

# RAN ENERGY EFFICIENCY JOURNEY

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## Energy Efficiency journey

Mobile Test Summit 2024  
Munich, November 20<sup>th</sup>

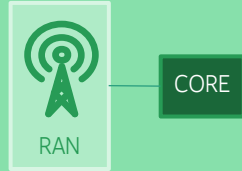


# Energy Efficiency journey – The challenge

BTS Energy consumption is an increasing contributor to mobile network OPEX

75%

of energy used in a CSP's network is consumed by RAN



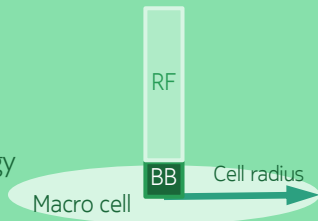
70%

of RAN energy is consumed by base station equipment



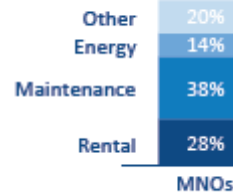
80+%

of macro BTS average energy consumed by RF



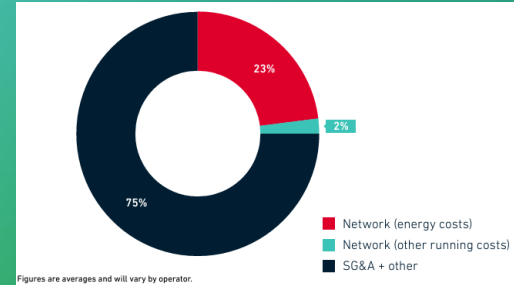
## Mobile operator network OPEX distribution

### Network OPEX distribution



Source: Arthur D. Little analysis

\*) Arthur D. Little viewpoint Feb. 2021



Figures are averages and will vary by operator.

\*\*) GSMA report Nov. 2020

- Energy OPEX is 15-30% in mature markets (up to 50% in developing markets with high proportion of off-grid sites)
- Electricity accounting for 23% of 5Y TCO for 4G, up to 28-32% for 4G+5G

# Energy efficiency journey

## Levers for BTS Energy consumptions improvement

### Hardware evolution

New ReefShark SoCs in baseband and RF coupled with latest technology innovations (e.g., Power Amplifiers). Better coverage performance = less sites.



### Software capabilities

Intelligent switch-off of unused resources with Micro DTX, Cell switch off, MIMO muting and Deep sleep modes.



### Energy efficient site solutions

Zero footprint site and minimized footprint sites with All-in-One Cabinets. Liquid Cooled baseband technology.



### EdenNet SON and RIC with AI/ML

Automatic configuration and AI/ML based optimization of energy savings functionality.



# Energy efficient site solutions

Site auxiliaries' energy consumption can be more than 1/3 of the total site consumption

## ALL-IN-ONE CABINET AND ZERO FOOTPRINT

### Benchmark

Active air cooling  
Flexi Power Rectifier

### All-in-one cabinet

Fan cooling  
AirScale Power Rectifier

### Zero Footprint site


No separate cooling  
AirScale Power Rectifier

 -30%



With All-in-one cabinet solution there's no need of traditional indoor shelters. Efficient heat exchangers are used instead of inefficient active air cooling. In Zero footprint site solution all equipment is mounted on a tower, pole or wall and no active cooling is used

## LIQUID COOLING SOLUTION

 -90%

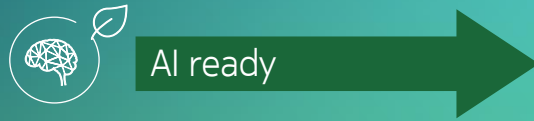
Cooling system  
energy consumption



Traditional site cooling systems depend on active air-cooling, that can exceed 30% of the total energy consumption of a base station. Liquid Cooling solution can reduce the cooling system energy consumption by up to 90%

# Energy efficiency through HW evolution

Every SoC generation brings significant capacity & energy efficiency improvements



Installed

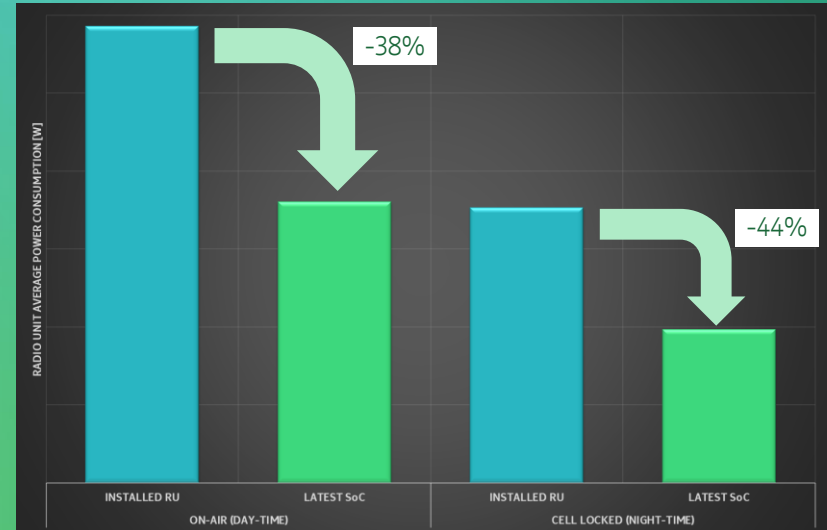
In volume

In development

ReefShark SoC

Latest ReefShark SoC

Next Gen ReefShark SoC



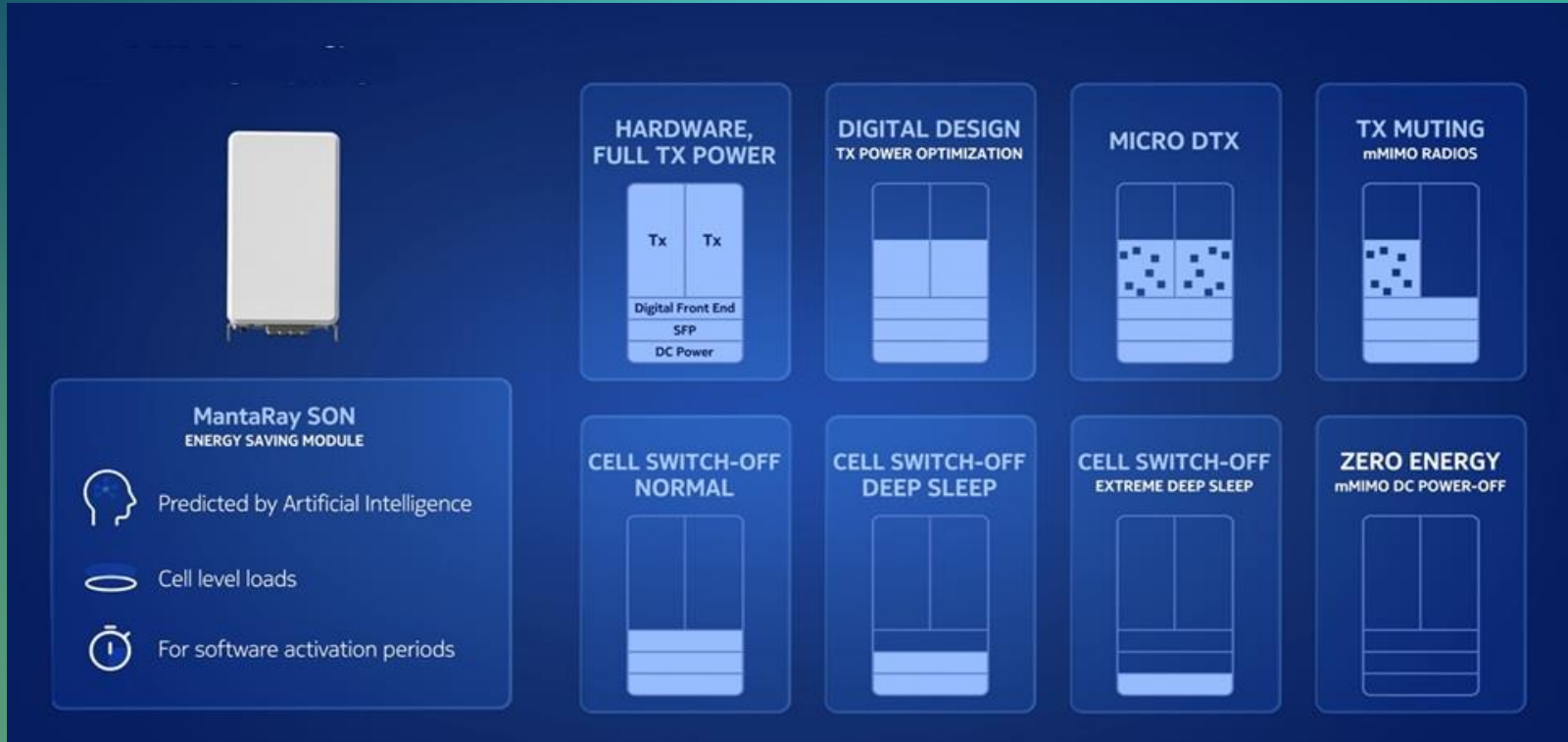
# Energy Efficiency in Radio

Typical stages of a mMIMO radio lifecycle Vs Energy consumption



# Massive MIMO radio energy consumption optimization

## Hardware, software and services together for maximum savings





# Massive MIMO radio energy consumption optimization

## Radio software features in actions

### DIGITAL DESIGN FOR ENERGY EFFICIENCY SERVICE

Balancing uplink and downlink coverage can reduce energy consumption. This can be automatized by SON module



### mMIMO RADIO TX MUTING FEATURE

Reducing power consumption typically at medium loads by switching of half of the TRX's



When cells are switched-off then DFE are switched-off (Deep Sleep) and SFP connectors too (Extreme Deep Sleep)



### DEEP SLEEP AND EXTREME DEEP SLEEP FEATURE

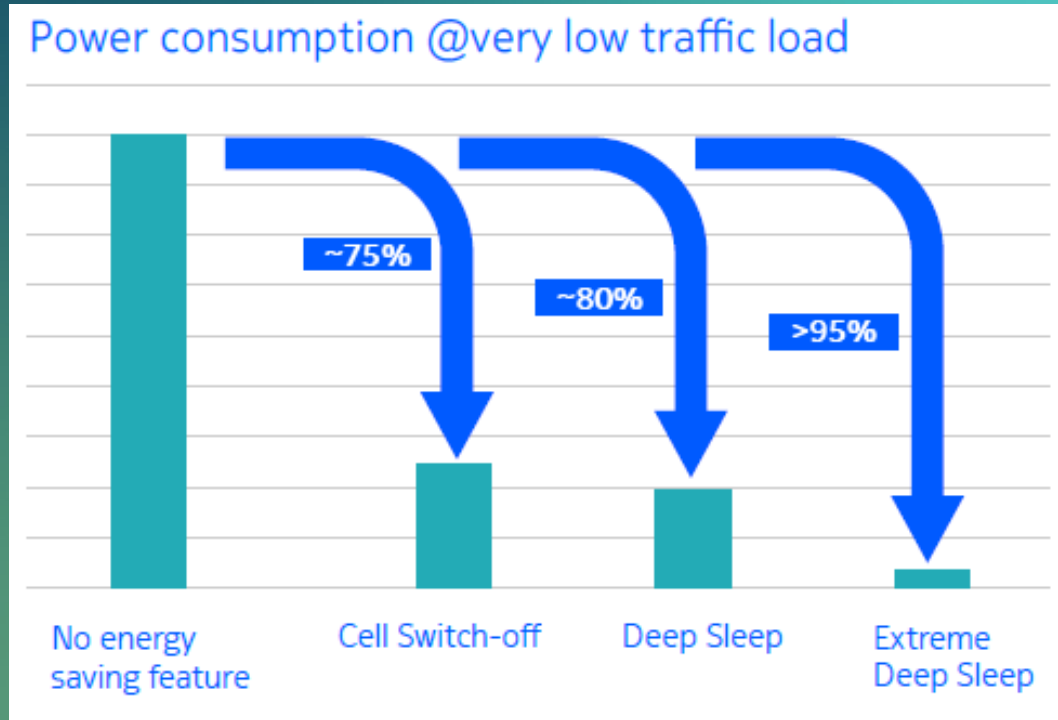


### ZERO ENERGY FEATURE

DC Power of the mMIMO radio unit from the PDU is switched off in zero traffic conditions (zero-watt solution)

# Radio HW and SW Energy solutions benefits

Path to zero traffic zero energy



>95% energy saving  
with extreme deep sleep  
feature enabled

Close to **ZERO ENERGY**  
when the cell is not on air

# Massive MIMO radio energy consumption optimization

## SON AI/ML modules in action

### ENERGY SAVING MODULES IN SON

Several AI-based modules available in SON to help operators in optimizing radio features intervention



### AI POWERED TX MUTING ACTIVATION PERIOD TUNING

Expanding and contracting by cell and by time the activation windows and aggressivity levels with help of AI/ML prediction algorithms



Based on an innovative AI algorithm invented by Nokia Bell Labs that dynamically adjusts thresholds for each activation period by preserving selected KPI performances



### AI POWERED LOAD THRESHOLD TUNING



### AI POWERED DEEP SLEEP CONFIGURATION

Wake-up from Deep Sleep mode takes some minutes and needs to be designed carefully. AI powered KPI prediction service identifies the best timeframes for Deep Sleep (de)activation

# SON AI/ML Energy solutions benefits

## Energy efficiency without compromising RAN performance

Enhanced energy efficiency through AI/ML

Cell level automated optimization of RAN energy saving features

Better visibility to RAN energy efficiency

Savings on top of RAN energy efficiency features:

10%

Average  
network wide  
savings

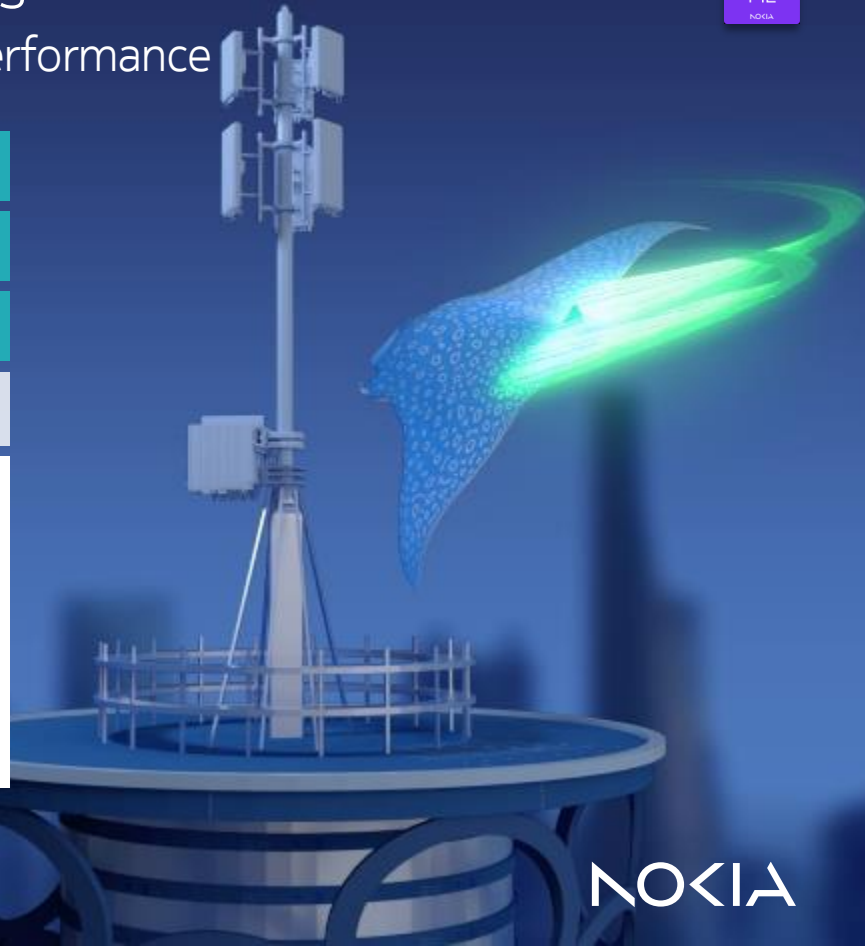
40%

Peak energy  
savings

Zero

Degradation in  
network KPIs

Measured results from live network



# Energy efficiency journey with Nokia

## Key takeaways

### Energy efficiency with hardware evolution



with Massive MIMO radios and AirScale Baseband powered by ReefShark SoC

### Radio resource saving with software features



Intelligent switch-off of unused radio resources, Path to zero traffic zero energy

### Energy saving software features orchestration with automation



AI/ML-powered MantaRay Energy for Network management and optimization

### Efficiency gain with Digital Services



AI/ML-powered services with digital twins and analytics tools

### Energy efficiency built into site solution



- Zero footprint /All-in-One cabinets
- Liquid cooling baseband
- Virtual power plant solution

### 3GPP standardization and AI driven innovation



Energy-aware optimizations for traffic, coverage, capacity, interference and mobility

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Test. Measure. Innovate

THANK YOU  
VERY MUCH

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