DevOps is a modern, agile way of working used in the IT sector and which is now being adopted by the telco world. It requires a change in work methods and behavior to create close collaboration between all involved parties. DevOps calls for tight cooperation throughout the software lifecycle and unlike traditional software development methodologies, relies on constant and immediate feedback at every stage of development.

When deployed in accordance with the specific needs of the telco multivendor environment, DevOps is a powerful way for operators to accelerate innovation and deliver new services much faster to win business in the rapidly changing telco market.
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Executive summary: DevOps helps accelerate innovation in the telco world

Telecoms is becoming a fast-changing industry driven by disruptive technologies and business models. Deploying the latest technologies is one of the most effective ways to respond rapidly to the market’s dynamics. A far-reaching development in recent years has been the adoption by telco operators of cloud-based technologies proven in enterprises and by web-scale service providers. Yet, while replacing proprietary platforms with open-source and off-the-shelf solutions reduces costs, it doesn’t necessarily boost business agility.

Greater flexibility requires a change in work methods. DevOps is an agile way of working. A huge ecosystem has been established around leading web-scale companies such as AWS, Facebook, Flickr, Netflix and Spotify, with a wide range of tools and services to enable DevOps practices.

This white paper describes key practices and how they can benefit the telco world, which has conventionally relied on separate development and operations to meet its stringent service quality requirements in a heavily regulated market.

Future networks must enable rapid service introduction

Software development needs to keep pace with rapid market trends

Market demands are outpacing traditional software development methodologies, tools and delivery mechanisms for most network functions which have their roots in hardware development. Conventional linear software development (the waterfall approach) provides a highly structured and controlled, although somewhat inflexible, approach to software development that has served the industry well. However, the slow pace of development makes it difficult if not impossible to keep pace with customer demands.

Furthermore, there is often minimal interaction between the engineers who develop the software and those who use the software, i.e. in the field. This can lead to developed software not meeting the needs of field operations as well as it could.

To take full advantage of deploying network functions in a cloud native environment, software development and delivery need to be more flexible and reactive to changes in requirements and operational demands.

Future networks bring a new, accelerated business environment

The number of connected devices and the diversity of those devices is exploding, driven by new services and the Internet of Things (IoT). With the new capabilities of 5G on the brink of reality, this trend is set to accelerate. Taking advantage of emerging business opportunities calls for operators to react quickly and launch new services rapidly. This will require a change in the way network capabilities are developed, deployed and maintained.

The way forward has been shown by the IT industry, which instead of delivering monolithic applications once or twice a year, breaks applications into smaller, independent functions that can be deployed more frequently. This is enabled by an architecture based on microservices and continuous testing and feedback between development and operational teams. The telco world is adopting this approach and adapting it for the stringent needs of the communications world.
The change requires an organizational and cultural shift for both vendors and operators. Close collaboration is essential, with close engagement, full transparency and shared responsibility. It is no longer enough to develop something and simply deliver it to the operations team to deploy.

The major points of this transformation are agility, flexibility, automation, quality, feedback and collaboration, all key components of the DevOps model.

DevOps practices

Achieve business agility by continuously deploying software

DevOps is a combination of philosophies, practices and tools that companies can use to address the opportunities of dynamic markets. DevOps calls for tight cooperation throughout the software lifecycle, from planning and requirement management, to operating the software.

Unlike traditional development and operations methodologies, DevOps relies on constant and immediate feedback at every stage of the software lifecycle, from customers and from the operational environment, supported by continuous monitoring of network Key Performance Indicators (KPIs) and other means.

This feedback is vital for continuous deployment, in which a flow of new integrated and verified code is continuously deployed into customers’ staging for acceptance and then into production environments. However, continuous and fully automated deployment to production challenges the telco world’s strict need for very high network stability.

DevOps in the telco world requires, vendors and operators to collaborate across corporate boundaries, unlike web-scale players in which both development and operations reside within one company.

Furthermore, while web-scale production systems are almost exclusively based on data centers (Cloud) with unified resources and infrastructure, the telco production environment comprises assorted network elements implemented over time.

Such challenges must be overcome to allow telco vendors and operators to constantly deploy and verify the newest software in production-like environments, verify their compliancy and provide the necessary feedback to development.

Telecom operators mostly run multivendor networks. The various vendors and partners therefore need to agree a common DevOps framework and operations with the operator. This commitment to continuous planning, integration, testing and deployment will deliver rapid innovation through collaboration.

Continuous delivery in a multivendor environment requires the automated integration and testing of all service components to ensure high reliability of service. The continuous technology evolution of a service component results in dramatically reduced deployment time, with frequent deliveries. Such frequent deliveries call for continuous service integration optimized for the high number of component versions. Complexity grows exponentially when the number of service components and their individual versions increases. Dealing with this complexity is crucial.
Simplify operations through architectural renewal

While a growing number of operators are adopting cloud technologies, the full benefits of cloud-based operations will only be realized by fundamentally changing software architecture. Current virtualized, monolithic architecture will not provide the speed and simplicity required by continuous delivery, deployment and DevOps.

New software architecture based on containerization and microservices will enable rapid updates and flexible deployments, eventually leading to incremental and fast introduction of features.

Microservice architecture aims to develop a single application comprising a suite of small services, each running its own process and communicating through a lightweight mechanism. Common characteristics of this architecture are:

- Autonomous systems: delivering business value independent of other services
- Simplicity: minimizing the number of components and interactions
- Loose coupling between services
- Strong cohesion within services
- Sharing common services (as load balancer, proxies) which avoid duplicating functions
- Component level scaling versus full service scaling (microservices can be scaled without scaling the full network element)
This architecture enables vendors to build incremental deliveries with small differences in code, which simplifies operations because the effort to update and verify software is significantly less. The effect on services and resulting faults are also reduced because only individual components are involved, and services can be rolled back significantly faster.

**Automation helps to boost quality and innovation**

Continuous delivery and deployment requires a high level of automation throughout the creation and operation of a product. Continuous testing is also needed to achieve the product stability and quality that a DevOps environment requires.

Continuous testing by the vendor and customer provides immediate and continuous feedback on every code change and every new feature. Automated testing and feedback require a common end-to-end test strategy. This helps ensure a focused approach to high risk, high impact products and solutions, while shared, automated execution provides information and boosts the flexibility and efficiency of vendors and customers. This enables them to more easily define requirements and refine the operation of the software.

Smooth progress through the verification stages also requires the automation of software delivery, deployment and updates. This enables vendors and customers to use their engineering skills to create innovative ideas and build an event-driven system that focuses on quality.

Continuous monitoring and feedback encompasses not just faults, but also normal operations and characteristics of software products. Automated performance monitoring provides insight into the software’s behavior that can be used to guide performance improvements. Continuous monitoring of errors enables vendors and operators to respond faster and more effectively, as well as developing preventive measures.
Supporting the multivendor environment

Unlike a web-scale organization, in which development and operations reside within the same company, a telco operator routinely buys network components from several vendors. Inevitably, the number of releases that an operator sees will grow exponentially, calling for equally numerous compatibility checks.

Synchronizing delivery from multiple vendors is essential. Portions of the operator’s infrastructure must also be open to allow testing and verification of new solutions. New channels for the automated collection of customized operational feedback on demand will also allow development teams to improve their components based on production data.

Nokia approach to DevOps for the telco world

At the heart of the Nokia solution is agreement between all involved parties - Nokia, operator and partners, supported by the Nokia product development and services portfolio. This leads to three key benefits - speed, quality and efficiency. This is a differentiating factor in the Nokia solution.

Role of Nokia

New Nokia services, such as software version management and software update in the DevOps infrastructure, reduce manual work. Project teams can focus on higher value-add topics such as customization and integration of standard DevOps tools with customer specific toolsets.
Operator requirements

To run continuous deployment and feedback, operators need an environment equipped with tools for continuous monitoring of the services deployed on software-defined infrastructure, as well as the infrastructure itself. This enables operators to accelerate the cycle time of requirements, testing, deployment, monitoring and feedback.

Role of partners

Nokia partners work closely as part of the solution and service value chain for operators, governed by global frameworks and contractual and operational arrangements to ensure continuous planning, integration, testing and delivery. A Culture of Shared Responsibility, as defined in the Scaled Agile Framework (SAFe) supports the aim of DevOps to tear down silos and build shared toolsets, vocabularies and communication structures focused on one goal: delivering value rapidly and safely.

What is the SAFe?

SAFe® is an online, freely revealed knowledge base of proven, integrated patterns for implementing Lean-Agile development. It provides comprehensive guidance for work at the Portfolio, Large Solution, Program, and Team Levels.1

Culture of Shared Responsibility2

It enables shifting some operating responsibilities upstream, while following development work downstream into deployment, and operating and monitoring the solution in production. Such a culture includes:

- Collaboration and organization – DevOps relies on the ability of Agile teams and IT Operations teams to collaborate effectively in an ongoing manner, ensuring that solutions are developed and delivered faster and more reliably. This is implemented, in part, by including operations personnel and capabilities on every Agile Release Train (ART).
- Risk tolerance – DevOps requires a tolerance for failure and rapid recovery, and rewards risk-taking.
- Self-service infrastructures – Infrastructure empowers development and operations to act independently without blocking each other.
- Knowledge sharing – Sharing discoveries, practices, tools and learning across silos is encouraged.
- Automate everything mindset – DevOps relies heavily on automation to provide speed, consistency, and repeatable processes and environment creation.

Sources:
2 http://www.scaledagileframework.com/devops/

Digital software supply chain

A more agile supply chain is needed to provide higher quality and visibility of the software distribution channel, while maintaining compliance with regulatory, security and risk-management requirements. The Nokia supply chain aims to provide software versions directly automatically and efficiently to any operator site based on always up to date sales and R&D pipeline data, as well as compliance with laws and regulations.
**DevOps automation platform**

The Nokia DevOps automation platform (formerly DevOps server) is deployed at the operator’s premises to orchestrate the workflow of any VNF delivery and feedback and close the gap between Nokia R&D and operators. The Nokia DevOps automation platform is the receiving end of the software supply chain and automatically triggers all VNF lifecycle actions (e.g. onboarding, deployment, update, terminate) with tools in the operator network, like VNF manager, for example Nokia CloudBand application manager. In addition, the Nokia DevOps automation platform can execute on-demand operational actions such as invoking tests, monitoring data collection and error handling.

Nokia DevOps automation platform serves a containerized microservice-based architecture, enabling infrastructure independency and configurable deployment options. It interfaces with operator tools, via APIs and plug-ins, to implement an event driven system.

All operational actions are monitored, with logs available for both Nokia and the operator via a web-based dashboard, or forwarded by built-in artefact management.

*Figure 4. The Nokia automation platform provides workflow orchestration*

**Process improvement**

Improving the software lifecycle management process depends on cooperation between application vendor and operator, with each sharing responsibility for DevOps. Both parties will benefit from increasing visibility and trust to provide better service to end customers, shorter lead and response times, high efficiency and quality to provide better service to end customers.

The following DevOps practices enable collaboration:

- **Test Driven Development (TDD):** This requires writing the test first, which ensures the developer understands the required behavior. The required behavior can also be considered as the Definition of Done for passing the test criteria. To implement a feature correctly the first time, the operator defines the required behavior as an integral part of a feature request (User Story). This leads to shorter implementation time, less testing and better perceived quality.

- **Continuous delivery and deployment:** These practices require end-to-end integration between the vendor and operator tool pipelines to create highly automated software lifecycle management.
• **Continuous monitoring and feedback:** Continuous monitoring relies on real-time data processing to continuously provide operations with service quality information and analytics. This information is key for continuous feedback to the software vendor, which happens at all stages of the software lifecycle, such as requirements planning, development and directly from the operator during acceptance testing and operations. This enables the application vendor to provide higher-value services to the operator, such as preventive maintenance and faster response times.

• **Site Reliability Engineering (SRE):** Nokia is adapting elements of the SRE model to support DevOps for telco. Nokia works closely with its customers on operator-specific adaptations, pre-production verification/support, deployment automation, delivery support, care support and customer requirement awareness. Knowledge of the multivendor environment and service lifecycle processes ensures sustainable DevOps for the vendor and operator.

What is Site Reliability Engineering?

Site Reliability Engineering (SRE) is a discipline that incorporates aspects of software engineering and applies that to IT operations problems. The main goals are to create ultra-scalable and highly reliable software systems. According to Ben Treynor, founder of Google’s Site Reliability Team, SRE is “what happens when a software engineer is tasked with what used to be called operations.”

Source:
https://en.wikipedia.org/wiki/Site_reliability_engineering

Conclusion: Fast service introduction and culture for rapid innovation

DevOps for the telco environment enables operators to offer new products and services more quickly and even to move more easily into new markets. It also helps to reduce the cost and risk of new service deployments; accelerate business development and innovation; and enable the operator to more effectively meet changing demand and address rapidly growing market trends.

DevOps for the telco world must meet requirements not typical in web-scale organizations. These include extra-organizational collaboration between vendor, partners and operator to minimize the risks associated with multivendor network complexity and the unwavering need for very high network stability.

Nokia applies DevOps internally and is running multiple Proofs of Concept with many operators in 2018. By applying its telco know-how, automation and analytics, and building close collaboration between all involved parties, the Nokia DevOps approach delivers three key benefits - speed, quality and efficiency.
Abbreviations

API  Application Programming Interface
ART  Agile Release Train
IoT  Internet of Things
KPI  Key Performance Indicator
SAFe Scaled Agile Framework
SRE  Site Reliability Engineering
TDD  Test Driven Development
VNF  Virtualized Network Function