Network optimization in the age of digitalization

Learning lessons from Henry Ford

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As a world leader in geospatial software for the telecommunications and utility industries, IQGeo is very pleased to sponsor this TechPros.io eBook. Telecom companies are facing major changes to their network infrastructure such as FTTH and 5G rollout. These challenges are forcing many global providers to rethink their software and network infrastructure and this eBook provides valuable insights into the priorities and perspectives of these industry leaders.

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Introduction

Organisations across the globe are being challenged to transform digitally. With the promise of improving processes, unlocking new capabilities and streamlining business models, digital transformation is disrupting entire industries.

Described as "both everything and nothing", digital transformation has already had a dramatic impact on the global telecoms industry, according to a study[1] by EY. In fact, the sector has already experienced large scale changes in technology cycles and customer needs. And the introduction of a new wave of competition has forced established operators to consider new approaches to remaining relevant.

To some, digital transformation is the difference between competing and collapsing, the crux of surviving the rapidly changing global business landscape. To others, transformation is a task that sits at the bottom of a never-ending to-do list. It is regarded as little more than another hype or business buzzword, the report explains. The EY survey identified controlling costs, embracing digital business models and boosting the customer experience as the key strategic goals keeping international telcos on their toes. While a broad range of IT improvements were on the agenda, the EY survey participants highlighted the network as being a top priority in the near-term.

But these seismic disruptions are nothing new. Consider, for example, how Henry Ford totally turned the world of transportation on its head at the start of the 20th century. He didn't invent the first car. Or even develop the assembly line. But he was able to totally revolutionise the industry by taking on a new approach; calling for the production of cars that the average American worker could afford.

Keen to discover how an increasingly disruptive technology landscape is changing the network as we know it, we enlisted the help of various communications industry insiders. In collaboration with Techpros.io, we interviewed various senior executives from some of the globe's major fixed-line, mobile and broadband network operators. As part of this interview process, we wanted to find out how modern telcos are optimizing network operations and how technological innovations are transforming the telecommunications space.

Their insights form the basis of this eBook. Focused around four key themes - automation, innovation (5G), transformation and information - they unpacked the challenges, the trends and the possibilities.

Keen to find out what they had to say? Keep reading.

[1] **www.ey.com/en_gl/tmt/digital-transformation-for-2020-and-beyond-eight-telco-considera**

Chapter 1: Automation

Are fully automated networks key to digital transformation success?

The value of automation is obvious - it saves valuable time that was previously spent tackling manual, monotonous tasks. And, in doing so, automation is shaking up entire industries and turning business models on their heads.

In December 1913, Henry Ford installed the first moving assembly line at the company's plant in Highland Park, Michigan. Making the mass production of an entire automobile possible, this innovation reduced the amount of time it took to build a car from well over 12 hours to just two and a half hours. By automating motor vehicle manufacturing, Ford enabled the continuous-flow of production, ushering in the era of the automobile for everyone.

It's no surprise that automation has already had a significant impact, especially within the communications industry where margins are being eroded by decreasing average revenue per customer.

One factor driving the automation trend is market demand for the "Netflix" customer experience; which is characterized by self-service, seamless interactions. Customers rarely have an interaction with an actual person because everything is set up so you can do it all yourself, which gives these players a lower cost base and significantly higher customer satisfaction than incumbent network operators.

Any conversation about automation relates to all aspects of network operations, including maintenance. New technologies make it possible to automatically monitor what is going on across the network, to autonomously respond and essentially self heal. With SDN and NFV, it's possible to virtualise and accelerate the process of provisioning network services. In this way, automation drastically reduces costs by taking the need for human resources off the table.

In addition to this, automation is a critical aspect of disaster recovery. If a system fails due to severe weather conditions or a natural disaster, businesses want to be able to manage the incident without any negative effects and get back online faster. Automation enables self-healing and self-optimising of the network, with the smart aspects of the network able to respond and ensure that the network operates more affordably and efficiently.

Are fully automated networks key to digital transformation success?

So, how do the survey participants feel about network automation?

If you look at what is happening in the software world, things have moved far ahead of how we're designing, building and operating networks at the moment, says Gilbert Owusu, Head of Practice, Business and Operational Transformation at BT Group.

He cites how the industry currently goes about building networks with a number of manual touch points as a classic example. People go out, but before they can actually do anything, they have to wait for local authorities and other agencies to give them the permissions they need. There are so many boxes that need to be ticked and it's currently quite a manual process. The aim is to automate the process, from the design and planning phase to the actual automation and optimization of how the entire network is managed and operated.

According to Ken Nowakowski, TELUS Communications' Director of Planning and Engineering IP Core Network Assurance, network automation isn't a question, it's a necessity. But he cautions that the process will be a lot harder than everybody expects. "Based on my experience to date, it's expensive. So I don't think we'll be experiencing the benefits of a virtualized network that we thought we would anytime soon."

Downtime Dilemma

For businesses with a revenue model that relies on the delivery of connectivity and networking services to customers – such as telecommunications service providers and e-commerce businesses – downtime[2] can cost as much as $1 million.

The era of automation means that we have to be less tolerant of any kind of failure, according to Ian Elborn, BT Group Network Services Integration Director. Mainly because modern businesses simply cannot afford to fail.

When it comes to automation, cost is a massive motivator, he says. But if you want something that is less expensive, it's likely that your level of service will be negatively affected. Expecting a telco to provide always on availability at a cheap price point isn't easily achievable, continues Elborn.

[2] www.evolven.com/blog/downtime-outages-and-failures-understanding-their-true-costs.html

Are fully automated networks key to digital transformation success?

Nowakowski is particularly interested in how things have evolved and how networks are becoming more logical and more software based versus the hardware platform world he grew up with.

"I started in this industry back in 1982, so I've seen a lot of changes. But at the end of the day the fundamental practices that make someone a good network operator remain exactly the same."

Ken Nowakowski, TELUS Communications' Director of Planning and Engineering IP Core Network Assurance

Addressing legacy infrastructure

Part of the challenge with a large network is that they are super heterogeneous, notes AT&T's Director Network Performance and Analytics, Chip Srull. There are various old technologies and old programming paradigms. This means that new networks need to be compatible with both emerging technologies and legacy ecosystems. At the end of the day, it can all be very difficult to navigate. Businesses must be able to pivot quickly and to adapt to new business practices as and when they emerge.

Obviously, achieving automation of the complete ecosystem requires connectivity via cloud, notes Sourav Lahero, Head of Data Centre at Vodafone. But just throwing cloud at the situation isn't the answer, he adds. Choosing what components go into the cloud is very important. Running a legacy network on a fully automatic cloud is almost guaranteed to present challenges. In order for networks to fully support automation, seamless connectivity between all the different components is a must.

With innovations like Artificial Intelligence (AI) building steam, and with big data and analytics having a sizable impact, there are new opportunities to proactively detect faults and then automatically dispatch engineers to fix issues before they arise, says Owusu.

For Network Orchestration Director at Windstream Holdings, Russ Bartels, the plan is to identify strategic services in the long term and then create opportunities to automate these. "Whether it's in the network orchestration and automation stage or it entails leveraging functionality like machine learning and AI."

The possibilities offered by automation are endless. But ensuring that the trend actually delivers on its promises means managing the new and the old, embracing new innovations that meet your needs and always working with the future in mind. A lot has changed in recent years and the changes keep coming. The service providers that stay ahead will be the ones that are agile enough to adapt.

Chapter 2: Innovation

How 5G is set to change the game

Henry Ford once said:

"Be ready to revise any system, scrap any method, abandon any theory, if the success of the job requires it".

Which is exactly what he did.

Innovation isn't about creating something entirely new. It's about taking what you have and making it better. 5G is ushering in the next generation of mobile network services. Much like the Model T, it's set to totally change the game. The value of 5G comes down to more bandwidth; offering vast improvements in speed. Another big selling point for 5G is low latency, which opens up a world of new possibilities for applications like autonomous vehicles, IoT and Telemedicine.

It all comes down to a densification of cells. 5G connectivity requires a large increase in the number of cells to cover a given area, and these will be placed in non-traditional locations - on utility poles, on lampposts and on buildings. This increase in the number of cells means that service providers must be more creative when it comes to placing these small cells and tackling the minefield of permitting.

But with more assets come greater management concerns. Small cell networks represent the decentralisation of assets. In order to support low latency, much of the infrastructure is being moved to the "edge" – taking it as close to the customer as possible. It's much easier to manage all of these resources if everything is more centralized in one place, but if it's spread across the grid, things can get complicated.

Let's not forget that handling all of this bandwidth, and offering low latency, means that there has to be fiber in the ground as a backhaul. Getting this right may require building your own fiber network or partnering with existing providers. And with fixed wireless, 5G potentially provides an access network architecture to address the last mile.

How 5G is set to change the game

The small cell revolution

For Chip Srull, AT&T's Director Network Performance and Analytics, there's a lot of pressure to be first. That being said, one of the greatest challenges AT&T faces – as the world's largest telecommunications company and the second largest provider of mobile telephone services – is actually making the transition from a 4G to a 5G network. And doing so fast enough to maintain a competitive advantage.

All modern telcos have to be very cognizant of the different pieces that must fall into place to make 5G a reality. It comes down to evolving the network very quickly, without introducing risks and exorbitant costs.

"5G is set to be incredibly transformative. Some have even described it as the biggest change we've had in our industry in the last decade."

Chip Srull, AT&T's Director Network Performance and Analytics.

If we talk about next generation technologies like 5G, the exciting part is the radical paradigm shift that will have to happen in terms of how these solutions are deployed. The current architecture is mostly closed, but with 5G we will be moving to a more open architecture wherein the control plane and user plane are separated, adds Sourav Lahiri, Head of Data Centre at Vodafone.

According to Philip Reichert, Head of Group Enterprise Network Incident Management at Vodafone, when looking at the latest and greatest tech innovations, one could talk about things like autonomous vehicles but he's most excited about the possibilities something like 5G offer.

"5G makes automation and society a whole lot smarter."

Philip Reichert, Head of Group Enterprise Network Incident Management at Vodafone

For example, let's imagine a city needs to remove waste, they have to send out loads of employees to collect everyone's bins. And sometimes those bins aren't even full, he notes. It's a huge waste of money. If you could easily and affordably see whether these bins are full or empty - with the help of smart sensors enabled using NarrowBand IT or any other dedicated IoT network - you don't have to send anyone out unnecessarily, especially in remote areas. Who wouldn't want to streamline processes and up efficiency like this?

But Rodney Heil, Senior Network Optimization Director at Windstream Holdings, and Ken Nowakowski, TELUS Communications' Director of Planning and Engineering IP Core Network Assurance, are sceptical. "I honestly think 5G has some proving to do. By this I mean that I don't see 5G today, or within the next couple years, as really driving tangible change," says Heil.

How 5G is set to change the game

From a telecoms perspective, 5G is just another access technology, it's nothing more than that, adds Nowakowski.

It can be challenging to handle the current rate of change across our industry, explains Heil. You make a decision about what device or platform to deploy and then in a matter of months, it's out of date. So it's important to balance the need for rapid deployment of the network, while also implementing something that can grow as the future evolves.

Reichert believes that one of the most significant hurdles is related to skills. It was about 40 years ago when the telecommunications really starting picking up. Most of the people involved in the early stages are now in their 50s, 60s and they're on their way out. Everybody's talking about what we can do and what we need to do, but everybody is also really concerned that there just aren't enough experts out there, Peichert explains.

There's no denying that 5G offers a whole other kind of network totally transforming how we live, work and play. But beyond autonomous cars, virtual reality and the Internet of things (IoT) - which we've been talking about for years - the promise of this next generation wireless technology isn't only about making our lives better or making our jobs easier, it's about unlocking possibilities that are totally unimaginable today.

Championing customer experience

Had Henry Ford asked people how he should go about improving transportation, it's likely that he would've heard calls for faster horses.

As service providers, we always need to look at things from the customer's point of view and then use our own understanding and expertise to shape our strategies, explains Gilbert Owusu, Head of Practice, Business and Operational Transformation at BT Group. We need to ensure that everything is seamless, irrespective of the technology or the products themselves. Today, offering a holistic customer experience is key.

Chapter 3: Transformation

Delivering fixed and wireless networks across an increasingly complex business landscape

"Any customer can have a car painted any color that he wants so long as it's black."

Perhaps one of the most famous quotes from the father of mass-produced automobiles, Ford's aversion to color diversity was highly strategic. Black was chosen because it dried quickly. And because speed was such a high priority at the Ford plant this approach meant that the volume of vehicles being produced could easily be increased.

This focus on transformation and doing things in a different way meant that all Model T's were exactly the same and Ford's output was as high as possible. His decision may have been pragmatic but the industry needed someone to challenge the norm in order for it to evolve.

More and more modern telecoms businesses are hiring digital transformation experts to help them incorporate digital tools and technologies into their offerings. This may seem like an obvious move considering how the world works but it's important to consider the history of these large, well-established organizations. Digital transformation is enabling telecoms businesses to go toe-to-toe with newer, more nimble, internet-first competitors. To remain a competitive option, they need to transform from a customer experience and a cultural point-of-view.

This demands that they offer new, digital products and compete in a different way because the playing field has totally changed.

Network Security

When looking at all of this connectivity - the greatest challenge is security. More connections mean more vulnerabilities.

Security issues and threats evolve very, very quickly. Faster, in some cases, than we can respond. As a result, service providers have to adapt if they want to offer reliable connectivity, without the risks, says AT&T's Director Network Performance and Analytics, Chip Srull. He suggests that as we move towards a world where more and more "things" are connected to each other, there just may be value in certain things staying disconnected, at least for now.

Delivering fixed and wireless networks across an increasingly complex business landscape

The value of consistency

For Ian Elborn, BT Group Network Services Integration Director, if you deliver your service in a consistent and repeatable way, not only do you keep your costs down, you're better equipped to deliver the same link to people in Papua New Guinea as you would offer to customers in Dublin. This doesn't mean that everything is exactly the same – it means that you have a template that carries across different projects but with a few region-specific changes.

Head of Practice, Business and Operational Transformation at BT Group, Gilbert Owusu, agrees. Each market has its own demography and demands. If you have a standard/consistent approach, you can handle cases with different requirements by making a few, simply tweaks. Automation is a key aspect of consistency, says Russ Bartels, Network Orchestration Director at Windstream Holdings. In order for us to move faster, we need to take the human element out of things. It comes down to creating standards and enforcing those standards – with a few case specific changes - all the way up the stack.

In a 2011 report[3] by McKinsey & Company, the management consulting firm outlined a few ways that the telco industry could reshape itself in order to handle new challenges. From changing up organizational structures and anticipating new trends to managing people and performance, the gist of the report was that times are changing and that the industry needs to change too. As the survey participants explained above, when embarking on any transformation efforts the key is to adapt and evolve but to always be consistent.

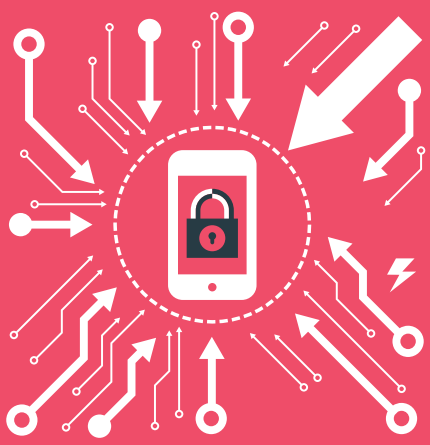
The next generation network build

Regulations, costs and time can prove challenging when building modern networks. Budgets are shrinking but upgrading equipment and modernising the network is a must.

Rodney Heil, Senior Network Optimization Director at Windstream Holdings, describes costs as the number one challenge around next gen builds. "Put simply, deploying dense fiber networks is not cheap," he says.

Chuck Stauffer, VP of Field and Maintenance Operations, describes permitting and licensing as major hurdles to scaling up fiber rollouts because everything is so highly regulated. Heil agrees. It usually takes quite a while to get all the approvals needed before rollouts can actually begin.

Given the fact that establishing these networks takes time, it's critical to build plant that is generation proof; using infrastructure that will remain relevant for many years to come. BT Group's Chief Technology and Information Officer, Hriday Ravindranath, believes that the fiber networks being deployed today are going to last for the next century, so ROI will become apparent over time.



[3] www.mckinsey.com/~/media/mckinsey/dotcom/client_service/Telecoms/PDFs/Reshaping_telco_organizations.aspx

Chapter 4: Information

Unlocking data insights, filling data gaps

Regularly described as the “new oil”, it’s safe to say that the generation of data is on overdrive. While all of this information holds incredible potential, this is only the case when it is used effectively. Simply having lots of data adds little value. Deriving actionable insights from this information is the real key to success.

Using the data he’d gathered in creating the Model A and the Model N, Ford was able to make certain deductions - one of the most valuable being that he needed to come up with a way to do more with less. And to achieve this level of efficiency on an unprecedented scale. Which is exactly what he did. As a result, the price of Ford cars declined, production skyrocketed, Ford employees got a pay rise and company profits went through the roof.

The value of automation was discussed earlier in the eBook. But getting automation right comes back to having the right information at your disposal. You can have all of this smart software designed to automate various processes, but these innovations are only as valuable as the knowledge you have gained about the network. For example, if your network inventory records are inaccurate, your network automation efforts will either fail or your results will be poor.

When building high-powered, good quality networks, getting accurate, high quality information back from third party construction companies is crucial. None of the automation capabilities big telcos have put in place are possible if the network is built on poor quality, incomplete data. A break down in delivering data can mean that it takes months to actually get customers connected and collect revenue.

The issue comes down to differences between “as designed” and “as built”. If you have to maintain what you’ve designed, it’s critical that all the ins and outs around how the network is built get back into systems of record. There can be a lot of good reasons why things would change during the actual construction of the network. These are understandable. But if things look different to how they were designed, changes must be recorded as accurately as possible.

Put simply, network innovations allow us to access more data, make sense of all of this information and, in turn, make better decisions, states Gilbert Owusu, Head of Practice, Business and Operational Transformation at BT Group. When this information is used effectively, we can empower both our field teams and our tech teams to do the best for our customers.

Unlocking data insights, filling data gaps

What many people forget is that so much of this is uncharted territory, adds AT&T's Director Network Performance and Analytics, Chip Srulll. So, after a particular project has been implemented, it's important to use the information we've gained to do a post mortem and identify where we could have done things differently or where our strategy wasn't as robust as it should have been.

In order for us to be successful the data accuracy has to be there, asserts Russ Bartels. We're simply not going to be successful with automation unless that data is accurate.

For Srull, the challenge is around integrating information from multiple systems all in a single place. Sometimes different tools produce contradictory information, which can be confusing and cause errors. Historically, we've had issues with database accuracy, he continues And, when you've got a large network, the databases can often get somewhat out of sync with what is deployed. "As we move towards newer, self documenting inventories embedded within the network, we'll be able to access all of the information we need much more rapidly." - AT&T's Director Network Performance and Analytics, Chip Srulll

When using data effectively, telco executives can generate incredible value and reduce costs across their entire operation. However, becoming an analytics-driven business certainly isn't a quick fix. It requires pulling data from multiple sources, finding the right tools to analyse this information and then translating these insights into actions that help you do business, better.

Securing skills

When it comes to skills, there's a massive disconnect, notes Network Orchestration Director at Windstream Holdings, Russ Bartels, Network Orchestration Director at Windstream Holdings.

In some instances, the technology is evolving so quickly that there simply isn't enough time to train people to work with it.

Similarly, as the industry undergoes all of these massive changes, there are numerous cases where field workers need legacy expertise but must also have a solid understanding of modern solutions and requirements.

Technology offers solutions to some of these skills hurdles.

For example, in areas where we are lacking skills, we can leverage technologies like augmented reality (AR), says Gilbert Owusu, Head of Practice, Business and Operational Transformation at BT Group. With AR, we can enlist the help of skilled experts from across the globe to remotely help engineers working on site, offering them the advice they need to successfully get their jobs done.

Summary

Dawn of the Digital Telecommunications Revolution

The degree of change we are experiencing today is analogous to what happened during the Industrial Revolution. This was a time when new ways of working were ushered in, totally transforming the status quo.

As communication businesses embrace digital and automation becomes more and more widespread, information is critical. Ten or twenty years ago, if there was a problem or a mistake in your records, it probably wouldn't have been as much of a big deal. But today, the quality of that information is essential to all the different processes that are happening across global networks.

Throughout this eBook, we've seen the value of data and showcased how data quality manifests itself in so many different ways across the telecoms landscape – from automation and innovation to digital transformation and information. With the introduction of new consumer touchpoints thanks to the Internet of Things (IoT) and Over The Top (OTT) business models, as well as the convergence of the physical and digital, the responsibility is on the shoulders of modern telcos to respond or run the risk of losing out.

Final thoughts from IQGeo

Peter Batty – Chief Technology Officer

Over the past decade, there has been a massive shift in the technology landscape, with wireless networking, smartphones and connected devices becoming an essential part of everyday life. This has created huge challenges for the telecom industry, while at the same time providing many opportunities to improve their own processes though digital transformation. And there are other technologies having a significant impact on the industry. In this eBook, Gilbert Owusu, Head of Practice, Business and Operational Transformation at BT Group, provides the example of how Artificial Intelligence (AI) is building steam, big data and analytics are enabling organisations to proactively detect faults and then automatically dispatch engineers to fix issues before they arise.

While the technology landscape has seen massive transformation, traditional GIS technology has changed very little over the last 20 years, making fundamental digital transformation extremely difficult. One big issue with legacy systems is their failure to deliver real-time, high quality, consolidated asset location data. In the eBook Russ Bartels, Network Orchestration Director at Windstream Holdings, said, "We're simply not going to be successful with automation unless data is accurate". Chip Srull, AT&T's Director Network Performance and Analytics, says that, for him, the data challenge is around integrating information from multiple systems all in a single place and that sometimes different tools produce contradictory information, which can be confusing and cause errors.

A lack of integrated mobile capabilities is another critical issue that legacy GIS struggles to deliver, inhibiting competitiveness and growth. At IQGeo we have a different approach to digital transformation. Our industry proven myWorld platform uses a mobile first architecture that is transforming operations at multiple large communications companies and our next generation software will further transform data capture and data maintenance processes, dramatically improving data quality and reducing costs compared to legacy GIS products.

We help organizations take control of their operational assets by creating, capturing and editing their geospatial data on any mobile device, online or offline. Our innovative architecture is challenging the role that costly and complex GIS plays in the geospatial ecosystem, while addressing many of the digital transformation requirements highlighted in this eBook.

Learn more at **https://info.iqgeo.com/next_gen_geo**

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Following a 16 year career in the Armed Forces as an Electronics Engineer and latterly, Helicopter Pilot and Commander, Ian moved into roles associated with operational management of services and capabilities in the finance and insurance verticals before moving to BT. Having worked for BT for the last 11 years, Ian`s expertise lies in the definition, transformation and delivery of operational and service assurance capabilities within traditional networks and the evolving Digital landscape. Ian is currently the Network Service Integration Director within BT, managing and evolving the network for one of the largest FMCG companies in the world.

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Dr. Gilbert Owusu heads the Business and Operational Transformation Research Practice in BT. He has a strong track record in applying AI, production management and operational modelling technologies to service operations which have led to significant customer service improvements and OPEX reduction in BT's operations. Gilbert's research on applying AI technologies for transforming service operations have been published widely in book chapters, conferences and journals. He is the co-editor of two books on service production management.

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Sourav Lahiri is a General Manager leading NFV & SDN function working with a large Multinational Carrier. He has a MSc in Telecom Technology from SM University. He has eighteen year career experience with Indian Telco's, System Integrators and Enterprises. He is passionate about technology and has lead teams to build and Operate Operator's access network. He has successfully run several Network transformation projects for a Middle East Telco, a North American Telco, a North American large publishing conglomerate to name a few. In his current role he and his team are building virtualized Data Centers within Telco's in Europe as per ETSI NFV standards. He currently resides in Pune with his wife Suparna and daughter Sayli. He is an avid sports enthusiast and loves following European football league and cricket around the world.

Russ Bartels Windstream

Russ Bartels leads cross-functional teams responsible for planning, designing, developing, implementing, and supporting a carrier-grade multi-domain service orchestration solution leveraging best practices in software defined networking and network orchestration. He is also responsible for Windstream's Big Data solution focused on network analytics and machine learning. A U.S. Air Force veteran, Russ began his telecom career with CenturyTel Wireless, now CenturyLink. Over the past 20 years he has held various architecture and leadership roles at Alltel, Verizon Wireless, Allied Wireless, and AT&T. In addition to his current SDN and Big Data focus, Russ' expertise includes designing, implementing, and supporting a variety of systems, including mediation, provisioning/activation, and CRM.

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Ken Nowakowski TELUS

Over 35 years' experience in the ICT industry. The past 21 years with TELUS Communications Inc. Other employers include SaskTel, British Columbia Systems Corporation, and TransCanada Pipelines. Possesses an excellent understanding of technology, products, services and their associated delivery and support best practices. I have led numerous teams in my career in support of the following:

- Large complex business customer solutions delivery.
- Business Process Transformational Change (fulfilment and assurance)
- Network Maintenance Engineering
- Service and Network Management Enablement
- Operations Readiness and new technology introduction

Chip Srull AT&T

Chip Srull is Director of Network Analytics and Performance at AT&T where he oversees network usage forecasting and advanced analytics efforts that drive AT&T's multi-billion dollar capital plan. Prior to that, Chip spent over 15 years in a variety of leadership roles in network operations, software engineering, and program management involving interoffice transport, network management, and digital services. Chip has an MBA from the University of Chicago Booth School of Business, a Masters in Computer Science from University of Chicago, and a Bachelor's of Science in Industrial Engineering from Michigan State University.

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Philip heads the 24/7 Incident Management teams in the Enterprise Service Unit for Vodafone Germany. Leading these teams he is responsible for the customer experience of Vodafone's Enterprise Customers and designs and constantly improves the Incident Management process on how Vodafone cares for technological issues of these customers. In the past Philip has gained experience in 5 different countries in the US, Spain, England, the Netherlands as well as Germany. As a certified project manager of PMI (PMP ®) he has a strong track record in managing big projects and is very interested in agile working methods. Especially working with Narrowband IoT he has trialed many promising ideas between leading companies in different industries and Vodafone.

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