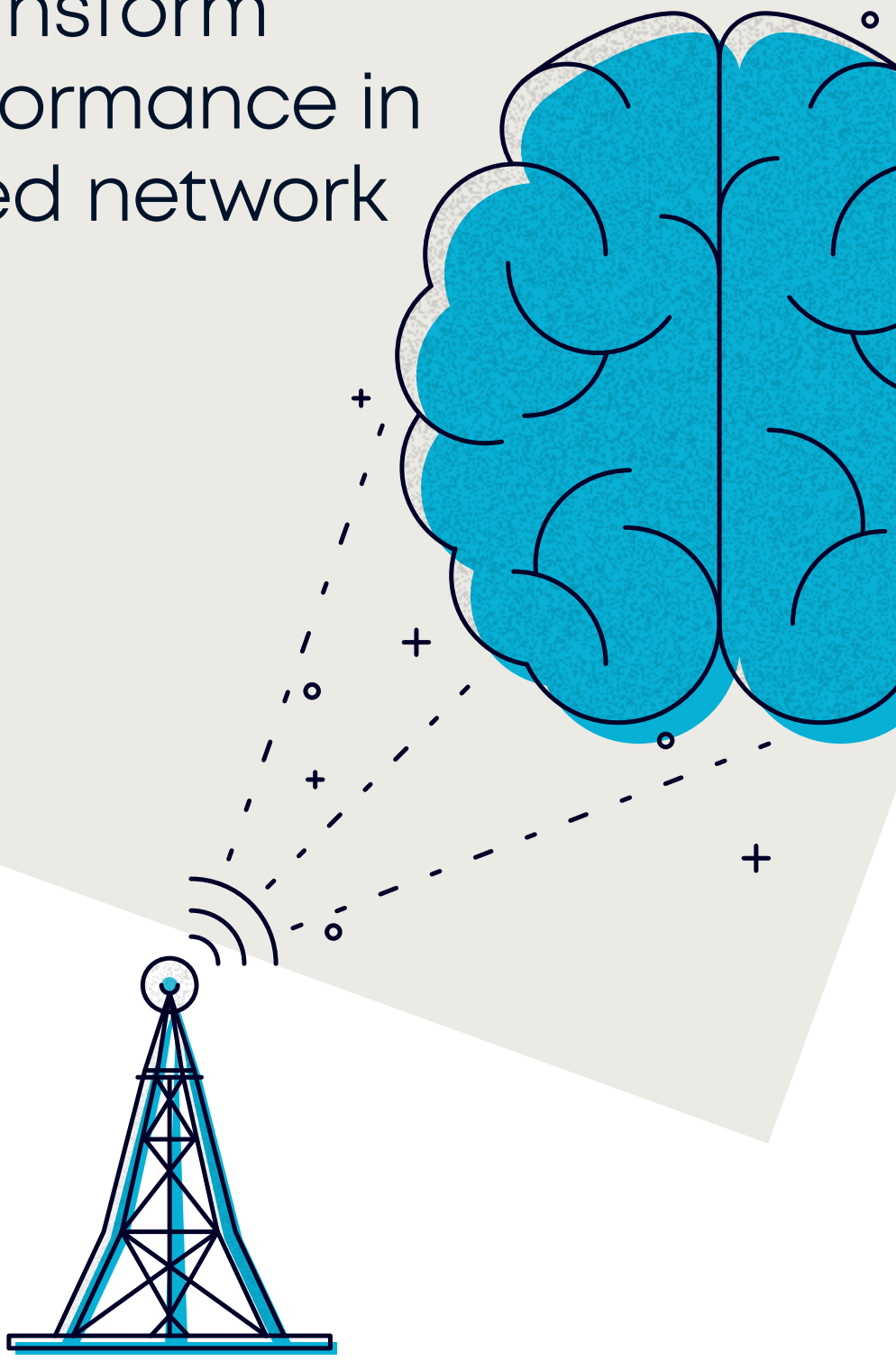
Innovation Briefing

O-RAN and AI: ready to transform service performance in the optimised network



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CC in three
Your key notes to take away

1. O-RAN and AI are the keys to automating network optimisation that will maximise service performance and transform user experience

2. The resulting improvements will drive network cost reduction, efficient energy consumption and generate new service revenues – without invading user privacy

3. Distinctive offerings will be created from standard telecoms equipment by integrating wider data sources with low level network data – but will require vendors with deep experience in service design, data mining, AI and the RAN

Introduction

The stars are aligning for the transformation of the communications network. The opportunities offered by the move towards open standards are combining with advances in AI to enhance the automation of network optimisation. The upshot will be maximised service performance and heightened user experience for consumers and enterprise users which will allow immersive services and advanced industrial applications to flourish.

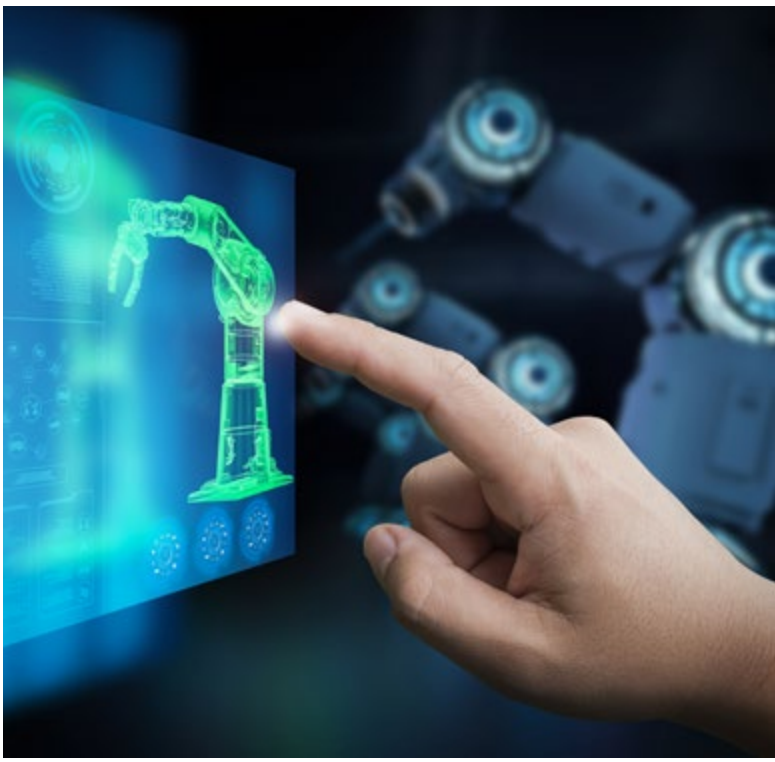
In this Innovation Briefing, we explore – and answer – today's crucial question. How can automation overcome the complexity of O-RAN networks to deliver this broad set of high-performance use cases?

Where do we stand today?

Immersive and complex applications are set to completely transform network requirements over the next five years. Services from metaverse applications to real-time robot control will require very different optimisation approaches. In addition, new architectures such as virtualised implementations in the radio network and non-terrestrial platforms are placing new requirements on integration as well as management systems.

A far greater degree of network automation is needed to deliver higher performing connectivity services to support these use cases as well as a host of different terminal types. Automation will also enable greater network utilisation and much more efficient use of spectrum, reducing network costs and energy requirements. Indeed, service providers will be able to accelerate their adoption of cloud-native computing, to grasp a wealth of data from the RAN with AI-powered analytics tools and – with an eye on sustainability – cut power consumption. It will, therefore, be possible to ease the management overhead of these increasingly complex networks with its myriad of vendors.

CC believes that delivering world-leading performance in this complex and evolving environment is not a nice-to-have. It is crucial if we are to create new sources of revenue for the telecoms industry and huge value for the users they serve.



What do we need to solve?

There are a number of challenges to be addressed – from ever-increasing expectations on user experience to the growing complexity of technology, supply chain diversification, sustainability and of course concerns about individual privacy.

Spotlight on user experience

We live in a world in which expertise and decision making is increasingly global and there is no longer an expectation for people to be physically close to the point where their actions are implemented. Everything from real-time stock market valuations to life-and-death decisions in operating theatres by remote surgeons are dependent on high-quality, instantaneous, stable and resilient communications. In addition, industrial machine control, robotic control and new machine-based terminal types are entering the picture. All of these will expect an optimal user experience delivered by a guaranteed quality of service.

Exacerbating this is the fact that for too long the industry has been dominated by a few vendors supplying the bulk of network infrastructure. A number of smaller, more dynamic vendors have been kept on the side lines. This reliance on a limited group of incumbents has stifled innovation and slowed the introduction of new technologies. It has also kept costs higher than they might have been.

O-RAN increases complexity of 5G networks

5G brought a significant increase in network complexity with it. Together with the three modes of operation (eMBB, URLLC and mMTC) the proliferation of thousands of small cells, private networks and the associated backhaul and edge compute infrastructure combine to make 5G both functionally and architecturally complex.

While O-RAN is opening mobile networks to innovative new vendors it is also a significant driver of complexity. Whereas previously operators could rely on end-to-end integrated solutions from a single vendor, now reducing the scope of integration efforts between a number of O-RAN vendors is a key to its success. Network components and even individual software functions provided by different vendors will drive a huge increase in complexity which places demands on smooth systems integration to ensure it all works well.

The challenge of insight without invasiveness

Monetising the insights that can be derived from network and user data without invading user privacy or damaging reputation is a challenge. Extracting high-level meaning from complex data is difficult, but that is where AI and machine learning can help.

There are many AI products coming to market aimed at managing the network but not focusing on the service itself. Focusing on improving customer experience and service performance is key to the future of mobile broadband infrastructure – especially as we enter a new age of services that rely on high performance and efficient network infrastructure.

Our vision of the way forward

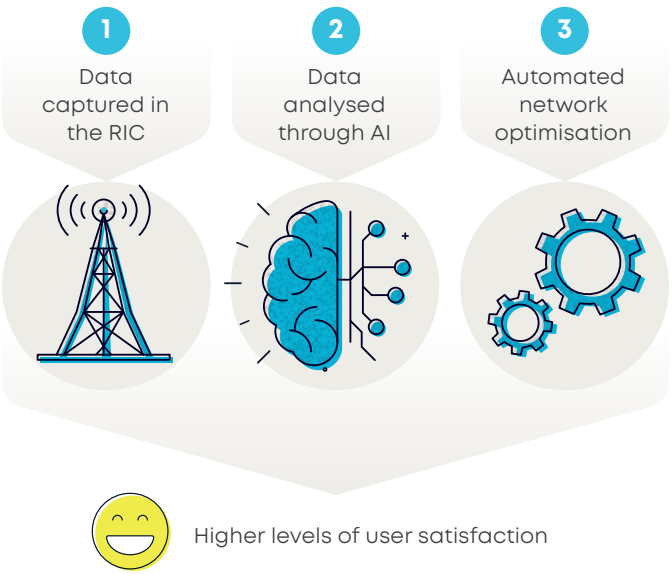
O-RAN and AI – the CC vision in brief

It's time to use the benefits of O-RAN and apply the latest AI technologies to directly optimise individual user/application performance – and so optimise overall network performance.

Crucially, the approach depends on deriving insights from network and user data without invading user privacy. O-RAN standards expose the network telemetry data that is necessary to be able to gain these insights.

Our approach is to address the challenges highlighted in the previous section through the use of service management and assurance. This in turn relies on greater use of network automation. Simply put, AI and network automation implements a control loop into network operations and maintenance as follows:

1. Network quality is measured using the large amounts of telemetry data provided by cellular networks which is exposed to the RAN Intelligent Controller (RIC) via standardised interfaces
2. This data is analysed and provides insights into current user experience plus network and service performance
3. Then, using concepts such as Intent-Based Networking (IBN), decisions are made based on these insights. IBN in its conventional form is a known software-enabled process that configures infrastructure on the basis of a business intent. For more, read our whitepaper: 'The pervasive intelligence of intent-based networking'. The decisions in turn lead to changes in configurations of network parameters to improve either individual or aggregate user experience. Or, in the long-term, to the deployment of additional network infrastructure. With pervasive intelligence, network faults can be predicted, and quality adjusted dynamically, actively and optimally to enable high levels of user satisfaction



Revealed: how AI can improve experience

The team at CC has applied bold creative thinking to develop technology that reveals how AI techniques can evolve automation far beyond network management into the realm of enhanced user experiences – whether that's an ultra-reliable industrial service or an immersive consumer experience.

CC works across all three stages of the control loop, shown in the diagram below. However, our most recent research focused on stage two, deriving insights from network and user data without invading user privacy. Essentially, AI is used to infer user experience. The algorithm we have developed is able to predict actual user/application experience which in turn allows us to adjust the network configuration to improve the quality of experience. As with much of our research, this innovation is made available to our clients as part of our collaboration, helping them create genuine 'new to the world' products and services.

Unpacking the research in more detail

We have focused our research on the performance of video services as these account for the majority of data on the internet. Delivering high-definition video – perhaps enhanced with augmented reality at scale – requires extremely high network performance. One solution is simply to overprovision capacity to cover peak loads. But this is inefficient from both a cost and a sustainability point of view.

A much better way is to create a higher level of automation within the network to manage resources effectively, while using spectrum and energy efficient service delivery. To explore the potential of AI-based service assurance we built a demonstrator xApp, which could be deployed on an O-RAN RIC, that predicts actual user experience through the use of the underlying network protocol performance.

THE RESEARCH, STEP BY STEP

The research shows that high-resolution video quality of experience can be determined remotely through machine learning that exclusively uses data from the normal operation of RAN. No specific data from the application is needed and as no modification of the application is required the technique can be applied to any service.

We achieve this by analysing data such as: retransmission rates, the modulation coding scheme, and block error rates from within the RAN as the video stream is being transmitted. This allows us to estimate actual user experience and from this we can propose adjustments the network configuration to improve the end user's quality of experience.

5G SANDBOX

We've developed a full end-to-end 5G deployment with virtualised core network, RAN, simulated RF environment and a virtualized UE. This allows us to extract telemetry data while changing operating parameters, such as increasing the noise on the RF channel or simulating congestion in the cell.

In order to initially train the decision tree machine learning algorithms, and subsequently validate the performance of the xApp to predict video quality, we performed a large number of tests across a wide range of congestion and RF noise.

USER EXPERIENCE

Our results revealed that we can analyse, detect and accurately quantify the degradation in transmitted video quality at the terminal using machine learning. By predicting quality of experience at the network protocol level, we have the ability to allocate resources dynamically and so ensure the user experiences a more stable service quality.

FURTHER APPLICATIONS

The use of a lightweight, robust machine learning model is attractive because it facilitates flexible deployment and use. While the demo applies to a single application – video streaming the technology can be used in similar xApps for other applications and services that require assured performance while effectively managing resources and energy or supporting premium services such as higher quality or augmented reality streaming services.

Predicting quality of experience – results from our research

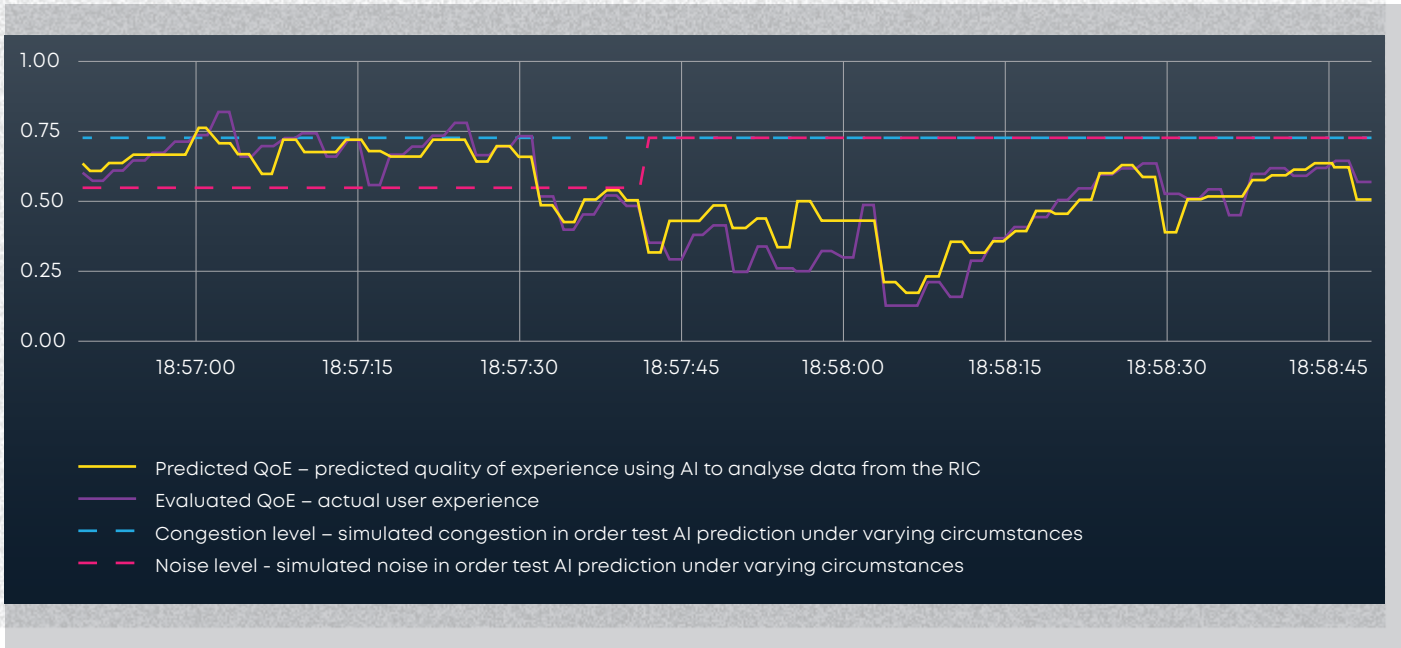


Figure 1: Our algorithm accurately predicts user experience that is matched to the actual user experience. This provides opportunities to automate network optimisation to assure experience is delivered to the desired level.

O-RAN and AI will transform quality of experience

Focusing on improving customer experience and service performance is key to the future of mobile broadband infrastructure, especially as we enter a new age of immersive services that rely on high performance and efficient network infrastructure.

Being able to infer service quality and user experience without having to invade the privacy of the individual customer gives us:

- Overall improved quality of experience on both an individual and an aggregate level without impacting user privacy
- More efficient use of available network infrastructure with the resulting impacts on costs and sustainability
- A platform for revenue growth through immersive media and improved customer loyalty that superior quality of experience brings

As we move into the next generation of immersive services there is an increased focus on the guaranteed delivery of high-performance connectivity. Metaverse-like immersive services require multiple synchronised high-quality, high-throughput data streams to ensure the desired customer experience.

We will also see an increasing number of new terminal types such as robots, cars and other machines operated by network-based services. Such devices are much more sensitive to imperfections in the data delivery and for them to function correctly network performance has to be optimised.

And at the same time, we are seeing a divergence in network architectures to include greater small cell based private networks, networks slices as well as non-terrestrial platforms.

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In summary

Future applications, terminal types and platforms will require end-to-end management tailored to optimise individual and aggregate user experience. The insights provided by AI-based analysis of network telemetry data will also allow vendors and service providers to dramatically improve network CAPEX and OPEX costs through improved infrastructure utilisation and hence also contribute to their impact on sustainability. All enabled by intelligent network automation.

Why CC?

While others talk about transformation, we'll collaborate with you to deliver it. Our global team will help you conceive and develop radical new-to-the-world breakthroughs. We're adept in innovation that can redefine markets, exploiting advances in RF, AI, digital systems and semiconductors. Clients work with us at all stages of the innovation cycle, from exploring new business opportunities and selecting the right technology path, to developing entire systems at scale, under immense time pressure.

Let's continue the conversation

We hope you've found value in this CC Innovation Briefing. Please get in touch if you are interested in building O-RAN technology and solutions – or in leveraging the benefits of AI and automation within communication systems.

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Lit-IB-005 v0.5 '2023_O-RAN_Innovation_Briefing'