Intelligent automation

How Intelligent RAN Automation is creating key use cases for service providers

Executive summary

The next-generation Radio Access Network (RAN) will need to support many use cases with different requirements at the same time, from simple voice and text messaging to extremely data-hungry applications, such as the streaming of real-time virtual reality (VR) feeds.

Intelligent automation is essential to meet growing network demands, manage the increasing complexity, operate networks more efficiently to provide the best network performance, and deliver a great customer experience with rationalized capex investments.

Our experience has shown us that service providers have a unique opportunity to monetize new 5G applications. However, there are also new challenges that must be solved. Increased operational complexity and the demand for superior user experience must both be satisfied to achieve successful monetization of 5G.

In this new scenario, the main challenge for the service providers is optimizing radio network resource utilization. At Ericsson, we can help you solve this challenge by making sure you run a more sustainable network, while saving time for your existing workforce, especially the operations team. This will lead to the optimization of investment decisions and reduce your capex and opex.
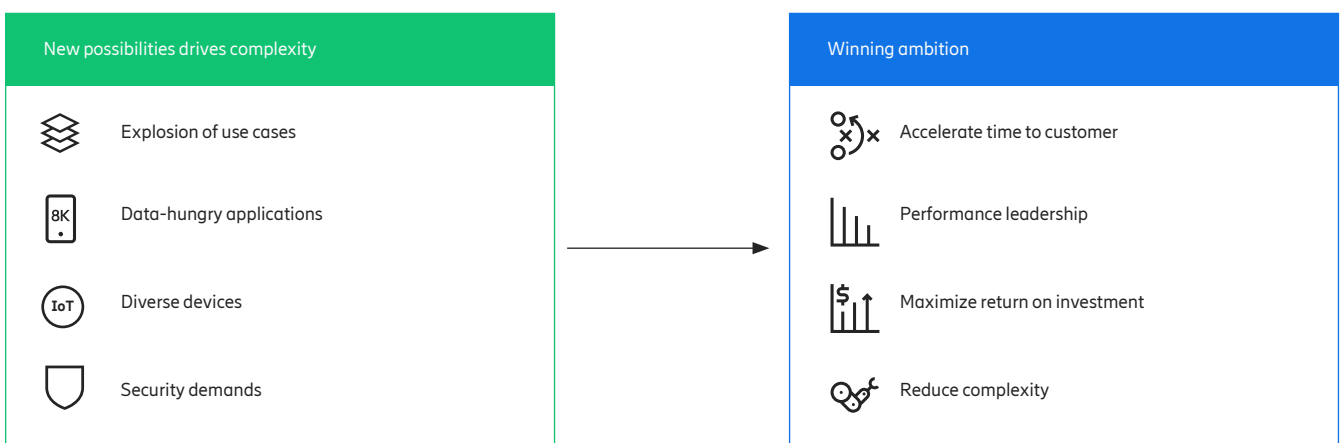
Service providers are looking for solutions to improve RAN efficiency, performance, and user experience as a must for monetization use cases, such as extended reality applications. The use case for improving energy efficiency is also in high demand to meet sustainability and cost-control goals. Service providers have realized that if 5G is managed the same way it was in previous generations, energy consumption will increase dramatically to meet rising traffic demands.

This is unsustainable in terms of cost and environmental impact. To break the growing trend of energy consumption, it's necessary to address the different parts of the network holistically and, while doing so, to make sure that the full 5G experience is delivered for your consumers.

Furthermore, as 5G deployments are evolving to the cloud in the RAN domain, you should consider the new security risks. While the cloud introduces advantages, it also expands the 5G attack surface that must be protected with a security-by-design approach.

Our intention with this guide is to show the intelligent automation solutions that address the main service provider challenges. They provide the highest ROI and shortest time to market, with a future-proof architecture that can meet the ever-changing demands for each service provider.

Figure 1: Drivers for automation

New possibilities drives complexity	Winning ambition
Explosion of use cases	Accelerate time to customer
Data-hungry applications	Performance leadership
Diverse devices	Maximize return on investment
Security demands	Reduce complexity

The four main domains of Ericsson Intelligent RAN Automation solutions

Exploring the typical use cases in the categories of evolution, deployment, optimization, and healing of the network.

At Ericsson, we have identified the main areas where service providers can benefit from AI-based automated solutions. We have applied our vast expertise in RAN automation spanning over two decades to provide a wide range of use cases that can fit in the following four categories: network evolution, network deployment, network optimization and network healing.

These four categories are supported by automation and the AI foundation that is applied in the software functionality, services and platform.

Network evolution
- enhances network planning with more efficient radio frequency (RF) planning, site selection and capacity management
- improves network and service performance and enables new revenues thanks to data-driven and intent-based insights and recommendations

Network deployment
- handles provisioning and life cycle management (LCM) of complex networks with optimal costs and speed to market

Network optimization
- offers intelligent autonomous functions to optimize user experience and return on investments, such as RF shaping, traffic and mobility management, and energy efficiency

Network healing
- ensures service continuity and the resolution of both basic and complex incidents, delivering high availability while keeping opex at a minimum

These domains serve four main value drivers: network sustainability, trustworthiness and security, efficiency and user experience. The intelligent automation evolution journey improves these benefits by creating networks that are more proactive and data-driven.

The AI and automation foundation for Ericsson Intelligent RAN Automation enables high performance and a shorter time to market for all the different use cases, while ensuring a high degree of flexibility.

Figure 2: Use cases for Ericsson Intelligent RAN Automation

Network evolution

Network deployment

Network optimization

Network healing

Automation and AI foundation
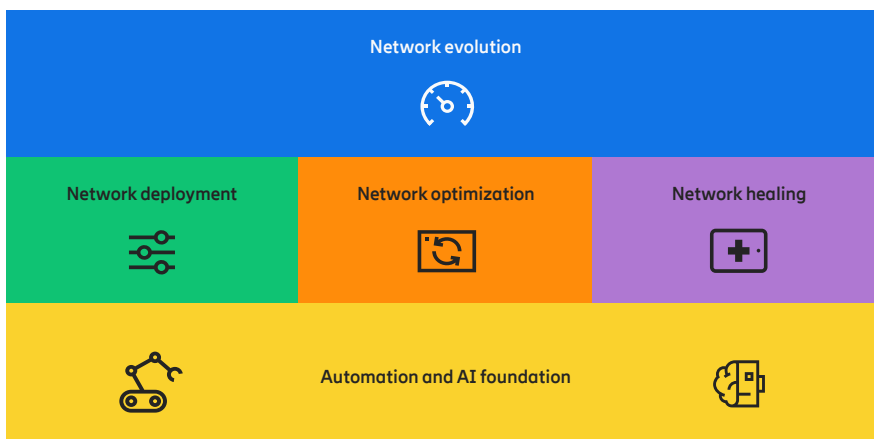
Make smarter decisions with AI

AI, automation and novel data-handling capabilities that support service provider decision making meet in the Ericsson Intelligent RAN Automation solutions.

We have considered how to provide support for decision making across the spectrum — from decision granularity to time frame, and from network planning to deployment, parameter configuration and tuning, and operations. Ericsson Intelligent RAN Automation frees up time and provides actionable insights for making decisions to create more end value for service providers and their consumers.

Reliable and relevant data is the single most important factor for making network decisions. Nevertheless, there is a limit to the amount of data humans can handle, and this is where AI comes in. AI helps to automate the data handling process to provide actionable insights.

Properly coupling AI, data, and automation creates a virtuous cycle where better data enhances the AI, which allows the organization to handle more data, thus creating even further improvement. Our findings demonstrate that the power of an intelligent data approach includes advanced microwave insights, more sustainable products, intelligent services and network evolution capabilities.

Investment decisions are driven by the long-term evolution of the network and its capabilities, such as the addition of new radio equipment, site development and new enriched radio functionality, including software upgrades.
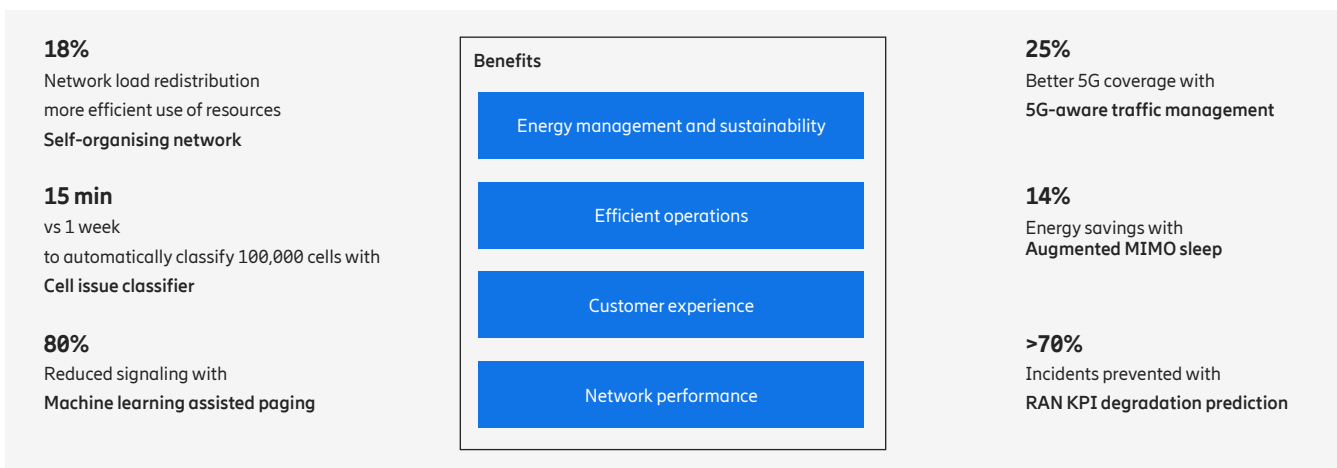
The network evolution area in Ericsson Intelligent RAN Automation deals directly with these use cases, such as capacity planning. Our solutions reduce the time it takes to evaluate new scenario development, a cumbersome process when done manually, which could limit the total number of scenarios and, consequently, the information available. Therefore, faster scenario development gives both a more robust data set of multiple scenarios and frees up time for deciding what improvements can be made and where. This intelligent process is further supported by radio frequency design and site-selection features.

A future opportunity for leveraging AI comes in the form of trade-off decisions. One such trade-off example is the choice between network performance and energy savings. Today, these decisions are taken independently, or with limited

insight into how they affect each other. Network performance is one factor that impacts the user experience and, by extension, the service provider. But energy efficiency also benefits service providers, their opex, the environment and increasingly environmentally aware consumers. By using data insight and AI, asymmetrical opportunities can be found. This means that in some traffic scenarios, a small-to-negligible decrease in network performance can allow for significant energy savings. For example, this can be done by pushing user equipment from a capacity cell to a coverage cell, allowing the former to be put in sleep mode. Finding the scenarios where this has minimal impact on user experience while granting high energy savings will require increased data insights and AI that considers traffic, time, location and services offered.

Overall, the purpose of our AI-based functionality and data-enabling architecture is to create a virtuous cycle that improves insights and decision making to enhance service providers' networks with reduced effort from operations teams.

Figure 3: How AI delivers value in radio networks

18%
Network load redistribution
more efficient use of resources
Self-organising network

15 min
vs 1 week
to automatically classify 100,000 cells with
Cell issue classifier

80%
Reduced signaling with
Machine learning assisted paging

Benefits
- Energy management and sustainability
- Efficient operations
- Customer experience
- Network performance

25%
Better 5G coverage with
5G-aware traffic management

14%
Energy savings with
Augmented MIMO sleep

>70%
Incidents prevented with
RAN KPI degradation prediction

What is the holistic approach of Intelligent RAN Automation?

Intelligent automation is embedded in our solutions, from RAN to network management, as well as our professional services offering.

Our intelligent automation is executed where required to ensure the best network performance and consumer experience.

When operating a RAN, deployed resources must be managed efficiently. There are two control loops acting together according to different time scales and scopes. Ericsson Intelligent RAN Automation solutions use AI algorithms integrated with existing processes and algorithms in these control loops.
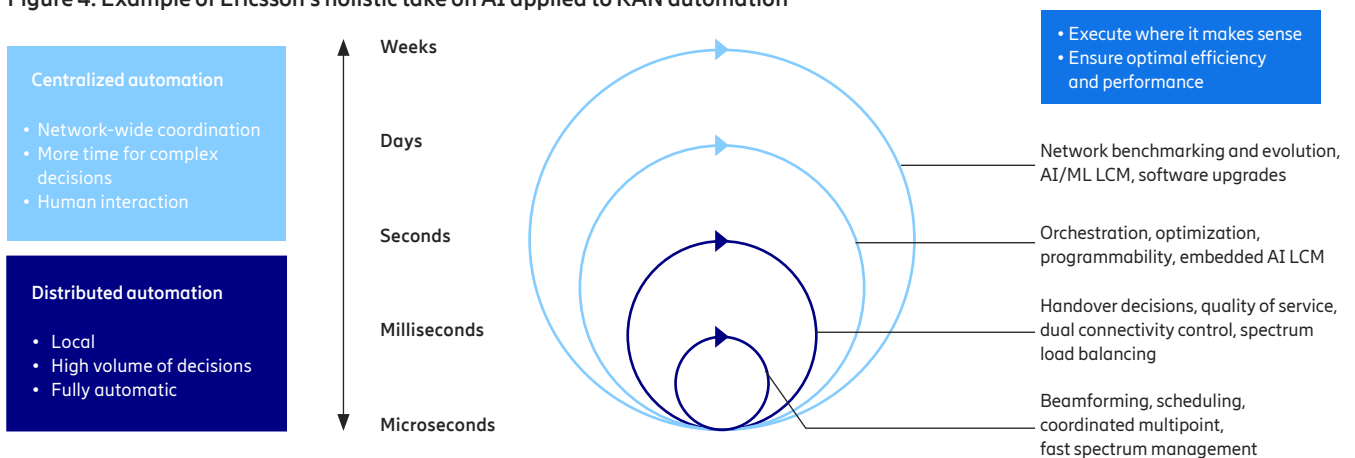
The two fastest control loops are related to the traditional Radio Resource Management — that is, traffic mobility operations. Innovation examples include the link adaptation feature that improves spectral efficiency by up to 15 percent in the fastest control loop. Functionality in these control loops is mostly autonomous, driven by engineered algorithms requiring complex configurations in a timeframe ranging from milliseconds to several

hundred milliseconds. In many cases, AI/machine learning (ML) makes it possible to enhance the network performance by up to 30 percent and also to minimize the amount of configuration optimization that is needed in the high level control loops by up to 90 percent.

The high-level control loops are related to traditional network operations. Examples include RAN coordination and network power management, which decreases energy consumption by up 20 percent. These high-level control loops encompass the bulk of the manual work that will disappear as a result of intelligent RAN automation, which explains why AI/ML is especially attractive in these control loops.

This holistic take is applied in all these use cases, which act on both fast and slow control loops for distributed and centralized automation to make the improvements scalable across the entire network.

Figure 4: Example of Ericsson's holistic take on AI applied to RAN automation

Centralized automation
- Network-wide coordination
- More time for complex decisions
- Human interaction

Distributed automation
- Local
- High volume of decisions
- Fully automatic

Weeks

Days

Seconds

Milliseconds

Microseconds

- Execute where it makes sense
- Ensure optimal efficiency and performance

Network benchmarking and evolution, AI/ML LCM, software upgrades

Orchestration, optimization, programmability, embedded AI LCM

Handover decisions, quality of service, dual connectivity control, spectrum load balancing

Beamforming, scheduling, coordinated multipoint, fast spectrum management

Why choose rApps for automation?

Deciding where to place the intelligence is not about deciding on one place to fit all, but on leveraging the different capabilities of the network layout to maximize overall performance.

The industry consensus is that increased openness and the resulting wider ecosystem will allow for more innovation, improved network efficiency at scale, and better network orchestration.

rApps have oversight of the network, which makes them good candidates for containing large portions of the policy and optimization. Intelligent deployment rApps act on the high-level control loops, half a second and above, which makes them ideal for central placement.

Centralized decisions are made with a holistic network view, and this will help to improve actions locally at the RAN level, for example, by optimizing the best baseband partner on the network level. Another example is an Ericsson rApp which can increase data throughput by up to 30 percent at the cell edge in a congested network. For these reasons, rApps can further enhance radio network functionality by providing a centralized view of the network.

Inter-rApp orchestration can be executed to secure network performance.

That is the role of the Ericsson Intelligent Automation Platform, our realization of a service management and orchestration (SMO) platform. Efficient handling of rApps will be crucial to support ecosystem development efforts to foster innovation.

From the telecom technological evolution perspective, intelligence in the rApp will enable network-wide performance, controlled via intent-based automated decisions in the higher-level control loops. Later, this will be cascaded to the network in fast control loops in terms of execution.
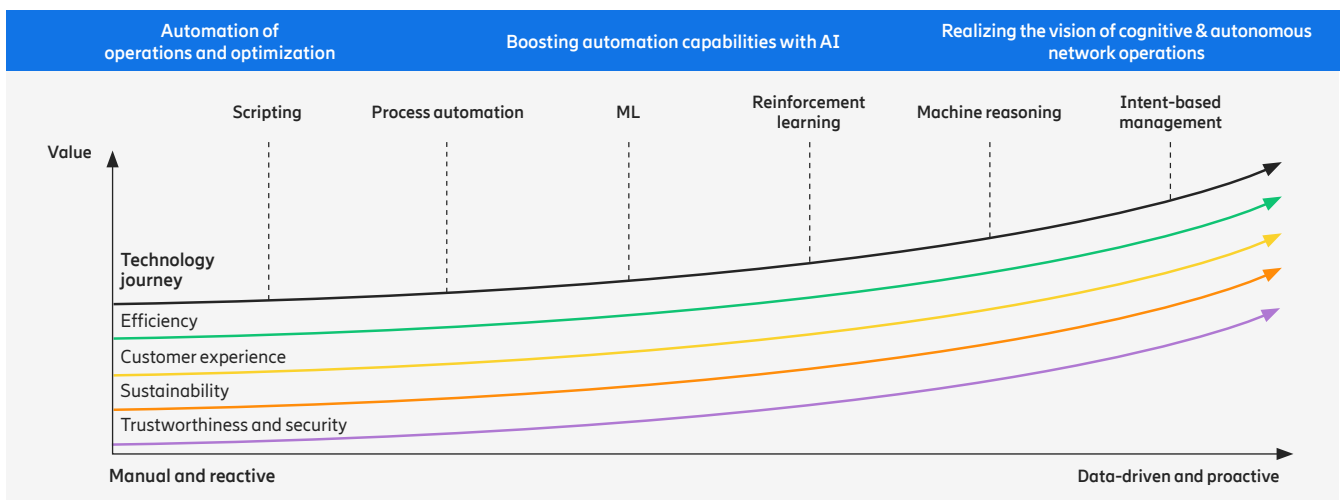
The architecture of rApps will provide a broader ecosystem to engage in the telecom space to create novel products, design specific solutions based on certain niche needs, and foster innovation to propel the industry forward.

Ericsson solutions for energy saving include radio features such as multiple input, multiple output (MIMO) Sleep mode, Cell Sleep mode, Radio Deep Sleep, and rApps for network centralized energy management, optimization and control. Some examples of existing rApps are:

- **Ericsson 5G Centralized Neighbor Relations rApp:** The automatic establishment of cell neighbor relations based on various measurements and detection
- **Ericsson Frequency Layer Manager rApp:** The dynamic redistribution of users in the most effective way to increase user experience
- **Ericsson Performance Diagnostics rApp:** The automatic cell-issue classification and root-cause analysis for the entire RAN performance optimization

The next step in the intelligent network evolution will be intent-based management, where intents will cascade from a higher abstraction level. Central orchestration and handling of these intents will be part of the RAN evolution, for which the rApps and SMO layer are well suited. Therefore, this architecture prepares us for the next step in the intelligent network evolution journey, where the main value drivers are network sustainability, trustworthiness and security, efficiency and user experience.

Figure 5: Evolution of intelligent automation

Automation of operations and optimization	Boosting automation capabilities with AI	Realizing the vision of cognitive & autonomous network operations

Scripting · Process automation · ML · Reinforcement learning · Machine reasoning · Intent-based management

Value

Technology journey

Efficiency

Customer experience

Sustainability

Trustworthiness and security

Manual and reactive   Data-driven and proactive

Intelligent services for tailored business requirements

All networks are different, and all service providers deserve dedicated use cases to match their requirements.

Ericsson provides customized use cases using AI technology, thanks to our intelligent services. We offer a dedicated local team comprising Ericsson network experts and data scientists, synchronized with Ericsson product R&D for use case design and enhancement of network products and features.

Our specialist teams work with service providers to translate their business goals, pain points and data into customized use cases for an optimized result in terms of efficiency, consumer experience and network performance.

Ericsson develops, per specific service provider's needs, customized AI algorithms for detecting, predicting, and/or measuring specific operational characteristics of interest in the service provider's operated network.
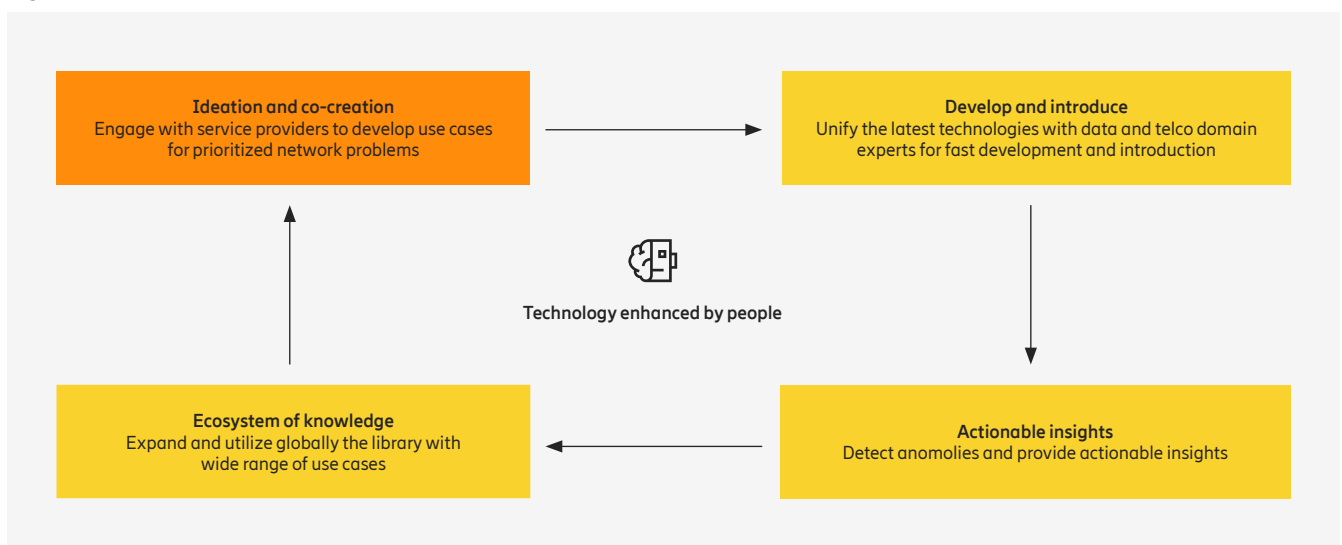
This AI software consists of an event or correlated set of events along with corresponding analysis, thresholds for distinguishing between normal and abnormal conditions (where applicable), an engagement plan for notification and/or execution of actions, and an action plan for handling the condition.

These solutions, known as "service continuity", are part of the Intelligent RAN Automation solution. They detect anomalies, and predict and prevent incidents. In essence, it is about actively working closely with the service provider's operations and maintenance (O&M) to prevent issues and have a positive impact with early detection, notification and actionable recommendations to stay ahead of the issues. The service will help the O&M

team become more successful, providing early notifications before alarms and complaints arise. Therefore, the O&M team can act before issues arise, resulting in improved network performance and revenues.

Our collaborative approach allows us to generate a wide range of use cases. These use cases have become part of our global library and can be replicated to solve similar issues for service providers worldwide. Bringing references from networks around the world allows us to test a specific network for globally known issues. These experiences help us to design a wide variety of use cases that can be tailored to fit individual customers. Our intelligent services apply advanced software functionality with AI technology.

Figure 6: Use case co-creation process for tailor-made service provider needs

- **Ideation and co-creation**
  Engage with service providers to develop use cases for prioritized network problems

- **Develop and introduce**
  Unify the latest technologies with data and telco domain experts for fast development and introduction

- **Technology enhanced by people**

- **Ecosystem of knowledge**
  Expand and utilize globally the library with wide range of use cases

- **Actionable insights**
  Detect anomalies and provide actionable insights

Conclusion

The target for service providers is to achieve more sustainable networks, better user experience, optimized capex investment and reduced opex by improving network performance.

To achieve these objectives, intelligent network automation is necessary. Networks require predictive capabilities to provide insights dynamically and in real time to support service providers in making the best decisions for their specific challenges and goals. AI-powered radio features and rApps, together with intelligent services and a future-proof intelligent platform, are required to succeed.

Technology leadership in AI technologies (such as reinforcement learning and digital twins), combined with network data expertise, is applied to RAN automation and makes the foundation of the Ericsson Intelligent RAN Automation ecosystem. We are committed to reducing the complexity of operations and empowering service providers to make the best decisions according to their needs.

The methodology used in Ericsson Intelligent RAN Automation is leveraging knowledge from historical and current real-time data to an extent that was not viable in the old paradigm, that of continuously training and adapting the ML algorithms. We are providing AI-powered solutions that are more accurate and efficient for certain use cases or applications than rule-based solutions, since they can dynamically adapt to network changes. In the long term, AI-powered solutions will be ubiquitous in the RAN and will facilitate the creation of the best performing and most cost-effective networks.

We have developed the following use cases that can be provided as an rApp:
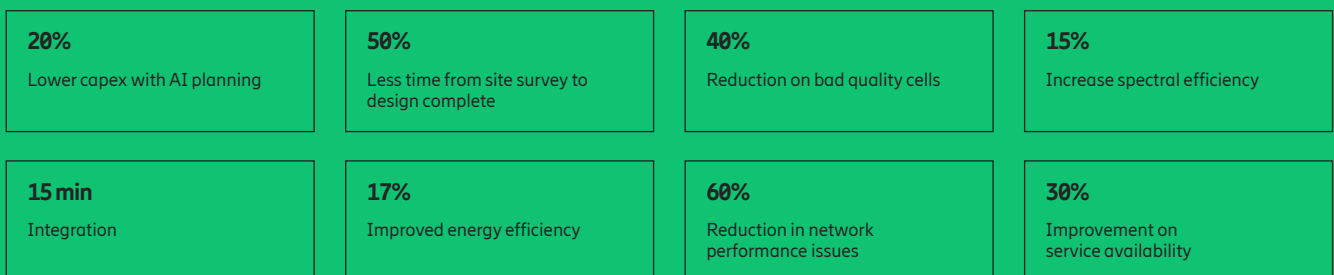• reducing the overall transmitted power by 20 percent, with a 3.4 percent saving on the electricity bill per base station (Ericsson Power Optimizers)
• saving daily radio energy consumption by 15 percent, with zero impact on user experience
• automating in-service software upgrades with no service disruption
• integrating new radio units in a shorter time with optimized configuration and with automated closed-loop assurance
• improving network performance increased user throughput and radio coverage at network scale without manual intervention

The foundation of this network evolution is a future-proof architecture with Ericsson Intelligent Automation Platform, which offers automation in the LCM, data access, and network element control. It also supports the execution of rApps from Ericsson, customers, and third parties, enabling an open ecosystem for innovation. Both rApps and Ericsson Intelligent Automation platform are based on cloud-native microservices architecture.

We are a leading player within the O-RAN Alliance to ensure that the SMO and its Non-RT RIC, rApps, and R1 and A1 interfaces will be secure. For more information, see: Ericsson in O-RAN alliance.

The telecom industry is in an evolutionary process where networks have become increasingly autonomous. The target is to evolve current networks so that they can follow the automation evolution path. Network automation is a journey that started more than 20 years ago with Ericsson. Today, with AI technologies applied in radio features, rApps, and services, we are in an advanced automation phase that enables service providers to overcome the complexity challenges and succeed in capitalizing on new 5G opportunities.

Figure 7: Intelligent RAN Automation measured benefits for service providers

20% Lower capex with AI planning	**50%** Less time from site survey to design complete	**40%** Reduction on bad quality cells	**15%** Increase spectral efficiency
15 min Integration	**17%** Improved energy efficiency	**60%** Reduction in network performance issues	**30%** Improvement on service availability

About Ericsson

Ericsson enables communications service providers to capture the full value of connectivity. The company's portfolio spans Networks, Digital Services, Managed Services, and Emerging Business and is designed to help our customers go digital, increase efficiency and find new revenue streams. Ericsson's investments in innovation have delivered the benefits of telephony and mobile broadband to billions of people around the world. The Ericsson stock is listed on Nasdaq Stockholm and on Nasdaq New York. www.ericsson.com