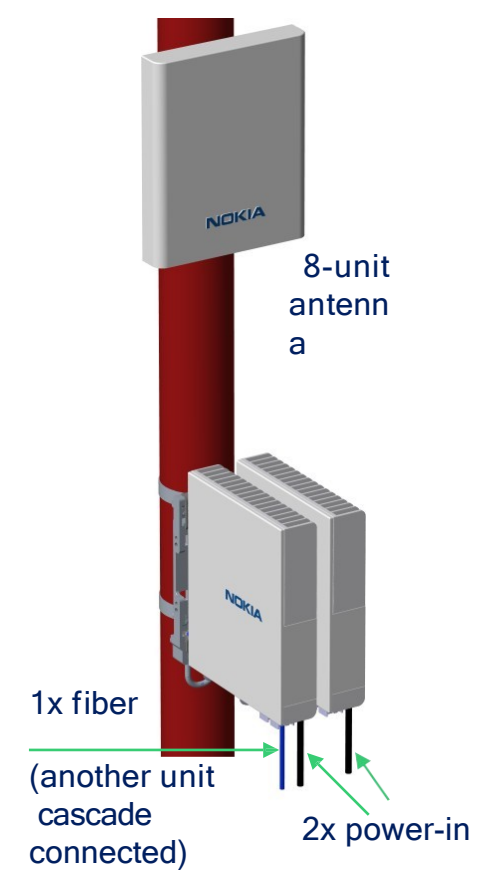
1 unit:  
1 band (cell) 4T4R w/  
integrated antenna



1 unit:  
2bands/cells @ 2T2R  
w/ external antenna or  
eMIMO omni sticks



3 units:  
3 bands/cells @ 4T4R with  
integrated dir. antenna  
1 fiber (w/CPRI compression  
& chaining)



2 units :  
1 band/cell @ 8T8R w/ ext.  
antenna (future 8x8 MIMO  
support)

# AirScale Micro 4x5 W - Compact size



FlexiMetro 2T/2R

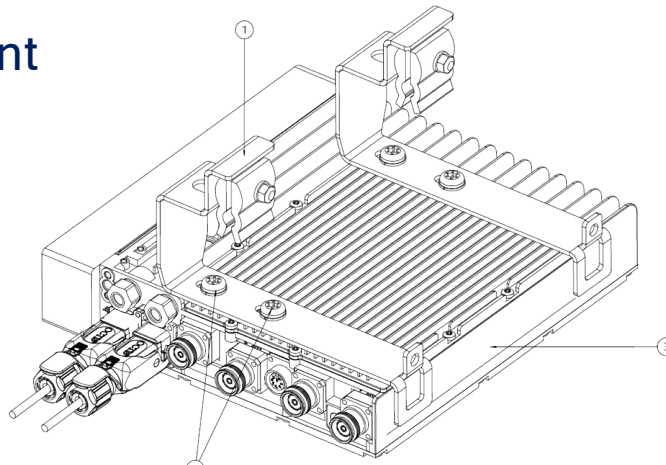
AirScale Micro 4T/4R



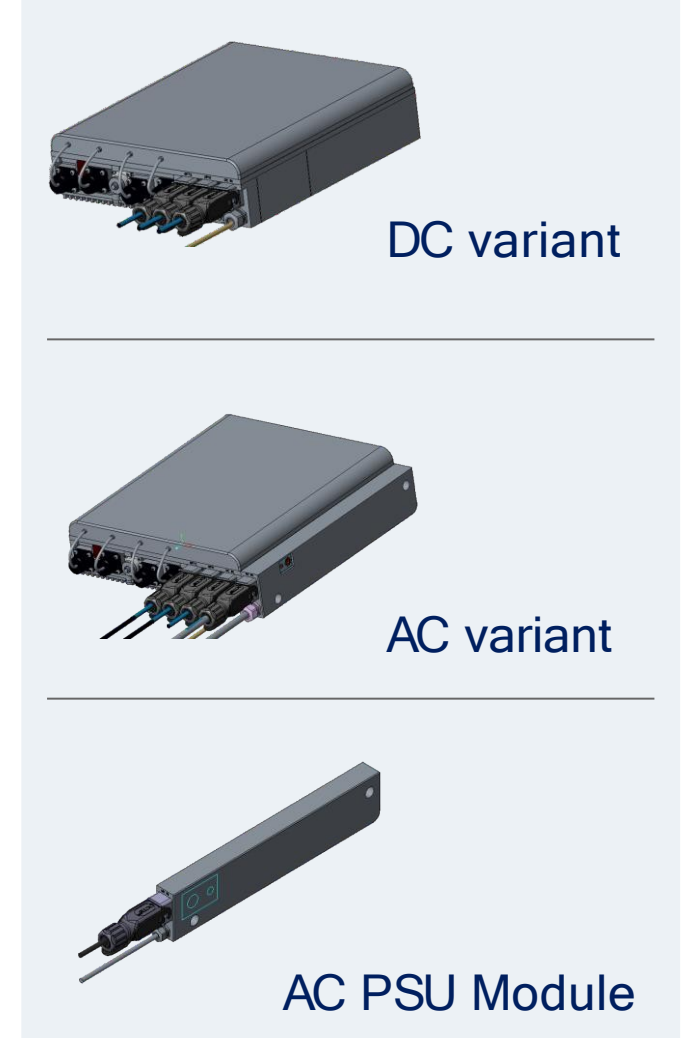
AirScale Metro vs. iPad



Shroud-mount



Strand-mount



DC variant

AC variant

AC PSU Module

# Small cells power solutions

Providing reliable power & backup to small cells

## Introduction

Nokia proposes a unique AC/DC to DC power solution with backup. Same form factor than any other Flexi platform product, this lightweight and compact solution fits perfectly with power need of DC small cells. The FPMA Power solution is available with different installation and mounting options.

RAN -  
Pico



## Applications

Greenfield site / site modernization

Good grid, outdoor site,  
Short battery autonomy

## Benefits

Cost effective solution  
Easy mounting  
Zero footprint, zero  
maintenance



Rectifier



FPBB (Battery)

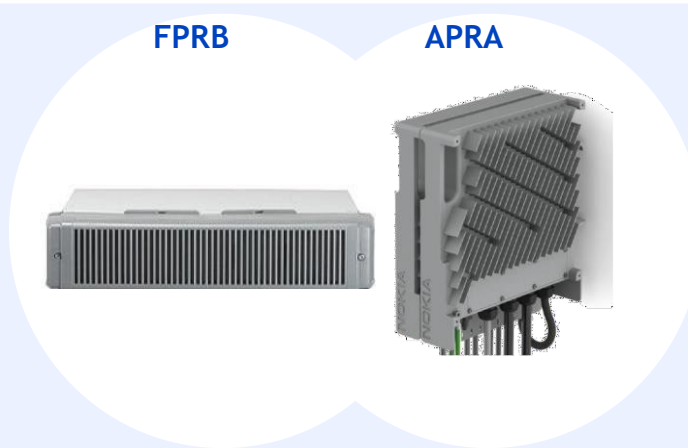
# Nokia Flexi and AirScale power rectifiers - FPRB &

## APRA<sup>1</sup> Zero footprint solution with high energy efficiency

### Flexi Power Rectifier B

#### (FPRB)

- Zero footprint high efficiency (~95%) rectifier for outdoor use (IP65)
- Advanced features: load shifting<sup>2</sup>, eco mode and generator support
- Scalable to large loads: from 3 kW to 27 kW, 25 kg per 9 kW
- Weight: 25 kg (one chassis and 3 rectifiers each 3 kW)



- Integrated to Nokia NetAct
- Supporting a wide temperature range from -40°C to 55°C

### Airscale Power Rectifier A (APRA<sup>1</sup>)

- Zero footprint high efficiency (~97%) rectifier for outdoor use (IP65)
- Advanced features : Load shifting<sup>2</sup>, solar connectivity and eco mode (planned 2023)
- Light weight scalable to large loads: from 6 kW (13 kg) to 30 kW (65 kg)

Flexi case mounting options

Significant energy saving by eliminating active cooling

Compatible with AirScale One Clip Rail

1 - Availability: Q2 2023

2 - Load shifting solution uses batteries during peak tariff hours and recharging during low tariff hours

# Energy storage

## Nokia Indoor/ Outdoor Lithium Battery Solutions

Nokia proposes power solutions including a large range of lead acid or lithium batteries. The Nokia Indoor/Outdoor Lithium Battery available in our portfolio provides higher capacity in smaller space and footprint with longer lifetime comparing to other batteries available from 3<sup>rd</sup> party vendors.

### Nokia Outdoor Lithium Battery-NOLB

- LFP technology
- Outdoor IP65 component
- Higher capacity than same size VRLA batteries
- Up to 3x longer lifetime in comparison with VRLA technology
- Capacity from 50Ah up to 9x50Ah



NOLB: Nokia Outdoor Lithium Battery  
NILB: Nokia Indoor Lithium Battery  
VRLA: Valve Regulated Lead Acid

NMC: Nickel Manganese  
Cobalt LFP: Lithium Iron  
Phosphate

### Nokia Indoor Lithium Battery-NILB

- NMC & LFP technologies.
- Highest energy density on the market (NMC)
- Low weight and volume
- Sustainability compliant, zero cost recycle (NMC)
- Higher number of cycles compared to competition
- Capacity from 50Ah up to 250Ah per unit



NOKIA