

WHITE PAPER



# Enhancing monetization with Advanced 5G RedCap services



NOKIA



## Summary

Reduced Capability, or RedCap, devices are set to enable a wide range of new applications by offering cost-effective, scalable connectivity while leveraging the capabilities of Advanced 5G. This whitepaper outlines how communications service providers (CSPs) can leverage the expanding RedCap ecosystem to unlock business impact, strategic value and monetization opportunities on the path to Advanced 5G.

### The evolution of cellular networks and the role of RedCap

Since the launch of 5G, cellular networks have exceeded peak data rates of 1 Gbps, transforming the smartphone experience and accelerating Fixed Wireless Access (FWA) adoption. However, many enterprises and IoT applications still operate efficiently with mid-range connectivity at speeds of around 100 Mbps—similar to LTE Category 4 (Cat.4), which has been the backbone of many industrial, vehicular and enterprise solutions for over a decade.

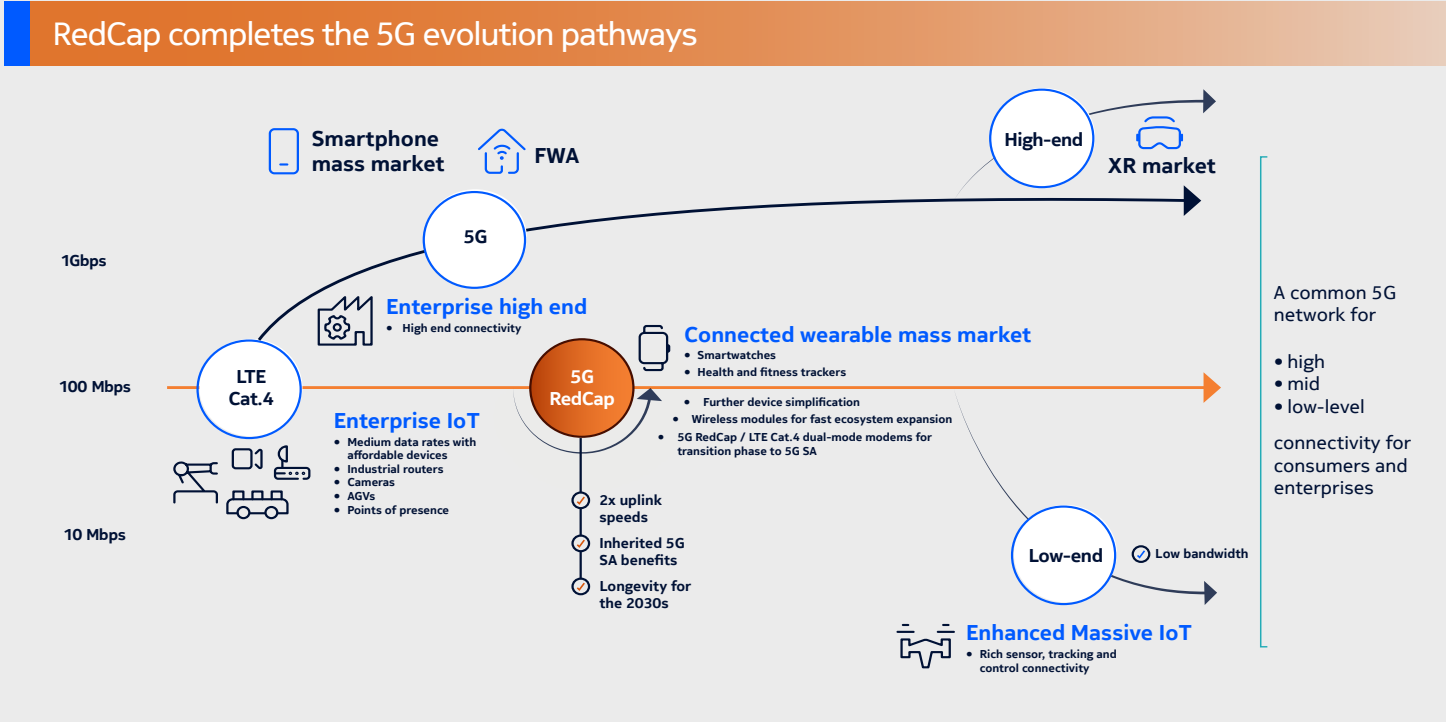
Enterprises are seeking lifecycle solutions with longevity exceeding 10 years, ensuring their IoT infrastructure remains future proof well into the 2030s, when Advanced 5G will dominate the connectivity landscape.

This is where RedCap comes into play. These devices bridge the gap between LTE Cat.4 solutions and the high-end capabilities of Advanced 5G, offering:

- Long-term affordability
- Optimization for Advanced 5G Standalone (SA)
- Superior security for enterprises and ‘regulated/sensitive’ services
- Superior uplink performance
- Seamless LTE transition

As RedCap adoption accelerates, Advanced 5G networks will eliminate dependence on LTE infrastructure, driving:

- **Enterprise-ready wireless modules:** Companies can integrate RedCap-powered routers, cameras and autonomous guided vehicles (AGVs) into smart factory and industrial operations.
- **Next-gen wearables:** Advanced 5G RedCap will power high-end wearables for health, fitness and safety, creating a new mass-market segment alongside smartphones.
- **Optimized IoT integration:** RedCap simplifies mid-data-rate IoT with a single, cost-efficient RAN (Radio Access Network) layer.



**Figure 1.** RedCap completes the 5G evolution pathways

### The path to Advanced 5G SA adoption

Most current deployments rely on 5G Non-Standalone (NSA) networks, where LTE and 5G New Radio (NR) coexist across use-cases. While this ecosystem has successfully delivered high-speed broadband and IoT connectivity, transitioning to Advanced 5G SA unlocks new efficiencies:

- **Lower costs and energy consumption:** RedCap minimizes LTE reliance.
- **Spectrum optimization:** Facilitates a smooth migration from LTE IoT use cases to full Advanced 5G SA adoption.
- **Monetization acceleration:** Our RedCap software implementations enable CSPs to fast-track Advanced 5G monetization strategies, ensuring they stay ahead of market demands.

Early adoption of RedCap will streamline the transition from IoT solutions, ensuring a future-proof spectrum evolution toward full 5G.

# Unlock new business opportunities with Advanced 5G RedCap

5G RedCap has matured to a commercially deployable stage. Operating within Advanced 5G networks, RedCap delivers data rates of 90–200+ Mbps. RedCap integration within Advanced 5G SA networks provides distinct advantages over LTE and 5G NSA:

- Optimizing network efficiency through streamlined 5G architecture
- Reducing energy consumption for cost-effective, sustainable operations
- Enhancing battery life, particularly for uplink-intensive applications

For use cases such as video surveillance and IoT telemetry, 5G RedCap doubles uplink speeds compared to LTE Cat.4, enabling smoother, higher-quality video feeds, as well as unlocking greater capacity and coverage while ensuring future-proofed spectrum utilization.

Positioned between high-performance broadband and cost-sensitive IoT solutions, Advanced 5G RedCap introduces a scalable, cost-effective path for industries requiring enhanced connectivity but without the complexity of full-scale 5G broadband. Features include:

- Network slicing for customized connectivity solutions
- High spectral efficiency for better data transmission in dense environments
- Increased network capacity to support growing IoT and industrial workloads

## Enabling video-centric and industrial IoT applications

RedCap supports mid-range, latency-sensitive applications, including:

- Remote-controlled machinery
- Emergency Voice over NR (VoNR)
- Augmented Reality (AR) applications
- Surveillance and security

It also supports the next wave of consumer and enterprise IoT, including:

- Wireless industrial sensors
- Smart grid & smart metering
- Worker safety wearables

## Future outlook: eRedCap and Advanced 5G

eRedCap is the next evolution of RedCap technology—designed to support ultra-low-bandwidth IoT applications with the same efficiency and security benefits of Advanced 5G. While RedCap is already commercially deployable, eRedCap extends 5G's reach to simple, cost-sensitive use cases that have traditionally relied on LTE Cat.1 or Cat.1 bis (second version). This makes it a natural successor as networks move away from LTE.

For low-data-rate applications, eRedCap offers a cost-efficient, future-ready alternative. Ideal for:

- Point-of-Sale (POS) systems
- Utility meters and tracking devices
- Asset monitoring and logistics

As the 4G IoT ecosystem shifts toward more power-efficient models, the adoption of 5G NR eRedCap ensures long-term, energy-conscious connectivity over standalone 5G networks.

Together, Advanced 5G RedCap and eRedCap will enable CSPs and enterprises to expand into new markets, unlock incremental value and drive a smooth transition away from existing infrastructure.



**Figure 2.** 5G RedCap expands the range of 5G use-cases (served over 5G-SA networks)

# Notable benefits of introducing RedCap devices on Advanced 5G networks

To understand the value of Advanced 5G RedCap in SA networks, it's important to view it within the broader telecom evolution. In 2015, the International Telecommunications Union's (ITU) IMT-2020 vision prompted 3GPP to define NB-IoT and LTE-M as low-power, wide-area (LPWA) enablers, forming the basis for massive IoT across 4G and 5G.

While high-end 5G NR targets ultra-fast broadband and LPWA covers low-end IoT, mid-range needs remained unmet—until RedCap. It offers a cost-effective, energy-efficient option for video-centric, industrial automation and real-time monitoring use cases, without the complexity of full 5G NR.

With simplified antenna setups and reduced RF bandwidth, RedCap is ideal for mid-tier industrial and IoT deployments.

The benefits of RedCap in 5G SA networks fall into three key categories:

## Reduced cost and complexity

Compared to traditional 5G NR devices, RedCap significantly reduces complexity and cost while maintaining the performance required for standalone 5G use cases. It offers:

- Optimization for Advanced 5G SA, eliminating the need for LTE/5G dual connectivity.
- Single-band operation, without carrier aggregation, streamlining device architecture.
- Reduced antenna configurations (e.g., 1T2R or 1T1R), lowering hardware costs.
- Narrower bandwidth requirements (20 MHz in FR1, 100 MHz in FR2) compared to full 5G NR.

According to 3GPP cost models, these optimizations result in an estimated 70% complexity reduction in frequency range (FR)1 and 50% in FR2 compared to standard 5G NR modems.



	RedCap UE Rel.17 (FR1)	eRedCap UE Rel.18 (FR1)	Reference 5G-NR UE (FR1)
Max UE bandwidth	20 MHz	20 MHz (RF), baseband may limit to 5MHz bandwidth	100 MHz
UE transmit power	23 dBm		
Number of UE Rx antennas	2Rx/1Rx		2Rx (FDD)/4Rx (TDD)
Peak rates (DL/UL)	226/91 Mbps with optional features	10/10 Mbps baseband may limit to 10/5 Mbps	N/A
Duplex mode	Full Duplex FDD Half Duplex FDD TDD		Full Duplex FDD  TDD
Architecture option	SA		SA, NSA
Mobility	Idle mode mobility & handover		
Voice support (VoNR)	Yes		
Carrier aggregation/ Dual connectivity	No		Yes

**Table 1.** Comparison of key attributes for RedCap and (e)RedCap vs. 5G-NR devices

## Lower power consumption and longer battery life

The simplified architecture of RedCap devices leads to significant power savings, resulting in longer battery life. Nokia offers features to optimize 5G NR user equipment (UE) power consumption, including specific functionalities for these devices:

- **Extended Discontinuous Reception (eDRX):** RedCap devices enter a deep sleep mode, dramatically reducing energy consumption. With eDRX, idle mode cycles extend up to 10.24 seconds, while inactive mode cycles can last up to 2.91 hours, far surpassing traditional 5G NR UEs.
- **Optimized Radio Resource Management (RRM):** Power consumption is reduced by extending RRM measurement intervals for neighboring cells, particularly beneficial for stationary IoT devices in industrial and infrastructure applications.

## Lower Total Cost of Ownership (TCO) for CSPs

Advanced 5G RedCap provides CSPs with a seamless path to integrate RedCap into 5G SA networks while optimizing costs across multiple dimensions:

- **Leverages existing infrastructure:** RedCap operates on the same 5G SA network as full-scale 5G NR devices, eliminating the need for additional infrastructure investments.
- **Maximizes spectrum efficiency:** RedCap runs within existing 5G NR spectrum allocations, allowing CSPs to enhance network capacity without acquiring additional spectrum licenses.
- **Enables cost-effective software upgrades:** Nokia's RedCap software upgrade simplifies implementation, allowing CSPs to unlock new revenue streams quickly while future-proofing their Advanced 5G strategy.

# Optimizing RedCap deployment in Advanced 5G networks

As Advanced 5G unlocks new connectivity, RedCap devices make 5G SA more attractive by offering lower complexity, reduced costs and tailored capabilities. They integrate easily with existing 5G infrastructure and support dual-mode LTE Cat.4/RedCap for smooth migration. Future enhancements will bring single-mode operation, single-receive antennas and reduced RF bandwidth for even greater efficiency.

## Key performance metrics of RedCap in Advanced 5G SA networks

With Advanced 5G, RedCap devices achieve improved energy efficiency, latency optimization and data throughput, making them ideal for applications such as industrial IoT, wearables and video surveillance. To delve into the specifics of these devices, it's crucial to highlight their key performance metrics within 5G SA networks, which include:

<b>Battery life:</b> <ul style="list-style-type: none"><li>• Wearables: 1-2 weeks</li><li>• Industrial sensors: Several years</li></ul>	<b>Data rates:</b> <ul style="list-style-type: none"><li>• Release 17 RedCap: 226 Mbps DL/91 Mbps UL</li><li>• Release 18 eRedcap: 10 Mbps DL/5 Mbps UL (optimized for lower power consumption and cost efficiency)</li></ul>	<b>Latency:</b> <ul style="list-style-type: none"><li>• Industrial sensors: &lt;100ms</li><li>• Video surveillance: &lt;500ms (optimization can take this further, but at the cost of battery life)</li></ul>
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## Optimizing RedCap deployment in Advanced 5G networks

Understanding the key considerations for deploying RedCap devices is essential for optimizing their performance in Advanced 5G SA networks, illuminating how these devices can effectively integrate into existing infrastructure and drive sustainable network growth. Key considerations for RedCap deployment include:

- **Network coverage analysis:**
  - RedCap minimally impacts overall 5G NR coverage.
  - No additional site densification is required in standard deployment scenarios.
  - While downlink performance may see slight reductions, superior Advanced 5G coverage enhancements compensate for this, particularly in the FR1 bands, where antenna efficiency may present challenges.



- **Network capacity analysis:**
  - RedCap devices have a minor impact on 5G NR system spectral efficiency and capacity under normal load conditions.
  - Enhanced networks slicing in Advanced 5G ensures eMBB users maintain high-performance service where RedCap also operates.
  - Advanced 5G significantly surpasses LTE in baseline capacity and efficiency.
- **UE power saving / battery life:**
  - Advanced 5G integrated advanced power saving mechanisms, enhancing RedCap devices' efficiency.
  - Features such as extended discontinuous reception (eDRX) and radio resource management (RRM) relaxation further optimize battery consumption:
    - o eDRX: Ideal for low-duty-cycle devices with infrequent data transmission
    - o RRM relaxation: Beneficial for stationary devices, reducing unnecessary energy drain from measuring neighboring cell signals



## Nokia's approach

Our approach to integrating RedCap into 5G SA networks can be seen through a variety of successful field trials. Through our technological expertise and commercially ready solutions, we are bringing Advanced 5G-powered RedCap ecosystems to life with several industry leaders around the globe:

- **Communications Service Providers:** Major CSPs have been conducting field trials with Nokia to validate 5G RedCap on fully operational 5G SA networks. These trials have been leveraging our:
  - AirScale RAN portfolio, optimized for Advanced 5G efficiency and scalability
  - Commercial-grade software solutions, integrating RedCap into live networks
- **Chipset providers:** We have been collaborating closely with top chipset providers Qualcomm and Mediatek, as well as various terminal providers, to ensure seamless interoperability of the Advanced 5G RedCap ecosystem with Nokia's 5G SA networks. This collaboration ensures that:
  - RedCap devices function efficiently in Advanced 5G SA environments
  - Optimized network slicing and power-saving features enable low-latency, energy-efficient communication
  - Future-proofing RedCap evolution through Advanced 5G advancements, ensuring a long-term scalable ecosystem

T-Mobile US has become the first major CSP in the Western world to commercially launch Advanced 5G RedCap, including a 5G-Secure Access Service Edge (SASE) solution for secure wireless connectivity. Around the globe, many CSPs are embracing RedCap innovation as part of their Advanced 5G journey, continuously evolving their mid-range data service offerings to meet the changing demands of the market.

Several commercial deployments have already taken place, notably across all three major operators in China, T-Mobile in the US, as well as numerous RedCap pilots around the world. Early momentum is also building in other markets like the Philippines, through DITO using RedCap in commercial service for FWA. These developments highlight the growing traction and transformative potential of RedCap technology worldwide.

# Conclusion

RedCap technology represents a pivotal advancement in bridging the connectivity gap between high-end 5G devices and low-end IoT solutions. By delivering efficient performance and cost-effective solutions, RedCap is set to revolutionize various industries.

## Accelerating 5G evolution with RedCap

In the evolution towards Advanced 5G, RedCap is more than just a technological shift; it offers CSPs a strategic opportunity to simplify their networks, support new services and expand into emerging market segments.

By unlocking spectrum migration towards Advanced 5G and beyond, reducing device complexity and enabling tailored services through network slicing, RedCap helps accelerate monetization and future-proof 5G deployments.

As a pioneer in this industry, Nokia is driving the commercialization and deployment of RedCap-enabled solutions. With our deep expertise in network design, deployment and monetization strategies, we provide CSPs with tailored solutions to maximize RedCap's potential in Advanced 5G networks.

Nokia is empowering CSPs and enterprises to fully harness RedCap's capabilities through:

- Strong partnerships with device and chipset manufacturers
- Advanced network slicing innovations, including edge-cloud connectivity
- Commercially ready software enhancements for seamless RedCap integration

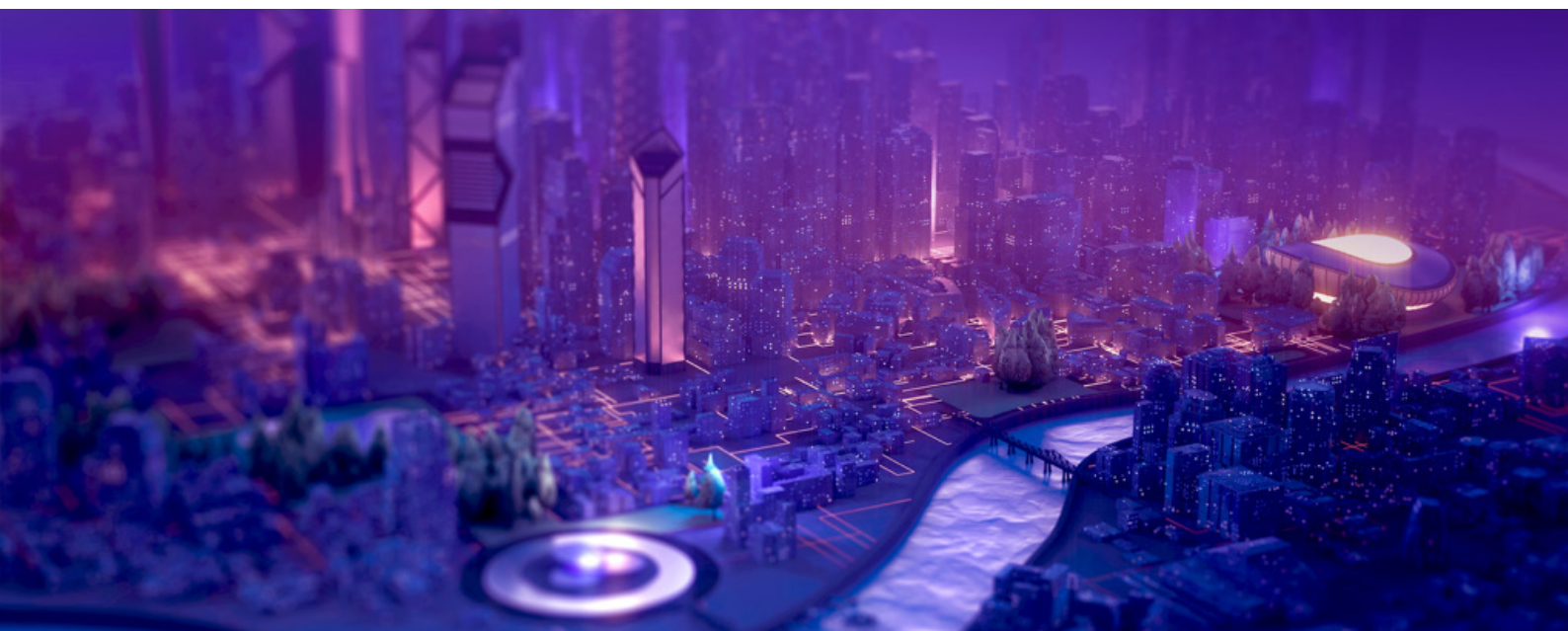
This helps unlock operational efficiencies and accelerate Advanced 5G adoption.

Together, these capabilities empower CSPs and enterprises to maximize RedCap's potential in delivering scalable, high-performance and future-ready networks.

For more detailed insights into RedCap technology, read Nokia's whitepapers:

⇒ [5G reduced capability devices](#)

⇒ [How network adaptations for 5G devices will lead to superior battery life](#)



## Glossary

<b>3GPP</b>	3rd Generation Partnership Project (by 7 telecommunications standard development organizations)
<b>AR</b>	Augmented Reality
<b>CSP</b>	Communications Service Providers
<b>DL</b>	Downlink
<b>eDRX</b>	Extended Discontinuous Reception
<b>eMBB</b>	enhanced Mobile Broadband (5G)
<b>FR</b>	frequency range (FR1 = below 6 GHz, FR2 above 24 GHz)
<b>FWA</b>	Fixed Wireless Access
<b>IoT</b>	Internet of Things
<b>IIoT</b>	Industrial Internet of Things
<b>IMT – 2020</b>	International Mobile Telecommunications
<b>LPWA</b>	Low-power, wide-area
<b>mMTC</b>	massive machine-type communication
<b>MBB/eMBB</b>	Mobile Broadband (3G/4G) / enhanced Mobile Broadband (5G)
<b>NR</b>	New Radio (3GPP term for 5G-radio access network)
<b>NSA</b>	Non-Standalone
<b>POS</b>	Point of Sales
<b>QAM</b>	Quadrature amplitude modulation
<b>RAN</b>	Radio Access Network
<b>RedCap</b>	Reduced Capability (5G-NR) devices, also called NR-Light
<b>eRedCap</b>	enhanced (further) Reduced Capability (5G-NR) devices
<b>RRC</b>	Radio Resource Control
<b>RRM</b>	Radio Resource Management
<b>SA</b>	Standalone
<b>SASE</b>	Secure Access Service Edge
<b>UAV</b>	Unmanned Aerial Vehicle (drone)
<b>UE</b>	User equipment
<b>UL</b>	Uplink
<b>VR</b>	Virtual Reality
<b>VoLTE/VoNR</b>	Voice over LTE / Voice over 5G-NR

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# NOKIA

## **About Nokia**

At Nokia, we create technology that helps the world act together.

As a B2B technology innovation leader, we are pioneering networks that sense, think and act by leveraging our work across mobile, fixed and cloud networks. In addition, we create value with intellectual property and long-term research, led by the award-winning Nokia Bell Labs, which is celebrating 100 years of innovation.

With truly open architectures that seamlessly integrate into any ecosystem, our high-performance networks create new opportunities for monetization and scale. Service providers, enterprises and partners worldwide trust Nokia to deliver secure, reliable and sustainable networks today – and work with us to create the digital services and applications of the future.

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