

NL-ix ENABLES ENTERPRISE EXPONENTIAL INTERCONNECTION

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The Neutral Internet Exchange (NL-ix) in The Hague, The Netherlands is one of the leading Internet Exchange Points (IXPs) in the world.

Ask founder and CEO, Jan Hoogenboom, about his vision for enterprise interconnection and what it means to the future of the IXP market, and he'll tell you that smart IXPs will pay close attention to how their business models and service offerings need to evolve as a result of enterprise digital transformation.

Recognizing future trends, anticipating shifts in the market, and proactively driving innovation through the adoption of new technology are not new to Hoogenboom. He has demonstrated visionary leadership in the IXP space for more than a decade, successfully identifying evolving trends in the market, and keeping his finger on the pulse of his customers' requirements. His focus on the customer and his ability to anticipate changing market dynamics and proactively adjust his business approach has paid off. Under his leadership, NL-ix has grown to one of the top five IXPs in the world, with 655 networks interconnected over a stable, low-latency, transparent fabric across 15 countries, 25 metropolitan areas, and 105 data centers.

One of the ripple effects of digital transformation is the exponential increase in interconnection requirements. As organizations digitally transform, they start to build digital native business processes with multiple clouds. This means that workloads exist in different places and rely on one another, which requires a completely interconnected IT fabric supporting all applications, services, devices, and locations.

As a result, Hoogenboom sees that enterprise IT teams will need to evolve to an "interconnection-first" strategy. To respond to the requirements of an interconnection-first strategy, Hoogenboom advocates that enterprise

customers become their own ISPs. In today's digital economy, interconnectivity is mission critical, and the "old world" response that interconnectivity is not part of enterprise core business has had its day. Network design, management, and cloud service orchestration expertise are crucial to today's digital business and will drive innovation and safeguard competitive position.

Interconnection is an evolution of the enterprise WAN as digital enterprises strive to maximize agility. As interconnection increasingly becomes a core element of enterprises' IT strategies, IT teams begin to take ownership of their interconnection requirements—reducing latency, scaling capacity and connections, driving down costs, and interconnecting sites with cloud and colocation-based applications and data. IXPs will need to be ready to provide the same level of on-demand services, transparency, and flexibility that consumers are now demanding of the enterprise.

IXPs need to evolve—embarking on their own digital transformation journeys to meet the increasing interconnection requirements of enterprise customers. Smart IXPs will evolve their business models and become geo-dispersed interconnection fabrics with software-based service offerings that are built on automated platforms to enable customer self-service, on-demand route configurations, and unprecedented transparency and flexibility.

Once again demonstrating thought leadership in the IXP space, Hoogenboom has set NL-ix on its own digital transformation journey with event-driven automation by StackStorm at the core of its strategy to deliver on his vision of automated software service offerings and business processes.



Enterprise Digital Transformation Demands Exponential Interconnection

This is the era of the technically empowered consumer—and consumers are now expecting the goods and services that they want on demand, served to them when and where they want them.

Meeting ever-changing consumer demands requires innovative enterprise business models. The resulting proliferation of digital product and service offerings requires that IT teams implement new technology, software, and automated workflows to be able to meet changing customer expectations.

According to IDC, “In the digital economy, products, services, and business processes are modular and software-based, delivering value through composite applications or mashups over secure high-speed interconnections integrating multiple partners’ networks. Digital media, ‘sharing-economy’ services such as Netflix, Uber, and Airbnb, and data-intensive, transaction-based retail and financial services processes feature distributed environments in which the database, payment processing, business logic, and presentation tiers may be located in multiple private and public clouds. The services, typically personalized in some fashion based on cognitive and big data-driven insights, are dynamically assembled and ‘shipped’ to the end user in milliseconds. The amount of data, the number of functions in the transaction flow, and the end-user experience are completely defined by the quality of the interconnection. Digital transformation introduces dramatic changes in business workflows, requiring coordination among multiple systems, networks, geographic locations, and ‘communities of value,’ *putting new emphasis on the criticality of an interconnection-first strategy.*”

Enterprise IT will need to automate business process workflows, leveraging event-driven automation platforms, such as StackStorm, to spur innovation, improve operational efficiency and respond to changing customer requirements. Additionally, IT will

need the ability to proactively determine bandwidth and latency requirements and be able to automatically optimize interconnection performance via low-latency connections. Enterprise IT will look for interconnection partners that can provide the innovation, scalability, velocity, agility, and transparency that their changing business environments demand.

The NL-ix Digital Transformation Journey

Recognizing the changing competitive landscape, Hoogenboom is being proactive and demonstrating thought leadership by embracing digital transformation at NL-ix. He has invested heavily in realizing the company’s vision of being the first pan-European Internet Exchange, and now has a reach that far surpasses the incumbent exchanges. Through its Digital Transformation journey, NL-ix will be able to fuse Hoogenboom’s vision for software-driven services with its pan-European, stable, low-latency network to provide its members with the next-generation interconnect services they need.

Delivering on the Vision

To begin the process of digital transformation, Hoogenboom assembled a team with the talent and skills necessary to deliver on his vision. Jan Paul Dekker joined NL-ix as Chief Technology Officer (CTO) to focus on creating new software-driven services. Dekker built a software development team to lead the NL-ix transformation and recruited Diego Luis Neto, a software engineer with extensive management and business process engineering experience. Neto is responsible for the architecture and design of the automation platform and related workflows focusing on three primary goals:

- Deliver transparent, automated software-defined services with an emphasis on customer self-service
- Rationalize and streamline the product portfolio
- Re-engineer and automate business processes and workflows companywide

Event-Driven Automation Drives Digital Transformation Strategy

Neto's team is responsible for developing and executing the reengineering and automation of all business processes companywide, and they have brought a DevOps mindset to the NL-ix digital transformation journey. While it was clear to Neto, the software development team, and the executives that automation is the key to their transformation from a technology perspective, they also recognized that transformation is not just about the technology. Equally important is the focus on transforming culture and creating an environment of generative collaboration, where everyone is included, and each team member is able to contribute their expertise to ensure successful execution of the vision.

After evaluating various automation approaches, Neto selected the StackStorm event-driven platform as the core of their digital transformation journey. StackStorm provides not only event-driven automation technology, it is also the ideal platform to transform culture, increase cross team collaboration, and deliver innovative business processes and services.

Why StackStorm?

"StackStorm was the perfect fit for everything," said Neto. "I needed an event-driven automation system that could react to input and perform complex operations in response. StackStorm enables us to develop complex workflows—for both customer-facing and internal business processes—across all departments in the company."

Neto found in StackStorm all of the automation capabilities NL-ix needed to help it reshape business processes and deliver on Hoogenboom and Dekker's vision:

- **Event-driven automation:** StackStorm enables NL-ix to plan workflow behaviors of the system in response to specific events or conditions.
- **Orchestration:** NL-ix is transitioning from a centralized information model to a distributed model, where specific applications reside in their own domains. StackStorm sits at the heart of the legacy and new environments simultaneously, operating as a message bus across all components of the architecture.
- **Transparency:** Teams can easily monitor workflow executions for assurance that they are in control of the automation and that actions are being executed correctly. Transparency is key to building trust with teams as automation workflows take on more and more tasks and become increasingly complex.
- **Easy integration:** Because StackStorm easily integrates with all NL-ix network infrastructure applications, it's a tremendously convenient system orchestrator.
- **Python, Linux-based, and Open Source:** Neto and NL-ix are big proponents of Open Source, actively participating and contributing to the Open Source community. They believe that Open Source helps accelerate innovation and delivers the power of community collaboration. With community brainpower behind Open Source solutions, he has confidence in the security of open source solutions. Another key factor in the adoption of StackStorm is the outstanding support he and his team receive from the StackStorm engineering team and community. The team is always willing to share its work with the Open Source community. For example, Neto's presentation can be viewed at <https://www.youtube.com/watch?v=VXWmx-sq2Pw&t=471s>, and the route-server configuration technology is available at <https://github.com/NL-ix/bird-stack>.
- **Modular, micro-services-based architecture:** A modular architecture enables clean application design, accelerates troubleshooting, and simplifies maintenance of the codebase and application.

NL-ix Best Practices in Deploying StackStorm

◆ Build a Collaborative Automation Team

When the development team needs to implement a new automation process, it gathers information and knowledge from team members to fully understand the details of the problem and design the best solution. Team members stay involved throughout the development process to validate progress. For example, NL-ix software developers are able to automate repetitive network engineering tasks and give tools to the network team to validate functionality. Network engineers don't need to develop coding skills, because the development of automated workflows are handled by the NL-ix software development team. Everyone saves time and stays focused on their area of expertise.

◆ Address Cultural Differences

The first step was to assess the company's cultural environment and determine that there were three distinct cultures:

- **Network engineering and operations:** This group is conservative and risk-averse. They prefer known processes and methods to maintain the infrastructure operations and are resistant to change.
- **Software developers:** Bringing a software development/DevOps team into an IXP is rare. However, with digital transformation as the goal, NL-ix needed to take an innovative leap forward. The software developers were the "new kids in town"—creative, experimental, and comfortable with fast-changing environments.
- **Product management and sales:** Sales and product teams want to make customers happy. A pragmatic, "just do it" focus is their hallmark.

Executive sponsorship is essential to success, but it takes more than an executive mandate to successfully change company culture and practices. Dekker knew it was critical to involve all of the teams in the process, so he involved all of the teams (software development,

network engineering, operations, product marketing, and sales) from the beginning. He clearly explained the market dynamics and why this transformation was necessary, and he engaged all of the teams to share their expertise in designing automation workflows. By recognizing and respecting each team's expertise, they successfully got the automation projects rolling. Dekker knew he had reached a turning point when network engineers began to envision new possibilities and proactively contributed new ideas for automated workflow functionality.

◆ Start Small to Build Trust and Take a Phased Approach

Neto advises starting with small workflows to gain trust and promote collaboration between teams and mapping your automation journey into phases with built-in mechanisms to provide feedback and foster collaboration.

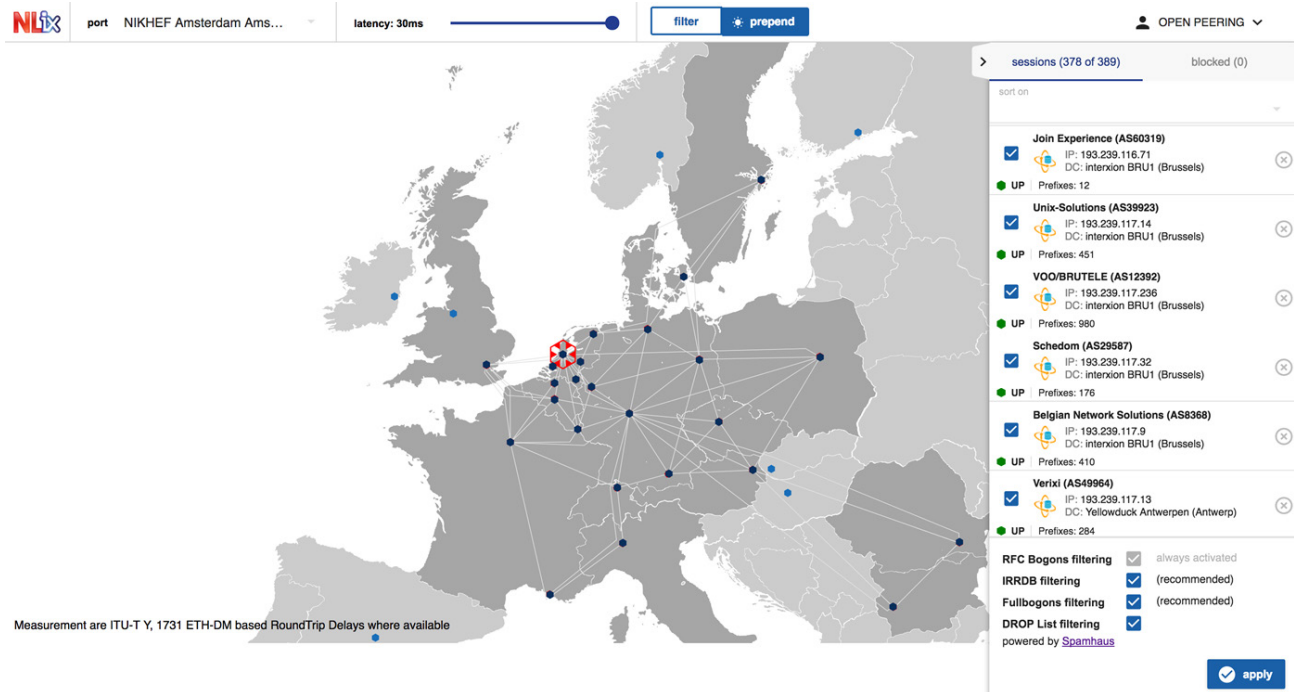
Phase 1: Dekker and Neto built their automation roadmap from the outside in. They prioritized two customer-facing projects—the NL-ix Route Configurator and the NL-ix Interconnect app—to deliver immediate positive impact on customers. The software engineering team worked quickly, delivering early prototypes so they could demonstrate to the sales, engineering, marketing, and business process teams how automation would make their lives easier. The following is a summary of the projects defined for phase 1:

NL-ix Route Configurator Service

Prior to launching the StackStorm-based Route Configurator Service, configuring NL-ix peering sessions required multiple emails and phone calls between customers and NL-ix network engineers—an error-prone process that took days to complete. The StackStorm based Route-Server Configurator Service gives peering customers easy ordering, greater flexibility, and more control over their services with complete transparency.

Once again, NL-ix is demonstrating IXP thought leadership. Providing customers with ease of ordering, flexibility, control, and transparency is new in the peering space. Traditionally, customers haven't

Figure 1. NL-ix Route-server Configurator Service.



had visibility as to how the network is configured. A graphical web interface makes the service easy to use and completely transparent to the customer. The Route-server Configurator Service helps customers configure their services to meet their specific needs. They can see their configuration and the specific ports associated with the services. Configuration now happens in seconds.

During development phase of the NL-ix Route Configurator Service, the software development team developed initial workflows and showed the results to the network engineers. Network engineers reviewed the output to confirm that the system was delivering the same configurations that they would have designed manually.

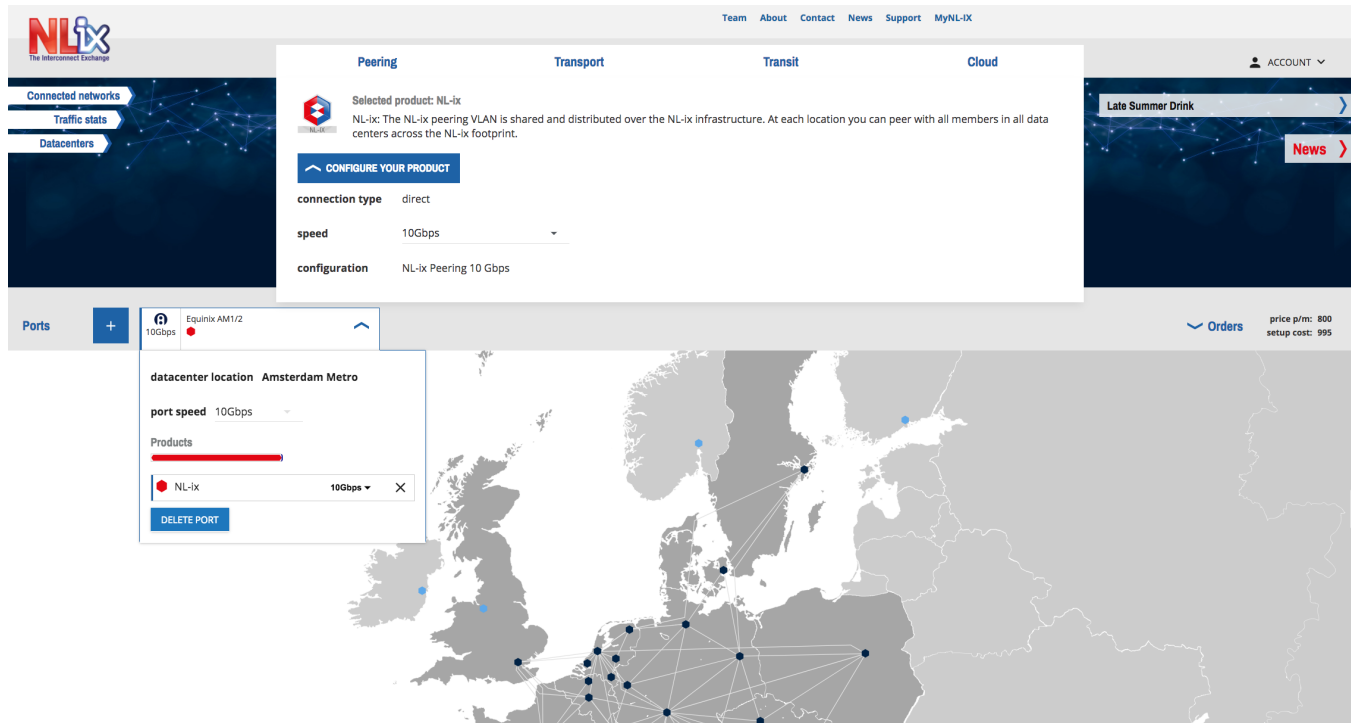
StackStorm automatically delivered consistent, accurate results, which convinced network engineers that it's to their advantage to have configurations done automatically with one click, rather than spend an afternoon manually editing a 100,000+-line configuration file.

Once network engineers saw the first phase of automation working, they gained trust in the StackStorm automation platform. This paved the way for close collaboration to create advanced network automation workflows. Now instead of seeing StackStorm as a potential threat to their jobs, network engineers see how automation frees them from boring, repetitive tasks and allows them to focus on developing new service offerings that increase revenue and competitive advantage. For more information about the Route Server Configurator, visit https://www.nl-ix.net/news/#blog_routeserverconfigurator.

NL-ix Interconnect App

The company completely redesigned its service offerings and gave customers a self-service web application to easily access the entire service catalog. Today, customers can request a quote for new services or modify their existing services via a sleek, friendly web interface. The app clearly shows the services that the customer already has and what they are changing.

Figure 2. NL-ix Interconnect App.



Bring Legacy Applications into the DevOps World

Developing the self-service web application required the transformation of all supporting back-office processes and workflows. In the past, NL-ix business records were stored in a single large legacy database. These records include customer data, billing data, technical service information, configuration, and enterprise financial data. To streamline business processes and make the business more flexible, NL-ix split functions into a distributed model, in which specific software manages each data domain. For example, there is the Salesforce CRM application, the Exact application for finance, and a custom web application for configuration management. For the moment, the legacy database must stay updated with all the data coming from the new applications. The StackStorm platform resides in the center of the system, acting as a “bridge” and handling the data synchronization between the legacy database and the new applications.

Phase 2: The interconnect app is a steppingstone to Phase 2 of the NL-ix digital transformation strategy. In Phase 2, the team will begin automating service deployment. Software and network engineers will collaborate closely to build the automation workflows for deploying customer-selected services. The goal is to put the intelligence of the network engineer inside the automated workflows. Because of the trust built during phase 1 of StackStorm workflow development and deployment, the network engineers are proactively engaging in helping to design this next phase of the automation journey.

◆ Provide Transparency and Control

The StackStorm platform’s intuitive interface makes it easy to trace the timeline of events and actions taken. This provides the network engineers with a sense of control because they can easily see what the system is doing and monitor it for accuracy.

◆ Implement Workflows in a Two-Layer Structure

For maximum flexibility in designing and modifying complex workflows, Neto recommends defining a structure with two logical layers.

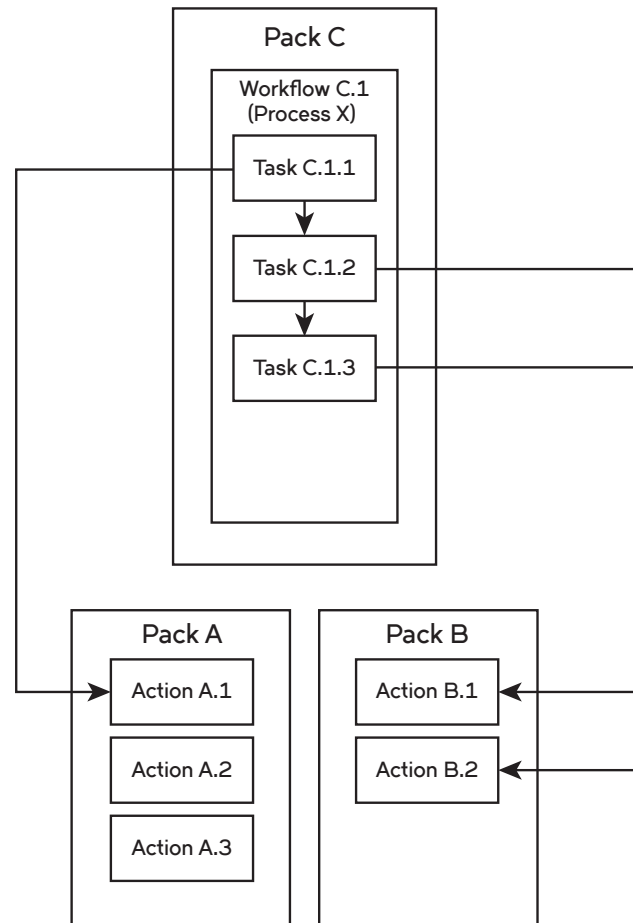
Basic packages interact with specific applications in a standard way so that all packs on the upper logical level can use the generic actions from the standard packs. For example, a MySQL pack exposes actions to perform standard Read, Create, Update and Delete on a MySQL database. Neto recommends using the generic automation packs found on StackStorm Exchange for different applications, which makes it easy to use (and customize as necessary) them and also share the work with the rest of the open source community.

The upper layer contains business logic workflows that call the functionalities in the lower layer to execute specific tasks. Having a two-layered structure is important in an environment where workflows need to be dynamic and easily modified. It allows flexibility to modify top-level business workflows without having to modify the underlying technical function actions and vice versa.

LIMITLESS POTENTIAL

NL-ix and its bold vision for interconnection is a great example of how the right technology can empower visionary leaders and transform organizations. Starting with the unusual step of bringing DevOps to the IXP environment and bridging internal cultural differences to unite disparate teams, NL-ix is fearlessly overhauling its processes for the benefit of customers—and its future. Although not visible to NL-ix customers, StackStorm sits at the heart of NL-ix operations, making it possible to go where IXPs have not gone before. What began as a ripple effect of enterprise digital transformation is becoming a tsunami of interconnection possibilities.

Figure 3. Multi-Layered St2 Packs Design.



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