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Artificial Intelligence Goes Mobile?

Georges Dassis, President, European Economic and Social Committee (EESC)


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Artificial intelligence (AI) is intelligence exhibited by machines. In computer science, the field of AI research defines itself as the study of "intelligent agents": any device that perceives its environment and takes actions that maximize its chance of success at some goal. Colloquially, the term "artificial intelligence" is applied when a machine mimics "cognitive" functions that humans associate with other human minds, such as "learning" and "problem solving".

Artificial intelligence (AI) has increasingly become one of the hottest topics in both business and science. More leading tech companies are showing their interest in AI investment, from Google's US$400 million acquisition of DeepMind, and Faraday Future's unveiling of self-driving supercars at CES 2017. These are just a few examples of the commitment companies have towards this cutting-edge technology, but one of the most promising areas for AI is in mobile.

The idea of having a personal assistant to help tackle everyday tasks is becoming more appealing to users everywhere. However, intelligent apps are not just limited to digital assistants but for a variety of purposes from security to e-commerce. Today, many companies are applying AI in their mobile apps to transform the customer experience.

With the advancement of AI technology, what challenges will this bring to operators?

These additional applications will therefore add increased demand upon the network, and will surely require operators to increase the capacity and/ or efficiency of their networks.

Fredric J. Morris
Editor-in-Chief,
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Connect-World

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Viva virtualization! The growing trend of SDN in enterprises

By Tullia Zanni, Head of Solution Marketing, Management and Offering at Italtel

From data centers to network infrastructure, the flexibility that virtualization can guarantee is now so well-known that shifting towards a software approach is becoming a widespread phenomenon. Cloud computing, Network Functions Virtualization (NFV) and Software Defined Networking are all changing telco infrastructures, leveraging the concept of virtualization and software typically found in traditional IT environments. This is also true for communication services providers' and large enterprises' networks. In particular, SDN is increasingly being deployed in large enterprises, especially in specific applications that provide a proven benefit in the short term. This comes from the need for companies to be more efficient and flexible; new services adoption could represent a business accelerator.

Previously many have been held back from launching these new services due to budget constraints but SDN adoption brings agility to traditional networks, improving services as a result of the mutual awareness between applications and underlying networks. The communication between the network and upper-layer applications becomes bidirectional, resource usage is always under control and infrastructure management becomes easy and cost-effective.

A use case for the enterprise: how to manage Quality of Experience

Unified Communications and Collaboration (UC&C) services are strategic applications for every company, enabling a smarter way to work and collaborate. The adoption of video UC&C applications is also crucial for the business development of enterprises with offices across the world.

Being able to apply suitable policies to shape the consumption of network resources, not only according to their availability but also to users' needs, is today a pressing requirement for enterprises. An SDN approach enables centralized and more flexible control of the IP network and provides IT managers a feasible way to dynamically manage high Quality of Experience (QoE) services, particularly in a multi-vendor environment, via a controller-based infrastructure, improving service adoption and usage.

Multiple UC&C services, together with other high priority applications, often share the same network resources, with each application being unaware of traffic generated by other applications, mixing on the same IP network real time communications traffic with internet traffic or other data.

As a result, traditional approaches for managing QoS and traffic prioritization are no longer adequate for delivering a high QoE. Bandwidth consumption has a great variability, static network engineering is difficult and applications have policy rules that don't take real time network usage into account as they do not have visibility on real network state.

To address QoE challenges, Italtel's approach leverages the concept of SDN with the related possibility to mesh up network level with application level.

The DAC approach

Bridging the gap between application needs and network resource availability, Italtel has developed a Dynamic Admission Control (DAC) solution. This enables dynamic tuning of Call Admission Control (CAC) rules and application prioritization, taking into account business needs and real-time network status at the same time. The result is the best QoE for multi-technology UC&C applications in a multi-site enterprise context, enabling smart usage of connectivity services.

Most UC&C applications already include a CAC feature that stops users from placing sessions when there is insufficient network bandwidth within the corresponding Class of Service to support these sessions (typically voice and video applications). Admission control rules typically rely on an application-level static accounting model of the network which is unable to respond to real time business needs or dynamic network changes.

Italtel's expertise and long track record in the development and integration of large-scale telecommunications infrastructure

enables a solution like DAC to significantly increase the return on investment that many companies seek for their IP voice and video assets. Our DAC solution is based on an accurate and up-to-date view of the physical network topology which enables dynamic tuning of CAC rules and application prioritization according to real time network status.

Netwrapper

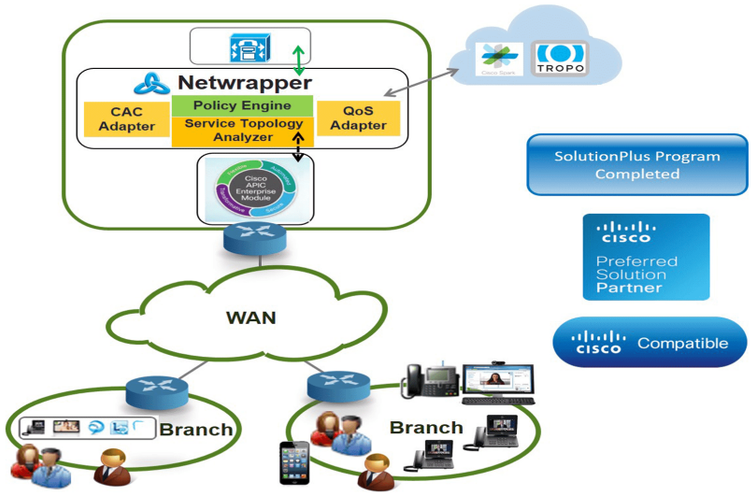
The engine of the DAC Solution is Netwrapper, a powerful SDN application that “wraps” network and services (applications) to enable a fruitful harmonization between them.

Built on top of Cisco Application Centric Infrastructure Controller Enterprise module (Cisco APIC-EM), Netwrapper is the outcome of the strong cooperation between Italtel and Cisco around Cisco’s DNA architecture and automation concepts.

Netwrapper provides IT managers with a unique tool for mapping UC&C service topology with enterprise IP network topology. The bandwidth needs of UC&C applications are compared with actual bandwidth usage and service provider bandwidth Service Level Agreements (SLAs). Call admission bandwidth parameters and QoS marking can be dynamically changed to match the available network resources with application requirements.

To make this possible, Netwrapper interacts with:
• APIC-EM, in order to gather all the information from the IP infrastructure (topology, flow path trace, BW stats) and to rule dynamically QoS marking policies. The interaction is based on REST API.
• CUCM, in order to gather all the information about UC&C services (service topology, audio and video call admission control bandwidth parameters, real time service bandwidth usage) and to dynamically implement changes to bandwidth parameters inside the CAC configuration. This interaction is based on specific service API and provisioning interface.

After undergoing a technical certification process, Italtel completed Cisco’s SolutionPlus program and is currently a “SolutionPlus” partner for the Netwrapper application, which is now available in the Cisco catalogue. This enables a one-stop ordering experience for Cisco's customers, channel partners and sales teams for selected third-party products and applications.



The “human interaction” of Italtel Netwrapper

The Netwrapper system offers an innovative interaction mode based on the concept of social communication, i.e. the use of chat systems and, in particular, Cisco Spark.
Italtel engineers taught Netwrapper to use human language through a chatbot – an Artificial Intelligence software that simulates a conversation between robots and human beings.
They then gave Netwrapper the ability to access Spark, a social collaboration platform developed by Cisco. ICT managers can therefore “chat” with Netwrapper through chatbots.
“Human Interaction” allows Netwrapper to interpret requests and – if necessary – ask questions to further clarify their context, perform the determined actions and finally provide answers in the chat.
This innovative feature of Netwrapper was first presented at Cisco Live! 2017 in Berlin.

ITALTEL

Smarter living: Artificial Intelligence goes mobile

by Thomas Rockmann, VP Connected Home, Deutsche Telekom

The overall trend in AI is integration, and it is a trend that impacts directly on telcos. Consumer AI may have begun life on mobile devices and in the home, but the broadening of its scope to include IoT devices has only just begun, and is progressing apace. From headphones to cars, smart home sensors to buildings, AI integration is underway, and this will exponentially increase overall network demand, as well as creating bottlenecks in unusual and unpredictable places.

Thomas Rockmann is Vice President of Connected Home, Deutsche Telekom's white label smart home portfolio and joint-CEO of the group-wide smart home project. Thomas is responsible for all aspects of the Connected Home business and has been instrumental in growing the business and delivering the white label solution with different partners across Europe.

Thomas joined Deutsche Telekom in 2000 as the group's senior innovation manager for product lifecycle management, where he conceptualized and launched Deutsche Telekom's product lifecycle management process and SAP tool, which today enables Deutsche Telekom to deliver products in a standardized way for all consumer customers.

An entrepreneurial leader with 20 years of experience in product development and execution, strategy, marketing, innovation management and business operations, Thomas has a deep understanding of the development of customer centric technology-enabled services.

Artificial Intelligence, or AI, has certainly come of age. Touching nearly every industry you can imagine, and creating many others that you probably can't, AI is everywhere. From the UK chancellor Philip Hammond's recent commitment to a £75m investment in AI, including £20m for businesses in developing AI, to a recent study from Deloitte that found that nine in 10 UK businesses plan to invest in the technology by 2020, AI is clearly here to stay.

From a telco point of view, AI will become an increasingly important in-house tool in many ways, facilitating and delivering a revolution in the power and subtlety of CRM systems, networks design and planning, as well as offering genuinely next-level adaptive capacity management. But it is in the hands of the consumer where the highest demand currently resides, and this fact also shapes the future for telcos.

A recent Gartner report predicts that 25 per cent of households will use AI-powered digital assistants as the primary interface for connected home services by 2019. This predicted demand is being ardently pursued by the consumer technology industry en masse, and already specialism among major players is apparent, with Amazon aiming to become omnipresent in everyday lives. Google has leveraged its core search and information services in the hunt for a conversational AI assistant across a range of user journeys. Meanwhile Apple's Siri has been exploring a premium hardware strategy, prioritizing superior audio performance above wider capabilities.

The overall trend in AI is integration, and it is a trend that impacts directly on telcos. Consumer AI may have begun life on mobile devices and in the home, but the broadening of its scope to include IoT devices has only just begun, and is progressing apace. From headphones to cars, smart home sensors to buildings, AI integration is underway, and this will exponentially increase overall network demand, as well as creating bottlenecks in unusual and unpredictable places.

Currently AI assistants serve two specific purposes. They provide semantic assistance, by using AI to recognise not only the words or phrases, but also the context. This is highly convenient, as users need to consider the context - and thus the underlying technology - less as the AI improves.

The second major purpose is bridging the gaps between devices, services and products, and this is where the smart home market really benefits. By blending together devices and services from multiple sources, accessed via the AI overlay, consumers are divorced from the intricacies of technology, and freed up to live their lives. For example, in Germany, a simple Alexa Skill means that Magentae SmartHome customers can use voice control to activate preprogrammed

situations or switch to the status "Absent". The wider potential is limitless, from delivering better dietary advice via smart fridge sensors, improved fitness through wearable devices allied with smart home data, or targeted healthcare in the home, this market is only just beginning.

This use of application programming interfaces (APIs) as an entry point into the AI space is certainly another trend that is on the rise. The major players have all taken great pains to entice developers to use their AI SDKs, and a certain amount of platform lock in is to be expected in many of the more proprietary 'walled garden' approaches that are visible in the market today. At Deutsche Telekom, we believe that open standards are always the better choice for the long term, especially when you consider the wider picture of partnerships, collaborations and the march of technology hardware.

The smart home market is key for telcos, and offering an AI solution has many attractions for all players. Striking partnerships with established AI brands or large consumer electronic vendors may offer the most effective onramp strategies. This would benefit a telco entering the AI space with speed to market, plus a mature technology solution to answer the question of how to safeguard existing customer relationships and grasp a better share of the monetization opportunities that come from the data they generate.

Indeed, at Deutsche Telekom we have recently announced plans to speed up the transition to AI during 2018 with the launch of an own-brand assistant and AI-enabled consumer speaker product to control smart home devices and DT's services such as EntertainTV.

Companies such as Orange (who DT has partnered with) and Telefónica are also developing proprietary AI assistants, as have other major players such as US-based Verizon.

Overall, whichever route is chosen by a telco, AI assistants provide a powerful opportunity to revamp offerings, with one key caveat - customers must be convinced of the improved experience, rather than another channel to sell additional products and services.

It is often the user experience potential that attracts service providers to AI, and as technology continues to improve this motivator will only become more acute. A particularly powerful example is the use of AI-integrated voice search within integrated entertainment products such as Video-on-Demand environments, where the traditional EPG (electronic program guide) is suffering significant overload. The importance of product discovery is often overlooked, but the history of technology should teach us that a superior technology or portfolio is not always more successful in the market than a competitor that offers a more intuitive interface or more easily explained benefits. The same is also true of smart home environments, where visualization-based control interfaces and dashboards controlling hosts of devices are already cluttered and demanding to navigate.

However, there is a specific challenge here to all parties - the integration of AI assistants from multiple vendors and service providers will itself generate a layer of additional complexity that could damage adoption if integration is not seamlessly managed by the industry - another vital reason for collaboration and partnership.

Another key emerging AI application is health monitoring, which can now be extended from the hospital to home, through smart home technology. A recent survey by Ovum found that 56 per cent of respondents were interested in using technology to help monitor the wellbeing of others. AI assistants are likely to become more relevant as health companions and organizers, providing information, gathering data, and helping patients carry out multiple tasks. This market is of particular interest to telcos, as older generations are more likely to trust established and familiar brands with which they have billing and support history, rather than new 'challenger' brands.

Health monitoring is also a good example of the support-heavy 'Do It For Me' rather than early adopter 'DIY' approach to technology deployment and integration, which is key USP for established telcos with their well-drilled online and phone support teams and on-the-road engineer staff.

Overall, the rise of AI is set to impact significantly on telcos, on the one hand driving up customer requirements and expectations, on the other providing vastly improved tools to deliver better, more targeted services. Perhaps most excitingly, AI offers the potential to develop brand new products and services and reinvigorate existing mobile services to boot. The time to act is now - see you in the mobile AI future!

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Mobile operators face dilemmas in pursuing self-driving networks

by Caroline Gabriel, Research Director, Rethink Technology Research

A key limitation of AI today is its modest ability to compute on the edge device itself – in a drone, for instance, enabling it to change its behaviour in-flight without the delay inherent in receiving instructions from the cloud. Miniaturizing AI effectively is very much a work in progress and risks being a delaying factor as MNOs work towards the new-look software-driven network architectures which will help get the best results from 4G and 5G.

Caroline Gabriel is the Co-founder and Research Director, Rethink Technology Research and Senior Contributor, Analysys Mason, Next Generation Wireless.

Caroline has been engaged in technology analysis, research and consulting for 30 years and since 2002, has been focused entirely on mobile and wireless.

As co-founder and research director of Rethink Technology Research, Caroline has developed a significant research base and forecast methodology, based around deep contacts with mobile and converged operators round the world. This addresses critical issues and trends in mobile and wireless infrastructure, and particularly operator deployment intentions for 4G, 5G, small cells, Cloud-RAN and other technologies.

She is also a senior contributor to Analysys Mason's Next Generation Wireless research programme.

She has led research and consulting projects with a wide range of clients, including mobile infrastructure vendors, large and start-up operators, regulators, trade bodies, government agencies and financial institutions. Her advice and forecasts have helped inform strategic decisions at a wide range of vendors, operators, start-ups and finance houses.

Prior to setting up Rethink, Caroline held various executive positions at VNU Business Publishing BV, then Europe's largest producer of technology related B2B reports and publications. She was the European content and research director, and was a member of the leadership team for VNU's online business. She holds an MA from the University of Oxford.

The critical architecture decision that every mobile network operator (MNO) needs to make in the next few months or years is how to balance resources between the centralized cloud and the edge of the network. The adoption of artificial intelligence (AI) to help optimize the network more intelligently and dynamically – and eventually automate it completely - should help with this, but it may also become part of the dilemma.

The new demands of the virtualized network:

Densification and the rise of virtualized networks both introduce a huge number of new components – from thousands of physical small cell sites to hundreds of dynamically provisioned virtual network functions (VNFs), to millions of connected devices - into the network. This means modern networks are becoming hard for humans to understand, predict or manage.

As MNOs move towards 5G, they are increasingly evaluating ways to achieve what Deutsche Telekom recently called "brutal automation" , and what Nokia and other vendors call the "self-driving telco". In this context, there is a move to go beyond SON (self-optimizing networks) and apply AI techniques to create a responsive network which orchestrates physical and virtual resources, and adds a high level of intelligence to the automation.

For instance, enterprise provider Colt has created a new AI-driven conceptual platform called Sentio, and is aiming to develop fully automated service management capabilities for network functions such as traffic flow classification, fault prediction, path optimization, capacity management, security, intelligent bandwidth-on-demand, and many others.

Once networks are virtualized, the potential to transform their efficiencies and responsiveness should be limitless. But only if the planning and management of the physical, as well as the virtual, resources is fit for purpose. Depending on the use case and business model, there should be an optimal allocation of network and compute resources to different places long the chain, from cloud to switch to local gateway to the device itself. Ideally this should be capable of adjusting to changing circumstances in terms of traffic levels and type.

AI can help address 5G's challenges:

The ability of AI to help make these decisions is key – building on deep machine-based analysis of traffic patterns, user behaviour and history, and many other factors. It is one of three main factors which are driving telcos' rising interest in AI:

- More intelligent optimization of their network resources to improve efficiency and customer experience.

- Building a new customer relationship through chatbots and other new interactions, which in turn enable hyper-personalized services.

• Harnessing the significant stores of valuable data which telcos hold on their subscribers and networks, for business-to-business revenue streams based on big data analytics and deep context awareness.

This interest is translating into real projects. A study of 48 mobile operators worldwide by Rethink Technology Research found that 58% were engaged in AI tests, trials or real world deployments, with machine learning being the most commonly used technology. However the same survey also identified a wide range of barriers which are deterring some MNOs, or slowing their progress (see Figure 1). Many of those relate to the uncertainty which surrounds a technology which, though many decades old, has only recently become commercially viable for telco networks.

A newly published survey of the broader telco space by CapGemini concluded that, while telcos used to be AI laggards, they are now leading large-scale deployments, with 49% deploying the technology, ahead of an average of 36% across all industries. These are being led initially, in the majority of cases, by customer service applications, but a full 93% of telco adopters said they expected AI to increase efficiency and effectiveness, while 79% claimed to have seen a 10% boost in sales thanks to AI.

Many MNOs are looking first to chatbots and digital assistants, which are becoming well understood by the commercial side of the telco business and are very visible to customers.

However, more transformative effects could come from optimizing the network on a fully dynamic basis, linked to customer experience (proactively shifting a high value customer, who has wandered into a spot where a small cell is about to fail, to another connection, for instance). It will be easier for MNOs to improve their overall customer engagement once they are delivering an excellent network experience. If that is not in place, Apple, Facebook and the others will continue to be the primary digital interface for most users.

Vendors start to support MNOs' need for intelligent automation:

Vendors are starting to support the optimization aim. Nokia has made several announcements, including its Autonomous Care offerings, unveiled in May 2017. ZTE has announced a platform which incorporates self-optimizing network (SON) capabilities as well as algorithms to support new interfaces based on natural language processing and facial recognition. The Chinese vendor aims to offer an end-to-end platform which covers a wide range of telco-specific use cases from intelligent automated networks to new consumer services, and which incorporates the algorithms along with the chips and terminal hardware. The elements promised include 'self-researching AI chips', robot modules and intelligent terminals such as smartphones and smart home controllers.

"Complemented with high computing power, precision algorithm and data analytics capability, AI technology will lead to the evolution of highly intelligent autonomous, automatic, self-optimizing and self-healing networks," ZTE said in its release. "The platform can help operators introduce new technologies and build next generation intelligent network more conveniently amidst the ongoing advancement of AI technologies."

ZTE's inclusion of smartphone and controller devices in its AI portfolio indicates that the algorithms – which, before the days of cheap mass storage and compute power – required a supercomputer to run, can now be applied to a mobile gadget. Intel and Qualcomm have both recently demonstrated neural processing engines running on chips targeted at gateways or mobile devices. They effectively take snapshots of broader machine learning models which are created and modified in the cloud, and run them locally to reduce latency and improve context awareness.

Centralized or edge architectures?

This helps, but does not solve, the issue of how much intelligence and processing should be placed at the edge as opposed to the central engine. A key limitation of AI today is its modest ability to compute on the edge device itself – in a drone, for instance, enabling it to change its behavior in-flight without the delay inherent in receiving instructions from the cloud. Miniaturizing AI effectively is very much a work in progress and risks being a delaying factor as MNOs work towards the new-look software-driven network architectures which will help get the best results from 4G and 5G.

Edge-based AI improves responsiveness but an efficient way of updating the central platform is essential to avoid fragmentation. There are daunting issues of supporting smooth roaming for users who move from one AI-optimized, context aware cell to another with no such user experience. For challenges such as load balancing across different locations and times of day, a common view of the whole network is essential.

So the ability to do more AI at the edge does not answer all the questions of how to harness resources most efficiently. Avitas, a GE venture to apply AI in the industrial sector, is at the coalface of this movement. It recently announced an alliance with Nvidia to work on enabling AI in inspection services for the oil, gas and transportation industries.

Nvidia wrote in a recent blog post : "How do you send a human being to inspect a petroleum refinery flare stack — one that operates at hundreds of degrees and requires negotiating a high risk vertical climb? The answer is you don't." While climbing a cell tower does not carry this level of risk, MNOs such as AT&T and T-Mobile USA have already experimented with drones to inspect and even install equipment, to save cost and liability. However virtualized, there will always be physical elements to a mobile network, and civil works can be the most expensive aspect of a roll-out, especially when it comes to large numbers of small cells to support urban densification.

Increasingly, AI can create 3D models of an asset such as a cell tower, then layer 'points of interest' on top of that to enable drones to spot problems and automate defect detection. Avitas and Nvidia are currently using truck-based AI engines to get closer to towers and industrial sites, but the aim is to get that intelligence into the drone itself.

AT&T is also working on an edge computing model with AI elements to boost automation, revealed Marachel Knight, SVP of wireless network architecture, at the Mobile Future Forward conference last autumn. It aims to design its 5G RANs so that network computing components are geographically close to a tower or small cell to lower latency. It has already said that it plans to fit its edge computing platforms with high end GPUs and CPUs, and coordinate and manage all these elements with its software-defined network (SDN) controllers.

The goal is the same for AT&T and for GE (and many others) – to make AI highly personal and context aware, in order to go beyond automation and improved decision support, and enable new ways of working. On that journey, the right decisions, about how much to distribute or centralize, will help decide where the MNO fits into the complex AI value chain.

Responsible development and use of mobile AI

by Kay Firth-Butterfield, Head of Artificial Intelligence and Machine Learning
Centre for the Fourth Industrial Revolution, World Economic Forum

The possibilities of smartphones with AI capabilities ("intelligent" phones) are endless. Equipping smartphones with AI chips provides faster processing and longer battery life, and adding effective machine learning abilities will enable the phones to adapt their operating systems to users' habits, tastes, and interests, thereby expediting more efficient and impactful use of mobile technology. And the leading phone companies and chip makers are already in the process of making such advanced mobile AI a reality.

Kay is a Barrister-at-Law and part-time Judge in the United Kingdom and Professor of Law. In the United States, Kay leads the Artificial Intelligence and Machine Learning program at the Center for the Fourth Industrial Revolution. Kay can comment on how AI and other emerging technologies will impact business and society, key developments in the sector, the relationship between AI andl law/policy.

Kay is an Associate Fellow of the Centre for the Future of Intelligence at the University of Cambridge and Fellow of the Robert E. Strauss Center on international Security and Law at the University of Texas. She is Vice-Chair of the IEEE Initiative on Ethical Considerations in AI and Autonomous Systems. She is one of Robohub's top 25 Women in Robotics in 2017. Kay co-founded AI-Austin, AI-Global and the Consortium for Law and Policy of Artificial Intelligence and Robotics. She is the former Chief Officer, and member, of the Lucid.ai Ethics Advisory Panel.

AI and its use in mobile technology are on the verge of reaching a technological tipping point, with tremendous potential for making revolutionary impact on humanity. And we have the power and responsibility to ensure that those effects of mobile AI are positive.

Mobile technology, dating back to Motorola's first DynaTAC model in 1973, and its recent accelerated advancements have fundamentally transformed our lives. The mobility and increasingly lowered price of mobile phones have enabled people to communicate with the rest of the world without being tied to physical locations, thereby facilitating business growth and accelerating globalization. And a bigger breakthrough came in 2007, when Steve Jobs introduced the iPhone.

The iPhone and other smartphones, especially after being equipped with AI assistants (e.g., Siri), led to increased efficiencies and synergies, revolutionizing the way people communicate, do business, and live. It is important, however, to recognize the unintended negative consequences that resulted from the use of smartphones and associated technologies, such as new and increased health risks (e.g., "smartphone addiction," insomnia), rapid decline or demise of industries and companies, and greater socio-economic instability. Learning from the positive and negative effects of smartphones and mobile AI on humanity thus far, as well as studying the future trends of mobile AI, will help us benefit from mobile AI in the future, while ensuring that socio-economic damage is minimized.

The ubiquitous possibilities of advanced mobile AI

The possibilities of smartphones with AI capabilities ("intelligent" phones) are endless. Equipping smartphones with AI chips provides faster processing and longer battery life, and adding effective machine learning abilities will enable the phones to adapt their operating systems to users' habits, tastes, and interests, thereby expediting more efficient and impactful use of mobile technology. And the leading phone companies and chip makers are already in the process of making such advanced mobile AI a reality. For example, the new A11 Bionic chip installed in Apple's latest iPhone X includes a "neural engine" that is specifically designed for machine learning. The A11 Bionic chip enables AI features and applications, such as face recognition, voice recognition, and augmented reality, with extraordinary processing power, performing up to 600 billion operations per second. Likewise, Huawei recently developed a new Kirin 970 chip equipped with AI capabilities via a "neural processing unit" (NPU), and Samsung is also in the process of adding AI-specific CPU cores into its mobile chips. Such AI chips, NPUs, and effective machine learning abilities are forecasted to become the norm in mobile technology, helping "intelligent" phones to better predict the users' needs, perform the desired activities more efficiently, and assist the users in making more informed decisions.

In addition to "intelligent" phones, it is anticipated that there will be a surge in the development and use of "intelligent" apps in mobile technology. Application of AI and machine learning abilities in apps essentially allows AI to potentially permeate every aspect of our lives, depending on the apps we decide to install on our phones. There are already several examples of AI-powered apps that recently entered the market. For example, MyKAI provides an AI-powered chatbot that helps manage and track the user's money. Another app, named Talla, serves as an assistant that

automates answers to internal questions submitted by employees of a company and manages and prioritizes work requests. There are many other examples of AI-empowered apps, including those that are already widely-used, like Facebook Messenger, as well as relatively newer ones like Focuster, Time, Memrise, Duolingo, and so forth, each focusing on helping users in different ways.

The use of intelligent phones and apps also have great potentials for helping better humanity on a broader scale. For example, there are currently initiatives that use mobile phones for health-related services, such as for diagnosis, disease monitoring and compliance, expert assistance, and promotion of awareness, especially in countries experiencing deficits in doctors. These initiatives, however, are still at relatively nascent stages due to the present technological limits in mobile technology. Similar efforts can become more effective and grow exponentially once mobile AI technology reaches a point of being able to provide reliable and accurate medical inspections, analyses, and diagnoses. This can lower the average medical costs for the public and provide them with greater access to healthcare (especially in countries experiencing deficits in doctors). This is attributable also to the smartphones' nature of being widespread, portable, easy to customize with special-purpose applications, and connectable to diverse devices (e.g., sensors, blood pressure monitors). Thus, continued development of effective AI and pairing of intelligent phones and apps provide endless possibilities for positively impacting humanity, ranging from providing AI assistants that help people perform various tasks to AI medical apps that can have widespread impact in providing cheaper and more widespread medical services to various populations.

Ensuring a bright future with responsible development and use of mobile AI

The potential for making disruptive positive impact with mobile AI is growing at an accelerating rate, propelled by exponential technological advancements in AI and machine learning, as well as quickly decreasing costs for producing powerful chips. But that potential also comes with risks that were unintended and often unforeseeable, such as job loss, unequal distribution of wealth, improper access to and use of personal information, and negative health effects. And the fact that the technological innovations are progressing at an unprecedented speed also means that the negative consequences are likely to be more unpredictable, occur more quickly, and have broader impact. It thus is crucial that governments, tech companies, entrepreneurs, and consumers meaningfully discuss, research, and create policies to ensure responsible development and use of mobile AI, to help better humanity and minimize the associated risks. Further, it is equally important for these different sectors to prioritize learning about the relevant technologies and to keep an agile and flexible mindset, so that the necessary safeguards not only can be timely established, but also timely adjusted and corrected, in response to the rapidly evolving AI technology.

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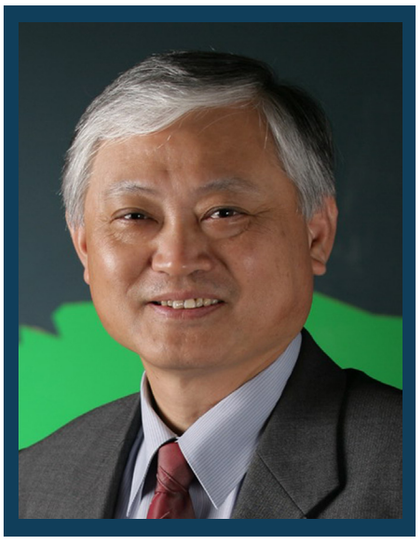

AI takes industry further, igniting the next wave of the IoT Revolution

by Chaney Ho, Co-founder, Executive Director of Board & Acting General Manager, Advantech Europe

The origin of AI dates back to as early as the 1940s, when definitions of AI were first proposed. Thereafter, applications of AI have been examples of both success and failure amid the waxing and waning of technological advancements. In recent years, AI has been improved vastly thanks to advances in computation and storage technology as well as breakthroughs in AI algorithms. Such improvements can essentially be attributed to big data, which has arisen from the advent of Internet-of-things (IoT) technologies and related devices and applications; ultimately, these advances have increased the availability and sharing of different types of data.

Chaney Ho, Advantech, Co-founder & Director of BOD, Advantech

As the President of Advantech, Chaney Ho is in charge of the company's global sales and marketing strategies. He is also leading the company in its new branding mission toward "Enabling an Intelligent Planet." As a result of his leadership, Advantech has received recognition through the years from the prestigious brand-consulting firm Interbrand as one of the Top 10 Taiwan Global Brands.

Through long experience in the company, Chaney has built a reputation as a leader in sales and marketing strategy, and in building global brand recognition. While leading Advantech Greater China, Chaney devised a deep penetration marketing strategy for the Chinese market, and achieved double-digit growth year after year. Now the greater Chinese market (including China and Taiwan) accounts for 30% of Advantech's revenue.

In 2010, after Chaney took over Advantech president's role, he participated in the planning Advantech's current vision "Enabling an Intelligent Planet" which speed up Advantech's entry to the Internet of Things (IoT) era. Chaney also lead the sector-Lead transformation of Advantech's organization so as to help it transformed from product-oriented to industry-oriented.

Chaney was born in 1954 and graduated from Tatung University in Taiwan, landing his first job with HP Taiwan. He started off as an engineer, and worked his way up to become a manager. Prior to Advantech, he worked as the general manager of Inalways Corporation. Under his management, Inalways successfully made its IPO on the OTC market in 1999, and was awarded the National Small & Medium Enterprise Award by the government. Chaney later won personal recognition, receiving the Small & Medium Enterprise (SME) Professional – General Manager Award, for his management performance with Inalways.

Chaney believes that talent is an enterprise's most valuable asset, and he likens himself to a coach for young and upcoming talent. He hopes to continue to guide newer employees, sharing insights gained from thirty years of

Ever since Google's AlphaGo computer program beat the world's top professional Go player, artificial intelligence (AI) has received a considerable amount of attention across industries. Businesses from different sectors are eager to harness the power of AI to boost their profits and value. Yet despite its growing role in the industrial community, AI has been around for a long time, and it is nowhere near the panacea some people believe it to be.

In simple terms, an AI system is built and "trained" with large volumes of data accumulated over time; without this critical process, an AI system is little more than an assortment of computer code.

The origin of AI dates back to as early as the 1940s, when definitions of AI were first proposed. Thereafter, applications of AI have been examples of both success and failure amid the waxing and waning of technological advancements. In recent years, AI has been improved vastly thanks to advances in computation and storage technology as well as breakthroughs in AI algorithms. Such improvements can essentially be attributed to big data, which has arisen from the advent of Internet-of-things (IoT) technologies and related devices and applications; ultimately, these advances have increased the availability and sharing of different types of data.

Many people are overly optimistic about AI. However, we should not overlook the fact that it is only when AI systems can utilize large volumes of data that they can perform in an intelligent manner. The growing popularity of AI, as well as its transformation from academic research to industrial applications, hinges on the vast amount of data generated by IoT technolo-

gy, which emphasizes connecting everything to networks. Big data provides the foundation upon which AI systems learn, allowing them to mature to the point of being able to make valuable contributions to business.

long as it is applied properly, it will soon be able to discern logical patterns in data accumulated over time, and most importantly, make predictions. Moreover, AI can be repeatedly trained to establish relations between current and previous data sets. Both of these streams of AI development have strong demand for data accumulation.

The type of data utilized in AI training should be in line with the intended application. For example, the data used for Go-playing AI systems do not apply to traffic management systems, nor are data for AI-based volcanic activity simulations applicable to AI-based push advertising. Even when data are selectively gathered from diverse sources—or designed through sophisticated means—different types of data still need to be used for different purposes.

Thus, for businesses seeking to adopt AI, one cardinal principle is to develop and select data sources that cater to their needs. Ultimately, AI is a tool that is intended to reduce costs and enhance efficiency.

To employ AI for smart manufacturing, you would need to collect data from machines on the production line in order to model the machines' operation, the results of which could be utilized to better formulate predictions. As an example of the benefits of AI, by setting up an intelligent production line, Mitsubishi Electric has improved its productivity by 30% and production-line uptime by 60%. Estimates show that making AI-based predictions can lead to an 80% reduction in forced outage rates and a 75% reduction in waste production.

Of course, whatever task you want to perform through AI, you need the right type of data or algorithm. As an example of this, Midea Group (a Chinese electrical appliance maker) was able to reduce its operating costs by 22% by implementing an intelligent production system that was based on historical data. Before adopting AI, you should assess how to leverage its benefits to accomplish your objectives or develop services that can increase customer stickiness, and this requires an understanding of how to acquire the necessary data to make such systems work.

In the past, the emphasis in traditional production and manufacturing was for actions to be performed by machines following precise instructions. In automation applications, however, the combination of AI and data make the manufacturing process more efficient through the use of algorithms, which can even help formulate future production processes in intelligent manufacturing.

Likewise, recent intelligent application developments have already had a fundamental impact on automation. Massive AI data analysis is a crucial step to further transforming the progress of intelligent manufacturing. However, it is only by careful selection and capture of specific relevant data that the degree and accuracy of intelligentization can be determined.

AI does not suddenly materialize without using relevant data; thus, data aggregation, storage, processing, and the precise application require careful consideration and analysis. Despite the involved challenges, AI has demonstrated the potential that it could dramatically improve efficiency by enabling a whole range of new smart manufacturing applications.

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How Artificial Intelligence and the IOT will transform customer service

by Adam Byrne, Chief Operating Officer, RealVNC

Adam Byrne, COO at RealVNC, predicts how connected technology and Artificial Intelligence is set to change customer service and allay fears over automation.

Adam Byrne is the Chief Operating Officer for RealVNC.

With a background in Mathematics and Computer Science and a career spent growing IT companies from the ground up, Adam Byrne brings both business and product development skills. He has full responsibility for overseeing day-to-day business operations, and makes valuable contributions to strategy and direction. He is building a worldwide ecosystem of technology partners and licensees in a variety of vertical markets. Adam's combination of deep technical knowledge and business acumen is driving growth, particularly in substantial new market-making applications.

As the digital economy breaks down barriers between vendors, customers, suppliers and employers, businesses will now use connected technology to give customers access to a broader array of knowledge, expertise and service than ever before. Trends such as automation of customer services are unpopular with consumers due to the loss of human interaction and ability to resolve customer complaints, hampering brand reputations and customer loyalty. Web, mobile and IOT apps are now the primary way companies interact with consumers and therefore the experiences they deliver via these apps determine how many customers they will attract or retain.

We are seeing pioneering companies adopt remote access technology to create a two-way 'always-on' customer service, empowering human customer service teams to be physically omnipresent across consumer devices in any location and enabling customers to physically interact with equipment in faraway training facilities. This is enabling companies to dramatically reduce call-outs and product returns while increasing brand reputation and customer relations. The technology will make limited human resources stretch further than ever before by enabling trainees, instructors, advisers, customers and support staff to be physically present inside devices across an array of locations.

Artificial Intelligence will soon add another dimension, empowering machines to learn from human customer support staff and predict and resolve customer queries at a faster rate than ever before. This will be incorporated into mobile apps and even vehicles, creating connected customer service on the move in, any location.

We predict that in 2018 companies will begin using technology to boost profit, maximise brand interactions and approach customer relations in a completely new way. Here are some of the big things coming up.

In the digital economy, brands often need to provide a premium experience to differentiate their technologies from rival offerings. They also have to make limited human resources stretch across an ever-expanding plethora of consumer devices, while improving first-call resolution rates and reducing product returns.

Pioneering companies have begun to apply the same thinking behind the remote 'IT help desk' to customer service to transform their entire customer experience. One pioneering telecoms giant has used remote access technology to let customer service agents 'remote in' to customers' living rooms to resolve technical problems, guide customers and even 'upsell' from any location. Customer service agents can now connect into home set-top boxes, TVs, tablets or smartphones to see the problems customers are experiencing in real-time.

Bank managers can remote in to cashpoints and give audio and video feedback on consumer transactions. Taxi firms and automotive dealerships will be able to remote in to vehicles on the road, connecting into the dashboard to fix technical problems, adjust the heating or air conditioning or guide drivers on how to use new vehicles. Telematics data can be sent to the cloud and combined with real-time customer support to guide drivers through queries in real-time, on the road.

This pioneering approach has led to a 30% decrease in onsite service calls such as truck rolls and a 30% increase in first-call resolution of customer queries for one of our clients. Making support staff digitally omnipresent also reduces the number of product returns and reduces demand for customer support over time by showing consumers how to use new devices or fix technical problems in their own homes or on the move.

The same works both ways, with customers now able to be present inside their service-providers devices to receive remote user training in new technologies. Some IT software developers now allow corporate customers to remote in to their

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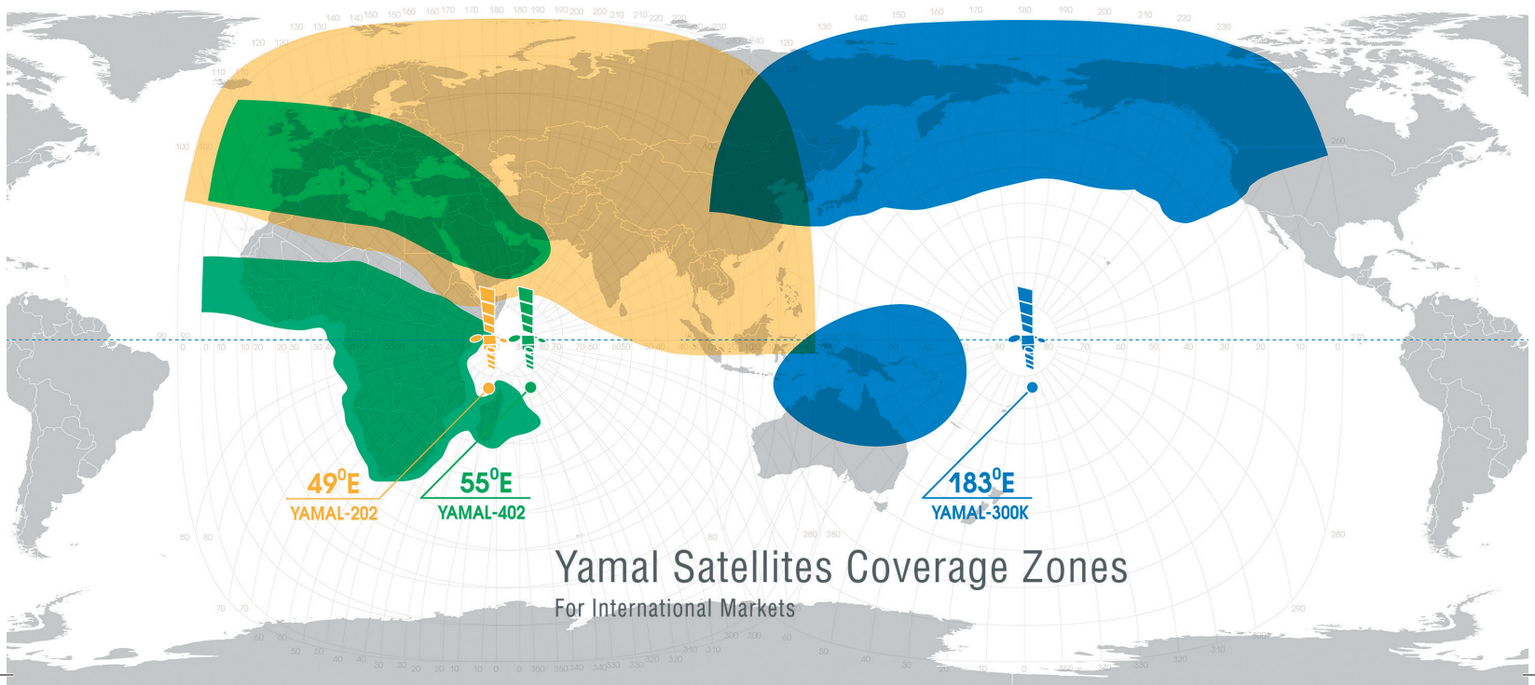

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For International Markets

training labs, and physically interact with faraway equipment and training machines. We will soon begin to see companies and consumers using remote access technology to deliver real-time, remote customer support inside everything from data centres to cars.

Remote access technology will also enable companies to provide endless 'over-the-air' upgrades for consumers and show them how to use new features in any location. Crucially, brands will be able to use remote access technology and the 'Internet of Things' as a marketing tool to create more brand touchpoints, foster long-term customer relationships and boost brand loyalty. 30% of mobile phones are currently returned within the first 14 days, often due to inability to use the device, however ensuring that there are more touchpoints with customers to solve any issues would contribute to a reduced return rate. Crucially, putting the human touch in online customer service, helps allay public concerns that the human element in customer service is being lost in the drive for efficiency savings.

Yet automated systems are also about to get more human. From self-service checkouts to auto-attendants, there is an outdated view of automation as a dumb, rigid system of customer service. But new machine-learning algorithms could use predictive analysis to instantly work out the solution to any customer query and then autonomously connect into customer devices to fix the issue, eliminating lengthy customer service waiting times and dramatically improving first-call resolution. The algorithms could be 'trained' by recording how thousands of customer service queries are successfully resolved until they can accurately predict the solution to any customer query. Mobile apps could include AI-powered 'virtual call centres' that can connect into customer apps to instantly respond to and resolve an unlimited number of customer queries. We will begin to see a generation of all-seeing, all-doing 'digital assistants.'

This combination of remote access and machine-learning could help relieve public concerns surrounding automation by providing customer service that is faster and smarter than humans. The banking industry, which is moving away from human face time and physical bank branches towards 'smart' ATMs, is an early pioneer of 'smart' customer service.

This will dramatically boost efficiency and drive major savings in customer service as machines can analyse data and take corrective measures far faster than humans. In future everything from audio and visual data could be shared between any IOT devices using the same principle of remote access technology, creating genuinely real-time interconnectedness and predictive customer service across the IOT.

However, this will also create a new and fundamental challenge for operators. The mechanisation of customer service will require immense consumer education efforts to help people trust machine assistants. They will also require a step-change in privacy and security, as both machines and humans increasingly become digitally omnipresent across IOT devices. If this challenge can be navigated successfully, the IOT will create a genuinely smart, predictive, digitally omnipresent customer service, allowing companies to automate and drive efficiency savings without sacrificing consumer satisfaction and brand reputation.

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Artificial Intelligence serving humankind

by Georges Dassis, President, European Economic and Social Committee (EESC)

The use of AI raises many moral and ethical questions, issues of security, transparency, control, private life, the effects on work, wealth distribution. It is therefore imperative that policy decisions be taken that not only create the regulatory framework for using this technology but that will also introduce education programmes for new technologies, devise ways of replacing jobs that are lost, possibly create new jobs, distribute some profits to help people who lose their jobs and ensure that work adapts to the new needs.

Georges Dassis, a Greek national, is the current President of the EESC. Prior to that, he was President of the Committee's Workers' group (2008-2015).

Georges Dassis, who opposed the colonels' regime (1967-1974), has been a trade-union activist from the age of 15. During his stay in Belgium in the 1970s, he became a permanent member of the national staff of the Belgian General Federation of Labour (FGTB).

Since 1981, he has been a representative of the Greek General Confederation of Labour (GSEE) to the European Trade Union Confederation (ETUC) - where he has been on the executive committee since 1982 -, to the International Trade Union Confederation (ITUC, formerly ICFTU) and to the International Labour Office (ILO). He is also one of the founder members of the GSEE's Labour Institute (1990) and its current secretary for international relations.

He has served several terms of office at the EESC, first between 1981 and 1990, when he was president of the regional section, and from 2002 to the present, leading the ECO section between 2004 and 2008. At the EESC, Mr. Dassis has been rapporteur on opinions such as the European minimum income, Social dialogue in the Economic and Monetary Union and the Cost of non-Europe.

Rapid development in the field of Artificial Intelligence (AI) in the United States has triggered a wide debate in Europe in both academia and society about how much space we want to grant it in our lives and how we want it to evolve. The position of the European Economic and Social Committee (EESC) lies between the extremes of fearing that AI will create an Orwellian authoritarian society and allowing automation to completely take over the world of work. The EESC believes that artificial intelligence in whatever form (e.g. machine learning, augmented intelligence, robots) should be regulated so that it works for the benefit of humankind .

This position is based on an acceptance that artificial intelligence can offer many benefits to society, a fact that also justifies the expected sharp increase in investment in this sector . It is sufficient to consider the applications designed to achieve more sustainable agriculture, better road safety, a more stable financial system, less polluting production processes, medical progress, safer and more efficient workplaces, more individualised education, better justice and a more secure society. AI is even likely to play a role in eradicating certain diseases and eliminating poverty. It can release workers from demanding and onerous tasks and give them quality time to spend with their families or devote to scientific or artistic activities. AI can also make an important contribution to industrial development and enhancing EU competitiveness.

However, the use of AI raises many moral and ethical questions, issues of security, transparency, control, private life, the effects on work, wealth distribution. It is therefore imperative that policy decisions be taken that not only create the regulatory framework for using this technology but that will also introduce education programmes for new technologies, devise ways of replacing jobs that are lost, possibly create new jobs, distribute some profits to help people who lose their jobs and ensure that work adapts to the new needs.

Although artificial intelligence has not yet been developed to the same extent in Europe, since its influence extends across national borders the EU must take a leading role globally in approving clear and comprehensive strategic frameworks based on European values and fundamental rights. The EESC has identified a number of key priorities for such a policy.

First, we know that AI systems do not have in-built moral values, which means that it is up to us to decide how they should respect our personal integrity, autonomy, dignity, independence, equality, security and freedom of choice. The data that they use must not be based on cultural or gender discrimination or promote such discrimination. Artificial intelligence systems must not operate in ways that violate the moral principles of a society as those principles have been enshrined in a legal system. Robots cannot do things that have not been permitted by people (eugenics, unauthorised euthanasia, torture, terrorism, etc.). Their use in war must be condemned.

Furthermore, use of AI in the real world raises certain security issues relating not just to the extent to which a system is

reliable, but above all to how that system will respond to unforeseen events. How does a system's self-learning capacity affect security, including as it continues to learn after coming into operation? Security requirements must be laid down jointly by policy-makers, AI and security experts, businesses and civil society organisations.

AI systems based on smart algorithms are having an increasing impact on people's lives: examples include intelligence-led policing, assessing mortgage applications and insurance approval procedures. Transparency is therefore essential with respect to operations and accountability. We must determine which decision-making processes can be entrusted to AI systems and which cannot, as well as the cases when human intervention should be preferred or regarded as obligatory. Even if it is not yet clear to what extent these systems will be able to have legal personality – and thus individual responsibility – in the future, this option is risky because it would make it easy for the entity producing or using the system to avoid being held legally responsible itself. It would also create an extremely precarious situation for consumers or accident victims seeking justice. If the Member States do not have adequate legislation in this area, the necessary measures must be taken to adapt.

We already know that smart watches, smart wristbands and even smartphones often transfer personal data to producers' cloud platforms. The issue of adequate privacy protection is particularly urgent also because the buying and selling of data, e.g. data collected by the manufacturer being sold on to third parties, is a booming activity. We will have to take care to protect children from the influence of such technology, as well as consumers and voters from possible covert manipulation. We must protect workers from monitoring that breaches their privacy and that uses their personal data without their consent.

However the area that will be directly transformed by AI systems is employment, with a knock-on effect on social security systems. Erik Brynjolfsson and Andrew McAfee of MIT believe that ongoing technological advances (including AI) are a "second machine age", but one that differs in two important ways from the "first machine age": (1) where previously the "old" machines largely replaced muscle power, the new ones are now replacing knowledge-based services and basic cognitive skills, which affects not just low-skilled workers but also people with qualifications, and (2) artificial intelligence is a general-purpose technology that is having an impact on almost all sectors simultaneously.

Given that most jobs involve a multitude of tasks, the risk of all a person's professional activities being completely taken over by AI systems or robots is close to zero. But in practice all workers will be faced with automation of some of their activities. Public authorities and the social partners will have to ensure that the time which is freed up is used constructively. There is also the fear that soon only certain low-paid micro jobs might be left for an ever-expanding body of flexible workers. Employment relationships will therefore have to be reset with the help of the social partners so that there is a situation in which part-time/flexible work is widely accessible and provides the worker with an adequate quality of life, and so that the automation of production does not prove detrimental to workers.

Instead of focusing on what artificial intelligence can do, it would be better ultimately to ask what it is that people are able to provide (creativity, empathy, cooperation) and what jobs we still want to do on our own, and to seek solutions that enable us to improve the cooperation between people and machines. In all cases we must invest in education when it comes to new technology. There must be a major focus on research into the big social issues such as the social applications of AI, with reference to the Societal Challenges pillar, and the effect of these innovations on society and ways of addressing this.

In any event, technological developments are weakening the position of labour compared with that of capital. Technological advances can also create income disparities between people at local, regional and global level. There is a risk that AI will reinforce these trends. Any increase in productivity, which is likely to be dramatic, should not be allowed to benefit the few but should benefit society as a whole. Taxation of artificial intelligence is favoured in some quarters, as is a social dividend from AI or dividing up the ownership of such systems between workers and employers. The need for a universal basic income is being invoked more and more frequently.

In a previous opinion the EESC mentioned the "digital dividend" and the need for this to be fairly distributed to guarantee positive effects for development. I believe that a share of the added value generated by the broad use of AI systems must be invested in workers, either directly or through investments designed to create new jobs and support the unemployed. This must not be left to the discretion of businesses but must be laid down by law and regulated by policy with the help of the social partners, so as to ensure a smooth transition to a new model of production that gives people more freedom and autonomy rather than leading to social exclusion.

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Artificial Intelligence – From smart device to intelligent mobile business assistant

by Andrew Yates, CEO, Artesian Solutions

Artificial Intelligence will become really exciting when it transcends any physical device and becomes part of the everyday fabric of life. When I get in my car in the morning and it tells me what meetings I have that day, who I am meeting, and the latest news about their company or social media post from their CEO or Head of Sales. When I sit down at my interactive desk and it has not only received a new request for information from a customer but already completed it based on deep learned knowledge of that customer as well as the unique ways my business is capable of responding to their requirements. Or even when I get home in the evening and my home knows I have had a tough day at the office so has put the heating on and run me bath. The possibilities are endless.

Andrew is the CEO of Artesian Solutions, a company which he co-founded. Artesian is a powerful Artificial Intelligence driven service that equips client facing teams with the resources they need to succeed in a modern commercial environment.

With over 20 years' experience of building early stage businesses and working in larger corporations, Andrew has a diverse commercial and creative skill set. Andrew enjoys guiding hypergrowth businesses working to create repeatable, robust and scalable processes to deliver lasting customer happiness and share-holder value.

I am in the Artificial Intelligence (AI) business, so I guess it is inevitable that I get asked questions such as "will AI really become part of everyday life" or "will AI go mobile"? If I wasn't such a polite person my natural response would be "of course it will stupid". After all why would Artificial Intelligence not manifest itself in any other way than mobile?

According to McKinsey Global Institute (MGI), AI is contributing to a transformation of society happening 'ten times faster and at 300 times the scale, or roughly 3,000 times the impact' of the Industrial Revolution. Perhaps the only technological development in modern history to match this impact is the mobile phone - almost 63% of the world's population own a mobile phone, with 2.7 billion people expected to have a smart phone in their pocket by 2019. Combine the two and exciting things happen - AI is most definitely heading to your pocket.

Let's face it, it's been a long time since the mobile was just a phone. It's a computer carrying more technology than we saw on Concorde or all the Apollo missions combined – such is Moores Law. Smartphone manufacturers are the true trend setters for not only mobile development, but innovation in consumer electronics in general. Apple is already working on the Apple Neural Engine to carry out AI processing on mobile devices, likewise Samsung have plans for an AI-based ecosystem across all their devices. And then we have the millennials – just watch the way young people (younger than me) expect technology to interact with them.

In terms of my specialism - Artificial Intelligence in the context of the delivery of business intelligence and actionable insight - it has perhaps already evolved out of the imagination or R&D centre and into everyday business as we know it. Companies can already use AI and machine learning algorithms to uncover high value information that improves their understanding of the customer and their drivers at any given moment, whether it be up-to-date firmographic data, identification of trends from patterns of behaviour, insight in to pain points or challenges they are facing, or emotional sentiments that signal an intent to buy.

Delivered via the ubiquitous cloud , AI is all about not only making sense of vast quantities of data, but using cognitive computing to try to understand why it's valuable to the recipient. In turn (if you get it right) this enables businesses to make better and faster decisions and position themselves to be constantly competitive in near real-time. Likewise, AI and machine learning platforms are getting better at predictive tasks, constructing models based on patterns of event types and customer attributes that correlate with eventual success, before the customer themselves even realise what lies ahead. The result is a highly sophisticated personalised sales strategy, campaigns and product or service development.

As the mobile workforce continues to grow at pace, it is inevitable that the eventual delivery mechanism for this intelligence will be the handheld device. Innovative mobile applications married to ever more powerful AI platforms increase their potential, taking devices from simply being smart, to making them into intelligent mobile assistants.

We expect business leaders, sales and marketing professionals, product managers and the like to be 'experts', so imagine then the potential of a new world where

every professional has a hyper-expert working away in their pocket. One that interacts with them in human-like ways and constantly sifts through thousands or perhaps millions of data points, delivering only the most relevant, timely and commercially valuable search results, direct to their smart device. These golden nuggets of intelligence will be based on its deep learned understanding of what is important in their individual ecosystem - whether that be a breaking growth story about a customer, the views of an eminent thought leader, latest mergers or acquisitions taking place in their market, a particular compliance issue that they need to address, or an emerging risk that needs action in order to mitigate damage to their business or that of a valued customer.

More than just a welcome solution to the problem of information overload or lack of time, AI paired with mobile offers the ultimate "always on", "always prepared" and "always responding" solution for today's business leaders, front line, and back office professionals. We operate in a world where there is a growing focus on customer engagement, and customer experience surpasses even product when it comes to retention and loyalty. A virtual assistant deployed in a mobile device will enable professionals to stay in constant communication with customers, provide them with the most relevant and timely content, and deliver the most direct and responsive service experience. No wonder industry analysts predict that the intelligent virtual assistant market will surpass US$11 billion by 2024.

Take banking for instance. Banks are working closely with technology and fintech companies and investing huge sums to develop and launch AI solutions across a wide range of disciplines to become more efficient, improve compliance, enhance customer engagement, reduce costs and enable employees to be more productive. They are using real time transactional analysis to build a better and deeper view of the customer in order to personalise and recommend value added products, and AI powered data software to identify sales opportunities and provide timely prompts and insights to front line relationship managers. They can utilise deep machine learning to improve the accuracy of fraud detection, and advanced analytics, run over huge datasets, to identify patterns and pull out nefarious activity such as money laundering. Imagine then if they could not only capture this information but deliver it right from machines into the palms of their employees at the precise time of interaction with a customer, not only helping them learn from the insight delivered but giving them an instant new way to act upon it.

To give a practical example. When undertaking any new financial relationship whether it be processing a mortgage application or business loan, banks have a legal obligation to undertake significant due diligence and risk management processes. Years ago this was conducted manually - checking credit history, gathering copies of passports, or pulling reports from Companies House. A very hit and miss solution that was hugely time consuming, and took front line banking staff away from spending time with customers. The banks then spent millions developing software and building back office customer on-boarding teams to improve the speed, accuracy and productivity of these services. With the introduction of AI for mobile, the potential exists to deliver this information straight back into the hands of front line teams, helping them insert themselves directly into the customer journey at every single touch point, with the highest level of confidence in every decision made, in the most time, cost effective, and customer centric way possible.

There is no question, AI is going mobile – it already is. Perhaps the bigger question is what happens when AI goes beyond mobile?

Artificial Intelligence will become really exciting when it transcends any physical device and becomes part of the everyday fabric of life. When I get in my car in the morning and it tells me what meetings I have that day, who I am meeting, and the latest news about their company or social media post from their CEO or Head of Sales. When I sit down at my interactive desk and it has not only received a new request for information from a customer but already completed it based on deep learned knowledge of that customer as well as the unique ways my business is capable of responding to their requirements. Or even when I get home in the evening and my home knows I have had a tough day at the office so has put the heating on and run me bath. The possibilities are endless.

But getting back to the now, business leaders must consider that their customers, and in turn their future success, will be directly impacted by the growing influence of Artificial Intelligence in mobile and their readiness to respond.

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The global search for education: Innovation, quality and mobile

by C. M. Rubin (Cathy), Founder, CMRubinWorld

"I think technology has the potential to unlock new approaches to assessment that will change what and how we teach. I believe that the current curriculum shape and form that we see around the world with subjects taught in silos has to change."– Jim Wynn

C. M. Rubin (Cathy) is the founder of CMRubinWorld, an online publishing company focused on education, entertainment and lifestyle, the co-founder of Planet Classroom a reality show for education and the co-founder of Henmead Enterprises, Inc., a publishing and strategic consulting company. Rubin's 30 years of experience as an author, journalist, editor, executive, and entrepreneur in the fields of publishing, film, television, video and education have fostered her expertise in identifying and evaluating national and global trends in key economic sectors and industries, including the impact of innovation and technology. Rubin is the author of three best-selling books and two widely read online series for which she received 2 Upton Sinclair awards. Her award winning series, "The Global Search for Education," brings together over 600 distinguished thought leaders from around the world to explore the key education issues faced by most nations.

Innovation and Quality: Two Sides of the Same Coin? was the title of Education Fast Forward's 17th global debate at Mobile Learning Week in Paris in partnership with UNESCO. The big debate brought together thought leaders in this field from all over the globe to discuss the latest news and views on the impact of mobile technology in life-long learning. To what extent is mobile technology strengthening the quality of education? What about access? Given the major focus on 21st century skills, what role can mobile technology play in curriculum innovation? What kinds of public policy proposals can increase the benefits of mobile technology in classrooms?

Joining us in The Global Search for Education today to continue the EFF17 discussion are Lord Jim Knight, Chair of the UK Online Foundation and HTI Education Trust, Thomas M. Philip, Associate Professor at UCLA, Professor Mike Sharples, Professor of Educational Technology at The Open University, and Jim Wynn, Co-Founder and CEO of Education Fast Forward and CEO of Imagine Entertainment.

Gentlemen: How do you see the principal pros and cons of mobile learning?

Michael Sharples: We are living in an increasingly mobile world, where people are continually on the move and ideas are fluid and rapidly changing. Mobile learning supports learning across locations and provides immediate connection between people and ideas.

The main disadvantages are that mobile learning doesn't fit well with traditional education. The focus on personal devices, learning across locations, and learning from experience just doesn't mesh with the classroom as a fixed location for learning and the teacher as source of knowledge and authority.

Jim Wynn: The pros include access to learning materials, other people and information; and convenience, including size, cost and anytime use. The cons include the 4 BILLION people without internet access, mixed phone quality, internet connectivity issues and inconsistent pedagogical quality of materials.

Lord Jim Knight: The most compelling use of technology for learning that I see is flipped learning. This technique should see more teachers pushing learning content to pupils in advance of class, to then allow face to face time at school to be used more effectively to embed the learning.

Mobiles will be used for bad behaviour. For bullying, for wasting time, and to distract from learning. But they can be used for research, for recording learning in an assessable format, and for individual response in formative assessment.

Thomas Philip: We need to start with questions that focus on what sort of learning experiences we'd like to facilitate and, even more fundamentally, the purpose of learning. Then we need to ask ourselves how mobile technologies might support this vision of learning. When mobile technologies are one set of tools in a repertoire of resources that a teacher/facilitator has access to, they can be leveraged in powerful ways.

"We need professional development for teachers so they can collaborate on the best pedagogy and differentiation. We also need to ensure no one is denied the advantages of the technology due to cost or lack of connectivity at home."– Lord Jim Knight

How do we make sure that mobile technology in classrooms works to benefit all?

Lord Jim Knight: We need professional development for teachers so they can collaborate on the best pedagogy and differentiation. We also need to ensure no one is denied the advantages of the technology due to cost or lack of connectivity at home.

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Mike Sharples: For learning inside the classroom, the biggest barrier to successful adoption is school policy. In some countries, such as Denmark, allowing children to bring personally owned devices into the classroom is just not a problem. The children use their phones and tablets where appropriate to supplement their learning, and the process is managed by the teacher. In other countries it has become a battle-ground between children and schools – with schools banning mobile devices and children seeing this as a provocation.

Thomas Philip: If classrooms, schools, and society are inequitable, the introduction of mobile technologies into classroom spaces will not fundamentally alter these inequities. We need to engage in the difficult work of understanding and addressing relationships of power, authority, and knowledge in the classroom. We must create learning environments where students and their cultural backgrounds are valued and built upon. We need spaces where students feel connected to their peers and adults. If we create these conditions, mobile technologies can benefit all students.

Jim Wynn: We need to look at what the need is first and engineer a solution to solve the problem. What we tend to see is a solution and people trying to see how to use it. I saw an example of young children sending arithmetic questions to each other via an app. Paper would have been better.

How are the current innovations in mobile tech shaping the global consciousness of our students?

Thomas Philip: Social networking coupled with the access to international and alternative news sources create unprecedented opportunities for young people to develop global consciousness as they learn with others from across the world.

Lord Jim Knight: The computing and communicative power of a smartphone is extraordinary. It allows us to consume and create content on the move and share it with anyone in the planet. As more of us in more parts of the world have access to these devices, we will see more national boundaries become irrelevant.

"Social networking coupled with the access to international and alternative news sources create unprecedented opportunities for young people to develop global consciousness as they learn with others from across the world." — Thomas Philip

How can technology innovate secondary language education?

Lord Jim Knight: Duolingo, a mobile language learning app, has 100 million registered users. It is not alone. Duolingo uses a pedagogy of small sessions of daily practice, taught by machine. Others link people over video to practice and tutor together. These are powerful techniques that can only grow in their impact.

Jim Wynn: The need to study languages without being controlled by the school clock is the first advantage – learn when you want is crucial for language development.

I think here is a lot of research that language learning needs feedback for it to be effective. There are apps now that can listen to you talk and let you know what you have said.

In what way will e-reading shape classrooms of the future? Can e-reading be a part of improving early-childhood literacy?

Lord Jim Knight: E-books allow access to much more content, more cheaply. They allow data to be collected as to where readers struggle to keep going, they can highlight, they can share annotations, they can follow hyperlinks and even consume video. That is powerful in education and should be used in schools. However, they are harder to share and in early childhood I am more of a fan of sharing illustrated books and the magic of people reading to each other.

Jim Wynn: E-readers that can be dynamic and fun will make a big difference. Some e-readers allow you to look up the definition of a word instantly, some allow you to follow a theme or a character so you can get under the skin of the text, some have random characters that talk to you or surprise you. The future is huge for this and some innovative work has even seen the book storyline change as you move through it. You can also hold every book you need in your pocket so it has a huge physical advantage too.

Michael Sharples: Interactive books that provide assistance with phonics, spelling and meaning development can be valuable in early reading.

"It is entirely possible to integrate mobile technology into classrooms, as has been shown by Denmark." — Mike Sharples

Given the major focus on 21st century skills, what role can mobile technology play in curriculum innovation?

Jim Wynn: I think technology has the potential to unlock new approaches to assessment that will change what and how we teach. I believe that the current curriculum shape and form that we see around the world with subjects taught in silos has to change. The content can remain but we should learn math in context and if we studied food, for example, it would need to cover math, physics, history geography, etc. Technology could track the learning object but unlock the ability to teach something in context. This would also enable the development of different characteristics in learners in a way that would be useful post formal education.

Lord Jim Knight: Mobile is good for research, for curation, for content creation, and for communication – therefore a great tool for teaching these skills, but not essential.

Michael Sharples: At The Open University we are developing tools and platforms for inquiry-lead learning in the wild, e.g. iSpot and nQuire-it.

What kinds of public policy proposals would increase the benefits of mobile technology in classrooms?

Lord Jim Knight: First and foremost is universal access. If mobile tech is embedded in learning than everyone needs equal access to devices and connectivity. There is great practice in this area but the digital divide persists in every country of the world. Secondly, we need good advice on technical and behavioural matters. Finally, we need training to give teachers the confidence to use these new tools and move on from the downsides of mobiles.

Jim Wynn: Allow teachers to use them and not ban them. Fair and equitable access would need to be considered so that there doesn't become a technology apartheid situation. Copy Uruguay and pass laws to protect learning technology budgets. When the UK ring fenced tech money in the late 1990, it made a huge difference to access.

Michael Sharples: There needs to be a policy shift from "ban and contain" to "manage and support". That happened with pocket calculators in classrooms in the 1980s, and connected multimedia mobile devices are now cheaper (in real terms) and far more powerful than calculators were then. It is entirely possible to integrate mobile technology into classrooms, as has been shown by Denmark.

The go-to strategy for fixed mobile convergence in the 5G era

by Faisal H. Usmani, Business Development and Strategy Lead - Communications, Cyient EMEA

5G will drive innovation and research in Artificial Intelligence (AI), a part of the industry that is attracting huge interest from the major tech players. Google's $400 million acquisition of DeepMind in 2014, for instance, demonstrated its commitment to developing mainstream AI applications. Mobile is one of the most promising areas of investment for AI, with it generating new revenue streams for CSPs by opening up new business propositions for them to offer customers.

Faisal Usmani is the Business Development and Strategy Lead – Communications for Cyient EMEA

Faisal has over twenty years of experience in the telecoms industry across both fixed and wireless technologies space. He is the Business Development and Strategy Lead for Cyient Europe responsible for supporting pre-sales, solutions, strategy and innovation for the complete communication services portfolio. In this role, Faisal has been significantly involved in defining and delivering cost effective solutions for supporting major FTTx deployments.

Prior to joining Cyient, Faisal spent the early part of his career with Ericsson, and Atos Consulting, where he held positions including Executive Consultant and NGOSS/NGN Solutions Capability Lead. He was worked with a wide range of leading global communications services providers including BT, KPN, Liberty Global, Vodafone and Swisscom.

Faisal Usmani holds an MSc in Telecommunications from University College London.

Communication service providers (CSPs) are facing increasingly volatile times when it comes to the mobile market. Fixed and mobile operator services are converging, such as Vodafone and Kabel Deutschland in Germany, Telenet and Base in Belgium and BT and EE in the UK.

At the same time, there is a growing call for 5G services to be rolled out. 5G will bring greater bandwidth and therefore the ability to communicate with far more connected devices and to manage more data at higher gigabit speeds. Carriers in South Korea, China and the US are among the most active in testing 5G technology. Increased synergies between fixed and mobile networks and the coming advent of 5G are driving the need for seamless fixed-wireless connectivity and the bandwidth potential to support bundled service offerings.

Mobile Artificial Intelligence

5G will also drive innovation and research in Artificial Intelligence (AI), a part of the industry that is attracting huge interest from the major tech players. Google's $400 million acquisition of DeepMind in 2014, for instance, demonstrated its commitment to developing mainstream AI applications. Mobile is one of the most promising areas of investment for AI, with it generating new revenue streams for CSPs by opening up new business propositions for them to offer to customers.

By its very nature, AI will make CSPs' networks more intelligent and smarter. Imagine a network for example, that could intelligently amend itself after sensing different pre-defined service levels or user behaviour patterns. It could interact through senses, prediction and reason. Enhanced levels of AI could also transform cellular networks from being network-centric to user-centric and ultimately, to information-centric.

Artificial intelligence can also be used in mobile apps to predict best possible options and provide recommendations to users in a predictive way through predictive analytics. In fact, Gartner predicted that intelligent apps would be one of the top ten strategic trends this year. Integrating automotive mobile apps in the car for instance, could inform the driver of the best places to park, or even if the car will itself fit into the space.

According to GSMA, one of the key battlegrounds for operators looking to capitalize on AI will be around voice interfaces that control and coordinate data and devices across a wide range of applications. Voice activation services, such as Amazon's voice-controlled digital assistant Alexa, for example, could be integrated into the car's electronics system for a more connected, seamless driver experience. With automated cars coming into play in the next three years, we will start to see mobile AI becoming much more commonplace.

Personalized customer experiences

AI is also driving more mobile personalization, enabling operators to completely

reposition the value benchmark of existing customer experiences. Using customer behaviour data, operators can make more informed decisions. For instance, Taco Bell's 'TacoBot' provides a bespoke user experience by providing recommendations on menu suggestions by predicting specific purchasing trends. The latest smartphone handsets come armed with a number of features to support AI performance. They're equipped with microphones, cameras and GPS tracking capability for example; with the latest offering from Apple, the iPhone X, even coming loaded with an A11 Bionic chip that supports Face ID's 3D scanning. Integrating AI with these features enables operators to make apps much more relevant and personalized to the specific user, in turn, making each app session more valuable than the last.

While this innovation enables a level of service that's never been possible before, data protection and data security, remain a key challenge. This is particularly true with new legislation coming into force across Europe next year – the General Data Protection Regulation (GDPR) – which will totally upend what kind of personal data that organizations are able to store, collect and use.

As AI advances the ability to perform complex analytics, it will become increasingly ubiquitous. If deployed correctly, 5G will provide a fundamental step change to improving the customer experience. 5G is set to be rolled out by 2020, bringing seamless connectivity, lower latency and faster mobility to connect to a wide range of services from transportation, mobile devices and IoT/machine-to-machine (M2M) services.

The fixed mobile convergence landscape

In response, a number of trends have emerged in recent years that are reshaping the telecoms market as we know it. One such trend is the growth of heterogeneous networks (HetNets) – mobile networks that are made up of a combination of different cell types and access technologies, such as small cells, microcells, picocells and femtocells. These networks are having a big impact on data capacity demands; enabling CSPs to better manage their peaks and troughs of traffic.

In addition, we've seen the emergence of fixed mobile convergence, a powerful tool to capture mobile customer from competitors. Early results show that converged customers have lower churn rate up-to 50% compared to non-converged customers.

Increased connectivity

We're also seeing a widespread growth in the Internet of Things (IoT) and M2M communication; with countless new devices being developed to support the connected society. The average family of four now owns 24 connected devices in total, compared to just eight devices in 2012. This is according to recent research from GSMA, which also reveals this figure is set to rise to 50 devices by 2022. These devices are set to support developments in connectivity across a number of different areas of everyday life – from connected homes and healthcare, to autonomous cars and smart utilities.

The competitive nature of today's personal and professional environments also requires a high degree of agility in terms of IT infrastructure, and as a result, we're seeing far greater traction in the uptake of Network Function Virtualisation (NFV) and Software-Defined Networking (SDN). The former enables CSPs to reduce the cost of a network deployment by using a combined approach of data centres and cloud infrastructure, whereas the latter is used to create a more dynamic network that can manage traffic and bandwidth better, enabling CSPs to provision new services quicker. Increased virtualization and orchestration will play a critical role in the dynamic integration of fixed-mobile networks.

The go-to strategy

For those CSPs who can approach this increasingly volatile mobile landscape in the right way, there is plenty of opportunity for them to improve their service provisioning, increase their market share and take advantage of the advancements in mobile AI technology. So, what is the best strategy to capitalise on fixed mobile convergence?

• Technology evolution
Key enablers such as fibre, 5G, SDN and NFV will play a central role in supporting the provision of bundled services and making convergence a reality. We'll also see increased smart device usage through IoT/M2M services.

• AI in mobile
5G cellular networks have advocated a revolutionary concept called network slicing. It allows operators to intelligently create customized network pipes to provide optimized solutions for different services that require diverse functionalities, performance metrics, and isolation criteria. This, when used in conjunction with AI-based inference engines, will draw inferences about people, content consumption and buying needs.

• Network, systems and information
Data rationalization in the B/OSS and network inventory layers respectively will prove to be critical in improving service fulfilment and assurance, driving operational efficiencies and maintaining quality of service and experience for users.

• Operational strategy
The adoption of a holistic framework based on industry best practices is essential for operators to define and implement their fixed mobile convergence transformation. This should be focused on services, people, processes, tools and infrastructure alignment, and will be key to supporting seamless alignment of fixed and mobile environments.

• Convergence, unification and optimisation
Processes and systems across marketing, sales, activation, provision and customer care must be consolidated.

In the increasingly turbulent telecoms landscape, CSPs' strategies for fixed mobile convergence should focus on achieving greater market share, reducing churn and increasing average revenue per user (ARPU) through offering bundled services with ubiquitous connectivity. By following the strategy outlined above, they will be able achieve operational transformation, meet their long-term objectives for the 5G era and take advantage of AI in mobile.

5G: Artificially intelligent, multi-gear networks required

by Hayim Porat, CTO, ECI

Machine learning and deep neural networks have been combined already in a variety of industries, from revising national air traffic patterns in real-time by mimicking the path-finding talent of ants, to running thousands of iterations to identify unique ways to achieve a goal dynamically. With 5G, these sorts of AI-based tasks will be commonplace, particularly in the realm of IoT, smart cities, and intelligent transportation systems.

Hayim Porat, CTO, ECI.
Hayim joined ECI to lead its innovation center and spearhead the efforts in the areas of NFV and SDN. Hayim is a key creator of the company's ELASTIC network strategy which bridges SDN/NFV, big data, security and cloud services with advanced networking.
Hayim brings vast experience in similar positions in the telecommunications hi-tech industry, amongst which are Chief Cloud and SDN architect at Toga Networks (Huawei R&D Center), principal architect at Tejas and founder and CTO of Ethos. Hayim holds an M.Sc. in computer science from the Technion and a MBA from Tel Aviv University.

The evolution of mobile networks is hitting an entirely new level with the advent of 5G. It is more than just a faster, better network built to handle more users, more data, and more services. In fact, 5G will require networking on a whole new level! After all this will be the first network designed to support non-telecommunications services, bridging wireless and wireline technologies, and providing new ways to support human and machine interactions.

5G demands we change the way we set up and provision networks, and manage network traffic. Static networks will be a thing of the past, as flexible and dynamic networks are needed to manage the fluctuations of a 5G world. The number of factors affecting the network will be endless. And the ability of humans to process and then act upon all this information in real time, or at any time, will be impossible. To support 5G, networks will need to be optimized for new paradigms of service delivery, effectively requiring artificially intelligent, multi-gear networks to deliver truly cognitive networks.

"5G is not just another G. It is a reference architecture of Gen-X networks that will be relied upon for decades," Heavy Reading, 2020 Vision, 2017.

Accommodating 5G's varied and changing requirements, particularly while bridging wireless and wireline technologies, means network architectures will, by necessity, be elastic and driven by artificial intelligence and machine learning. Up until now, the predominant discussion among network vendors regarding changes to the network architecture has focused on what is commonly referred to as network slicing. Network slicing is more than a new network feature. It is a new way to engineer networks. To be implemented properly to meet 5G's service objectives, it requires an in-depth understanding of several basic tenets.

Setting the Service Level Agreement (SLA) Criteria – 5G will not only connect millions more users and devices, but now, each user or device will require a different level of service, whether that means guaranteed bandwidth 24/7 or only peak traffic, maybe super-low latency, or even an always-on capability. Although SLA criteria changes from user to user, the service also must be able to adapt from both time to time and situation to situation – dynamically, and fixing issues in real time.

Dynamic Networking – The different types of services will need to be dynamically provisioned, optimized, and assured. It will no longer be enough to rely on (static) over-provisioning that worked in 3G and 4G to ensure SLAs are met. The network must be able to adjust dynamically to traffic surges (often caused by external events like gaming, sports, world news, weather, etc.) or failures.

Proactively Assuring the Network – As opposed to today's networks, 5G will require assured services. For example, imagine slowing down important vehicle-to-vehicle (V2V) communications as thousands of autonomous vehicles are caterpillaring down the freeway, practically bumper-to-pumper, during rush hour. Or how about a slight delay in the feed for a remote surgery? Best-effort network assurance of the past will no longer be acceptable, because these services require assured networking.

Not Just Another G: Carrier Revenue's Impact

Dynamic, optimized, and assured networks? Today, most carriers choose at best only two of these (if not one, or none), but all three are compulsory for 5G. Assuring services is extremely expensive and complex. Expensive sensors, monitors and counters are required across the network to truly assure services. In fact, much of today's networking equipment does not lend itself to accurately monitor traffic. So, to legitimately assure 5G services, service providers will need to leapfrog their current capabilities by a million miles.

This means, already expensive 5G networks will require even more investment.

To realize profits on these immensely expensive 5G networks, carriers can no longer afford to just build thicker "pipes." The investment in the next generation will require carriers to sell bandwidth resources several times over, dynamically and for different types of services, (e.g., Network-as-a-Service (NaaS)). Service providers will need to fundamentally change the way they regard services to enjoy additional, flexible revenue streams, and, more specifically, service assurance.

Today's Networks Are Service Blind

Today's networks are "service blind." The network (bandwidth) resources are designed and built as a pool of resources against a general aggregate of service needs. To match network performance to individual services, carriers resort to resource reservation, or dedicating bandwidth to these services, whether the services need the bandwidth all the time or not. This is massively wasteful. As industry experts have pointed out, services are provisioned and monitored by overlay (OSS/BSS) which have no real view of the network resources. The results are:

- Massive over-provisioning
- Inability to support super low latency services
- Unassured diversity
- Unassured availability

Today, for business services, service providers often take extraordinary precautions to assure that services perform according to SLAs. As noted, this often requires large investments in monitoring equipment along with necessary over-provisioning and redundancies to ensure service availability. These investments are often covered by the exorbitant prices paid by the enterprise for their services, (e.g. enterprise-grade VPNs). These services are usually planned at the onset, and statically provided throughout the lifecycle of a long-term contract.

But with the varied environment targeted by 5G, monitoring performance and entirely preventing lapses must be achievable across the entire network and changes must happen on the fly. Nothing currently available allows vendors to monitor end-to-end performance, let alone correct issues and reroute traffic in real-time.

Taking a "Scout's Honor" approach to delivering on an SLA will no longer be sufficient in 5G. Customers will need their services with the performance parameters they are paying for, not fines when there are service lapses. The number of factors affecting the network will be endless, and much cannot be foreseen and accounted for in advance. Humans are inherently unable to process all this information in a timely enough manner to meet the new SLA requirements.

Therefore, carriers need to rethink their entire network strategy, leveraging advanced technology to deliver service assurance via dynamic, proactive actions to ensure that services are delivered in case of sudden traffic changes, network deterioration, or failures.

The solution: Artificially Intelligent, Multi-Gear Networks

There is no way to achieve cognitive networking currently. The requirements are far too massive and unpredictable for humans to make the necessary calculations for making the network function to SLA specifications. To support a 5G world, networks need to be optimized for new paradigms of service delivery in two main aspects:

1.They need to be multi-gear:

- Ability to combine multiple packet and optical technologies in various ways to create network slices to efficiently transport different service types.
- Built-in flexibility to enable dynamic shifting of resources from one network slice to another, based on the creation of new services and changing traffic patterns.

2. They need to be AI-driven to achieve the required self-organizing capabilities:

- Real-time awareness of both service needs and multi-gear network capabilities.
- Autonomously and continuously create and adjust network slices based on service needs, optimizing for SLA performance and network utilization.
- Use machine learning to continuously improve the network slicing provisioning, monitoring and assurance decisions.
- Instantly reconnect or divert the traffic, or add resilience or redundancy, to the network to ensure SLAs are met.

Machine learning and deep neural networks have been combined already in a variety of industries, from revising national air traffic patterns in real-time by mimicking the path-finding talent of ants, to running thousands of iterations to identify unique ways to achieve a goal dynamically. With 5G, these sorts of AI-based tasks will be commonplace, particularly in the realm of IoT, smart cities, and intelligent transportation systems.

A Phased Implementation

This approach is a radical departure from how networks are engineered today. Fortunately, AI-driven multi-gear networks can be introduced in phases. The initial phase can cover a limited geographic area or a specific portion of the network (e.g. backhaul between the radio and the network core). The AI engine may also enable human oversight or limit autonomous decision making, whereby any major reallocation of resources requires human approval.

In this manner, we can gain experience and confidence in an AI-driven multi-gear network on a manageable scale, then to expand deployment in multiple dimensions (time, geographic coverage, span of network control and ability for autonomous decision making) as we invest in 5G technologies and services in the years to come.

While we would all agree the migration to 5G is essential for many reasons, we must also recognize that our ability as humans to process and then act upon all the information needed to keep the network running optimally in real time is impossible. Our evolution to networks optimized for the new paradigms of service delivery of today and tomorrow will require a significant investment in artificial intelligence, machine learning, and deep neural networks, to finally deliver truly cognitive networks needed for 5G and beyond.

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Why 5G will be the nervous system that support the AI brain

by Gabriel Chiriacescu, Director, Product Management, Keysight Technologies

Gabriel Chiriacescu, Director, Product Management for Keysight Technologies looks at how 5G will form the network that enables truly pervasive AI applications.

Gabriel Chiriacescu is the Director, Product Management for cellular network test products at Keysight/Ixia. Gabriel has more than 15 years of experience working with wireless technologies, from 2G all the way to the upcoming 5G networks.

A native of Bucharest, Romania, Gabriel holds a BS in computer science from the Polytechnic University of Bucharest. After living several years in Los Angeles, California, Gabriel is now based in North Carolina and enjoys discussing about Agile development, Internet of Things and everything 5G-related.

No matter what you think about artificial intelligence (AI), it's coming fast, and infiltrating all aspects of our everyday lives. From personal assistants like Siri and Alexa, to behavior-predicting algorithms and recommendations from companies like Netflix and Amazon, to medical diagnostics, forecasting the weather, and autonomous vehicles, advances in AI technology are accelerating. The machines haven't taken over just yet, but they're certainly proving themselves to be very useful in all sorts of sectors.

The main driver behind these advances in AI is machine learning, which crunches massive amounts of data and analyzes it to find patterns that can be used to help make decisions, or predictions about possible actions. This data is harvested from and exchanged with a wide range of sensors, feeds and sources: some of which will be local to the AI-powered device, with others based in remote locations, whether in an enterprise's HQ, in the cloud or in a data center on another continent.

In other words, AI-powered devices need to be able to seamlessly communicate and integrate with a range of external networks if they are to deliver truly intelligent features and functionality. After all, there are limits to the amounts of data that many devices can store and process: they need to be able to connect to external resources and share data in order to get smarter.

Just as the human brain relies on input and feedback from sensors all over the body in order to function, AI relies on having pervasive, reliable, secure, and ultra-low latency connectivity to the outside world as its nervous system. Without this bandwidth available, the vision of true interactive AI can never be fully realized.

Connecting the AI brain

So how can we put in place the ubiquitous, high-speed connectivity that will be the nervous system for AI? The short answer is 5G, which will ultimately rival, and even surpass, many of our current wired and wireless options for connectivity. The widespread roll-out of 5G technology will enable a giant leap in mobile speeds and bandwidth, offering up to 20Gbps with less than a millisecond latency, enabling real-time connectivity for mission-critical and potentially lifesaving devices and applications.

This in turn promises to deliver will enable truly always-on connectivity, in even the most challenging and remote areas of the world, and seamlessly connect billions of smart devices with a wide variety of speed and data volume requirements to networks.

But the dream is not quite a reality just yet: it needs a concerted effort to succeed. Here are the five key technological innovations which will be key to ensuring that 5G will deliver on its promises of speed, responsiveness and scale:

Speeds and feeds: Speeds of up to 20 Gbps will be achieved using a combination of innovations such as carrier aggregation (CA), massive multiple input multiple output (MIMO), mmWave new radio, and quadrature amplitude modulation (QAM).

Unlicensed spectrum: MNOs are increasingly using unlicensed spectrum in the 2.4 and 5 Gigahertz (GHz) frequency bands. 5G networks will need to tap into the vast amount of spectrum available in these unlicensed bands to offload traffic in heavily congested areas and provide connectivity for billions of smart devices, with the aim of giving users a seamless experience, whether they are operating on a licensed or unlicensed band.

Internet of Things (IoT): IoT devices pose a diverse set of needs and challenges for 5G networks. Unlike smartphones and other cellular devices, IoT device communications can be sporadic, as many of these devices 'sleep' to extend battery life for long periods of time — hours, days, or weeks — before transmitting a few bytes of data, and thus needn't always be connected to the network. 5G networks

must be designed to handle infrequent, but important communications from these types of IoT devices. Although the amount of data these devices send may be significantly lower, they may still be of a time-critical nature.

Virtualization: the need for ultra-low latency in mission critical applications (such as driverless vehicles) means that key base station functions must be distributed, with some moving closer to the network 'edge' and others being pooled in the cloud. Another example is that vertical sectors will require different types of services from the 5G network. Some will need high bandwidth, while others will need low power. Some will need very low latency, and others will need very high availability. These demands for flexibility and elasticity can be supported only by advanced network virtualization that enables a virtual evolved packet core (vEPC), centralized radio access network (C-RAN), mobile edge computing (MEC), and network slicing.

New Radio (NR): Although the other 5G innovations introduced in this section are all strong starting points, 5G NR is a true 5G native technology that has yet to be standardized. 5G NR addresses the need for a new radio access technology – a physical air interface – that is required to achieve the extreme bandwidth, low latency, and massive scalability requirements of 5G.

Putting 5G to the test

Developing and realizing these new network architectures and wireless connectivity that will enable true AI, means that the emerging 5G technologies and infrastructures will need rigorous testing, so we can be sure they work as intended.

However, building a 5G test architecture will be challenging because the use cases vary hugely, from supporting Internet of Things (IoT) sensors, to autonomous vehicles, to streaming of high-definition video content and more. Endpoints will appear and disappear rapidly, cell-site complexity will grow with network sharing, and even the bandwidth required for the visibility traffic itself will require new ways of thinking.

Due to this, product designs, business plans, operator architecture, and network upgrades must all progress together as we continue to integrate, and depend on, software and smart technology in our daily lives. Testing early and often will help to develop the complex, interconnected global nervous system that will support and deliver the advanced applications of the 'AI brain'.

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The computer as an author

by Ron Moscona, Partner, Dorsey & Whitney LLP

This article looks at how the law may need to adapt to the advent of computers as authors and inventors, and how existing concepts of intellectual property rights can cope with the world of AI.

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The author is a partner at the London office of international law firm, Dorsey & Whitney LLP, specialising in the protection, enforcement and exploitation of intellectual property rights and in a broad range of technology-related work. He has been practicing in this area since 1995.

Traditionally, the capacity to create and invent has been considered a uniquely human quality – one, perhaps, that distinguishes us from the animal realm. Society likes to celebrate creativity and to commemorate its great intellectual creators by putting their images on pedestals and money notes.

As technology develops, however, it becomes clearer that machines can undertake many intellectual tasks and in some respects can be far more adept at it than people (they can certainly be faster!) These days, a simple (not particularly 'intelligent') programme running on a mobile device or on an airline's entertainment system can easily beat even an accomplished player in a host of cerebral games – chess, bridge, scrabble – once considered as requiring at least a decent level of intellectual capacity.

The next step, known as 'Artificial Intelligence', is where programmes will progress from merely executing complex intellectual tasks - for which they are laboriously programmed by humans - to the phase where they can learn on their own. Computers that learn will be able to digest information, process it and then generate their own hypothesis, experimenting with their ideas and drawing their own conclusions. By developing the capacity to learn, computers will inevitably start to create, generating original outputs and new solutions.

Two principal concepts underlie the legal protection of intellectual property rights – the idea that creators should be rewarded for their intellectual contribution and the policy to incentivise the effort and investment required to generate valuable intellectual output. These two ideas are reflected in some of the fundamental legal principles in both areas of copyright and patents.

This article looks at how the law may need to adapt to the advent of computers as authors and inventors and how existing concepts of intellectual property rights can cope with the world of AI.

Originality

A central doctrine underlying copyright protection is the requirement of originality. European legal systems, in particular, focus on the idea that the author's personality is embedded in the work and that a copyright work in one that expresses the 'author's own intellectual creation'.

Common Law system tend to approach to the idea of originality in a more utilitarian way – requiring merely a minimal degree of skill and labour – the so-call 'sweat of the brow' approach. However, hard work alone will not do. Courts will only recognise a work as 'original' if its creation involved an element of skill, judgment, taste etc. A computer can certainly work hard to create a work, but can we then say that the work demonstrates skill or judgment?

Computers are already routinely used for generating work automatically, for example, charts based on data. Many such works do not attract copyright protection, not least because the work is only a reprocessing of existing data and therefore not original even in the narrow sense. Some works like computer-generated animation can raise more interesting questions, although currently such works are still the product of real creative people merely assisted by computers. In the future, however, AI may take over much of the creative process and questions of originality may need to be considered in relation to the computer's own creative work.

Authorship

Copyright, like most areas of intellectual property law, places emphasis on the author, which is assumed to be a mortal individual. Title to rights usually derives from authorship (and from employment relationship). But UK law already addresses the issue of computer-generated works. The author of such works is deemed to be the person undertaking the arrangement necessary for the work to be created

(Copyright, Designs and Patents Act 1998 ('CDPA'), s. 9(3)). A similar approach can be adopted for patents (where the human inventor or his/her employer has the initial entitlement to claim the invention) and for other rights.

However, is it right that protection should be extended at all to works truly created by computers? Copyright is protected to ensure a financial reward for authors and their heirs. That is why copyright lasts for the life of the author plus 70 years (as opposed to 20 years for patents). If corporations use computers to do the work of authors, composers and artists (which may not be far-fetched) it is far from obvious that copyright protection should be extended to such output.

On the other hand, copyright is also used to protect industrial output, for instance, computer code. Software is protected as a business interest rather than to reward the intellectual contribution of authors. This is probably also true for many other functional works which are still protected along traditional lines (and for the full term of copyright) but which may be more suitable for protection for their investment value.

The law eventually may have to recognise a separate category of works, like software and perhaps other types of practical works which may be increasingly created by computers. Such works may justify a different scope of protection in the future than that extended to works of genuine cultural value (which, at least for the foreseeable future, are likely to be created only by humans). The existence of a human creator may be part of the test for distinguishing between different categories of works.

Inventive step

Patents are protected not so much as a reward for intellectual creativity as an incentive to invest in research and development and to publish the technical details of inventions. From that perspective, it should make no difference whether an invention is conceived in the mind of a human engineer or through automated learning processes of an 'intelligent' computer.

Take the case of the drug development process. Computers are already used by researchers to help design new molecules, engineer genes and create and run the models that predict how new compounds might react with the human body to cure diseases (and to avoid undesirable results). In the future, AI programmes with advanced learning capabilities will be used to expedite these development processes. Computers may be able to devise and examine numerous hypothesis, create multiple design options and run simulations of the results. Computers learning from their own experience may well be able one day to design new compounds, delivery systems and formulations. Humans will remain part of the process, defining development objectives, considering ethical, economic, business and financial considerations and guiding the AI processes. But one day it might be the programmes, rather than people, that actually will conceive the technical solutions. The same may be the case in many other technical fields where humans might take a more peripheral role in the design process.

If the patent system is there to provide economic incentives, there is every reason to grant patents for inventions even if they are created by artificial intelligence. Yet even patent law is steeped with notions of human creativity, in particular the twin concepts of the 'inventive step' and the 'average person skilled in the art' (being the notional individual or team who understand the technology but lack the imagination to invent). Patent law proceeds on the basis that an 'invention' worthy of legal protection is not just a new technical solution with useful industrial application, but one that also embodies a 'spark', a leap forward that was not obvious.

The requirement to show an 'inventive step' reflects the idea that the legal reward is given not merely for the effort but also, importantly, for the intellectual contribution. But it also reflects a policy to grant patents only to ideas that actually contribute to technological advancement. Smart computer programmes may be able to conceive such advancements that justify patent protection. Yet how we define the 'inventive step' may need to be reconsidered when artificially intelligence machines really start to generate useful inventions.

Protecting intellectual property in the world of AI

The advent of artificial intelligence may force society to recognise that creativity, originality and inventiveness are not those enigmatic qualities unique to the human mind that perhaps they were once thought to be, but rather more simply the expressions of an advanced level of processing capacity. We might be a very long way away from seeing real scientific breakthroughs achieved purely by artificial intelligence and who knows whether AI computers will ever be able to produce works of true originality, quality and cultural value, as opposed to more utilitarian or formulaic output. But it looks like the days are not too far off when computers will start generating – based on their own learning capabilities – much of the kind of useful ordinary works, designs and solutions that are routinely (and for good reason) protected by intellectual property rights.

Legal doctrines that developed around human qualities would need to be reformulated or expanded if the systems of reward and incentive are to continue to operate in a world where creative tasks are performed largely by computers. There will come a point where the very fundamental purposes of intellectual property protection might need to be reconsidered. Economic reality rather than mere technical developments will ultimately determine the course. As ever, the world will continue changing and the law will have to catch up.

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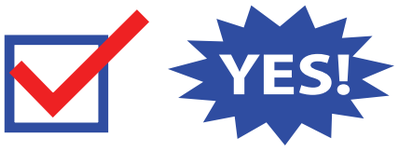

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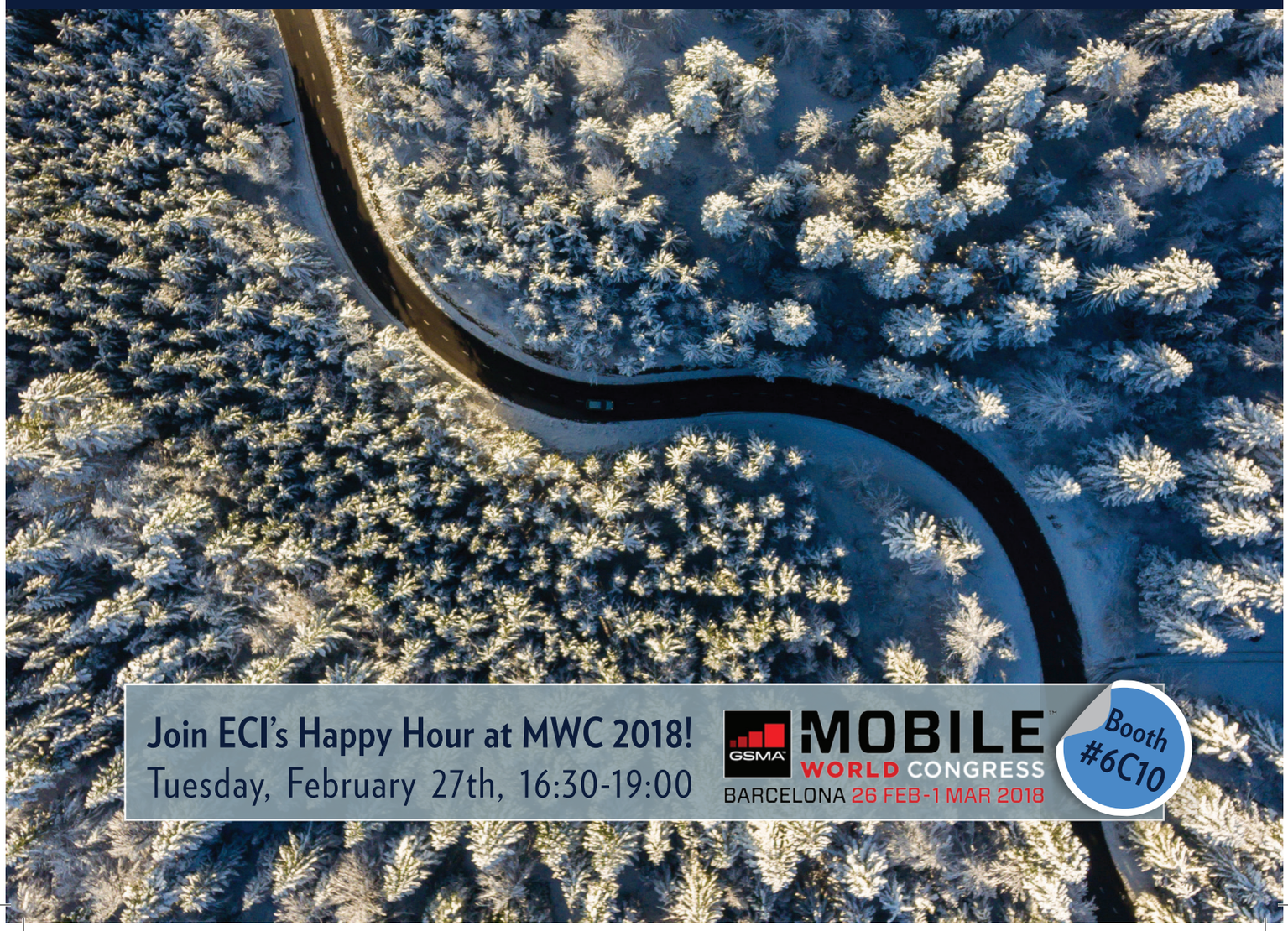

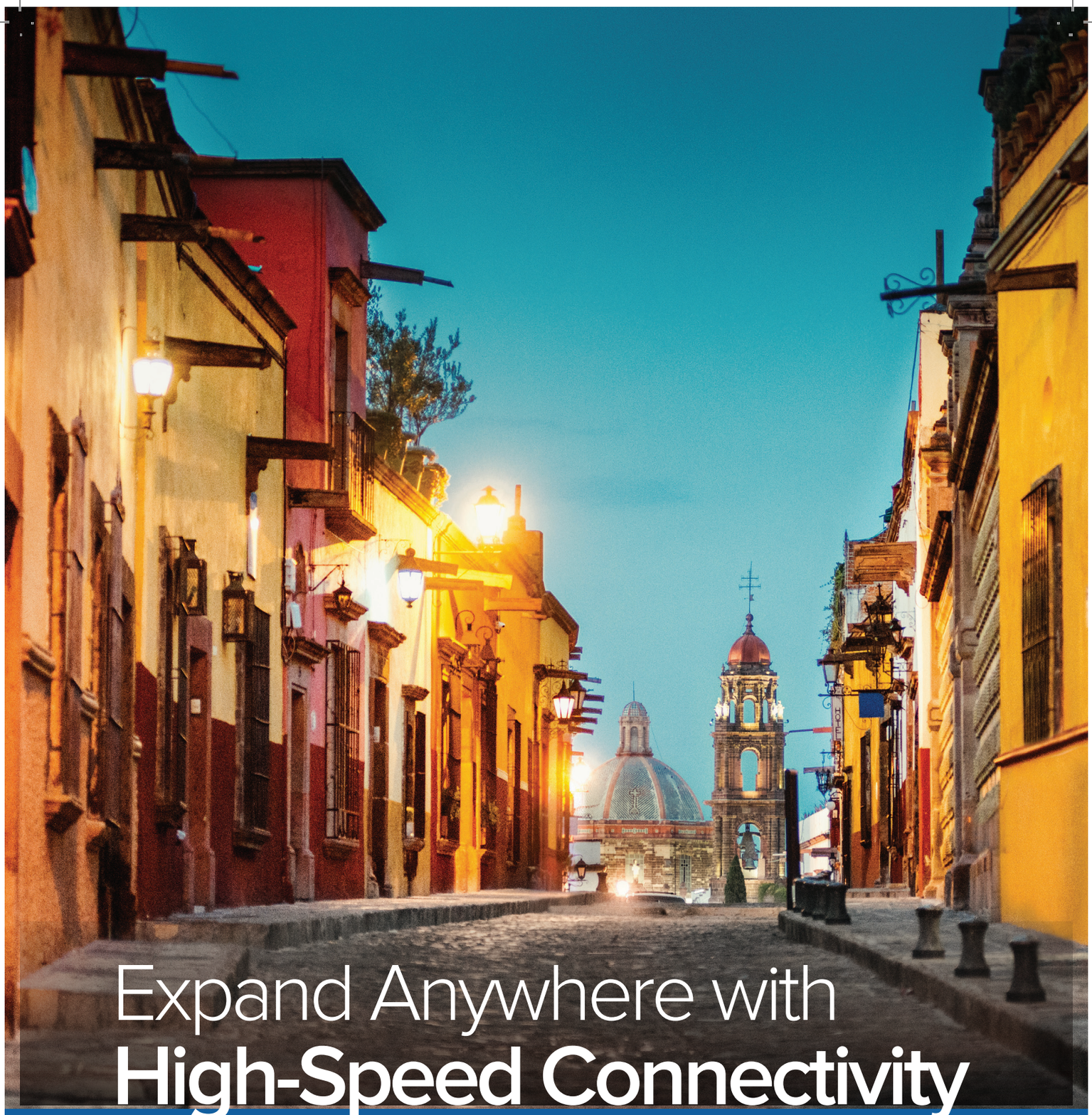

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