
Nile Solution Architecture: Our Innovation Principles

A close look at challenges with legacy enterprise networks and the unique technology behind the Nile Access Service

nile

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Digital Innovation Gap

IT leaders face a growing innovation gap. To support digital innovation projects, legacy IT infrastructures cater only to organizations with ample budgets, large teams of certified engineers, and capital to acquire the latest shiny product. Traditional vendors lock advanced capabilities for network security, management and operations behind resource barriers: intensive training, niche certifications, and complex integrations.

The result? A risk-laden gap between digital innovation and legacy IT reality. Incumbents of the enterprise IT infrastructure industry continue to stay comfortable in their software and hardware roadmap that continues to burden IT with heavy operational overhead and greater risk for infrastructure security. The only visible act from piecemeal legacy solutions is to translate innovation into digital chaos. As IT leaders drive transformation initiatives, their teams strain under the weight of their aging infrastructure.

Nile's approach to enterprise networks flips the script.

For the first time in the industry, it integrates cloud-native software delivery model, as-a-service consumption, zero trust security, service level guarantees, and lastly AI networking into a single solution architecture. With these ingredients, the result is a next-gen enterprise network.

This new approach eliminates time, resource and knowledge gaps, reduces business risk for CIOs and IT leaders who are trying to realize their digital innovation agenda without breaking the bank. This paper explores how Nile's industry-defining technology closes this digital innovation gap for all. By redefining the principles of state-of-the-art secure connectivity, Nile fosters a new path forward. One that's designed to empower enterprise IT teams of all sizes to realize their transformation vision and compete in the digital future.

Network Industrial Complex

It has always been the case that legacy IT infrastructure vendors drop ship a box or two at customer sites and simply ask them to “call back when something breaks”. Customers almost always are left alone when designing, installing and maintaining multiple generations of hardware products, software licenses and support contracts.

Behind the scenes, fragmented hardware and monolithic software architectures seem to defend the operational complexity and inherent inefficiency. The infrastructure creaks under mounting technical debt. Countless hours in creating per-box golden configurations limit flexibility and speed of execution. It considerably increases risk for network intrusions, increasing cyber insurance cost for digital initiatives, as it adversely impacts overall security posture for the IT infrastructure.

This legacy approach makes IT innovation dependent on and reactive to product choice, capital availability and business real-estate plans.

When the legacy house of cards falters, vendors extract more value via professional services. Expensive consulting engagements impose heavy “innovation taxes” on progress. In the last 30 years, each product innovation within IT infrastructures - and especially within enterprise networking - came with specific hardware SKUs, software releases, security overlays, licensing requirements and support contracts.

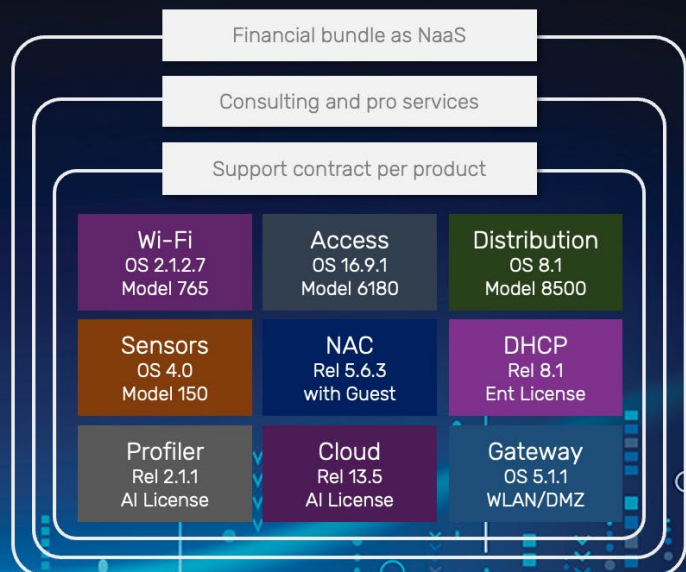
The operational burden was left to the enterprise IT teams to navigate. Way more time and resources than expected were required to keep the infrastructure up and running. Complexity continued to climb with every budget, security and performance compromise that was made over the course of its lifetime.

Today’s Approach to Enterprise Networks

Self-contained technology delivered in separate boxes

Each with product SKU, software release, licensing and support complexity

New service contracts and financial bundles to tackle inherent inefficiency



The top 10 problems of the Network Industrial Complex:

- 1. Proliferating SKUs and software versions:** Each new capability requires purchasing, integrating, and maintaining new hardware and software bundles. Just within campus and branch this means consumption of 10+ products and services.
- 2. Poor visibility and control:** With each element monitored separately, IT lacks holistic insight into utilization, and user experience. Granular control is almost impossible. There is absolutely no service level guarantee for coverage, capacity or availability. It is all left to chance to see if things break.
- 3. Fragile policy enforcement:** Security relies on manual changes across fragmented hardware and software solutions, considerably increasing risk. Zero trust security principles that are the cornerstone for cloud networking are nowhere to be seen.
- 4. Lack of monitoring for blindspots:** With limited device integrations, security teams lack visibility into network activity relevant to threat detection.
- 5. Uncoordinated updates:** Security vulnerabilities and patches are addressed in isolation, rather than holistically, further increasing exposure.
- 6. Manual, error-prone management:** Every function demands custom configuration across multiple elements. This makes Quality of Service (QoS) and infrastructure security policy definitions complex and fragile.
- 7. Impossible to enable closed-loop automation:** It continues to be an elusive goal in legacy environments due to fragmented data and controls.
- 8. Inefficient workflows:** IT teams rely on manual, multi-step processes for provisioning, troubleshooting, and maintenance - impeding their agility to respond to business needs.
- 9. Reactive vendor support:** Issues are reported to vendors after-the-fact, delaying remediation. Problems linger while awaiting vendor response.
- 10. Incohesive troubleshooting:** Disjointed alerts and reports require manual correlation. IT teams continue to hunt for a resolution as they reactively analyze reported incidents.

If eliminating all these burdens is the goal for the enterprise networking industry today, ...

- Is hiding the complexity away the right answer?
- Would it make sense to trust the network industrial complex to address these issues?
- Why don't we start with a clean sheet of paper, with new principles, and look beyond the roadmap of legacy infrastructure vendors?

Organizations are faced with tremendous opportunity (and the challenge) of utilizing data and AI to improve what they do. At this point... capital is too expensive, talent is harder to find, competition is fierce. Driving a new growth model with as-a-service technology consumption to improve business efficiency is a mandate for IT leaders. And for IT professionals, a new operational model that automates traditional IT operations with AI is the best way forward to keep up with the business growth.

New Innovation Principles

Next generation of enterprise networks hence call for unifying network engineering, zero trust security, and traditionally manual lifecycle management in a single intelligent system designed for full stack integration and automation.

Thankfully, we have some hope.

Here at Nile, we propose new innovation principles for secure connectivity to break the mold of incumbent product centric solutions of the last 30+ years.

Today, IT organizations of any size and individuals across a wide ranging set of industries, can boost their innovation and productivity through digital innovations powered by data. It is now possible to transform knowledge into intelligence by organizing, manipulating and learning from vast amounts of data in our personal and work lives.



Redefining Innovation Principles for Enterprise Networks

Integrated data model as the secret ingredient

Consume
as-a-service

Enterprise IT

Closed Loop
automation with AI

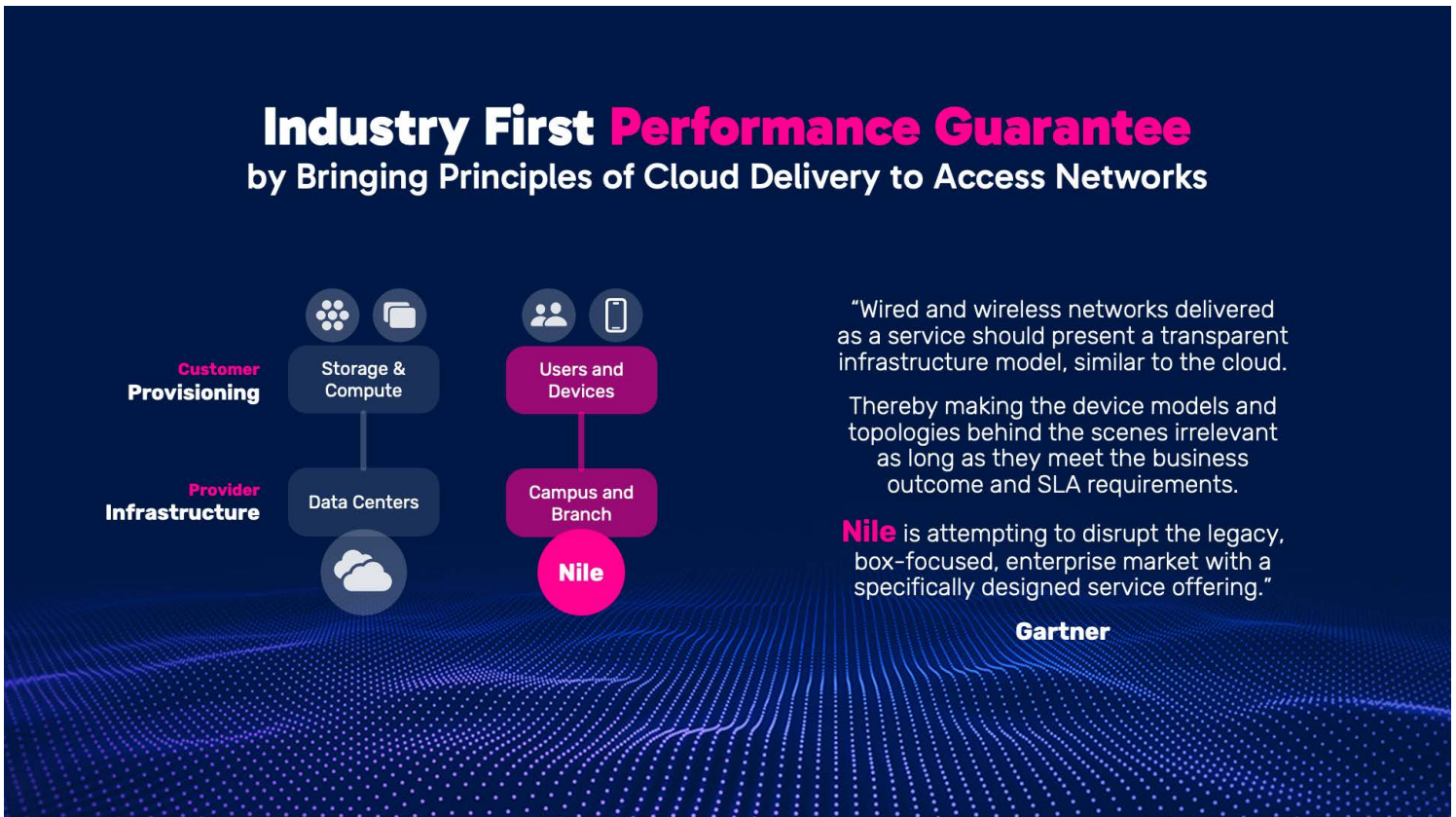
- Innovation at the speed of the cloud
- Assist expert resources for day 2/N operations
- Bridge the budget gap to tackle refresh
- Accelerate knowledge to design and scale

Nile Access Service

Here at Nile, we join others who move to bring automation to all aspects of their technology solutions for organizations of all sizes. We do so by bringing data centric design, zero trust security and continuous automation with AI to enterprise networks.

Our journey started by translating the enterprise network at campus and branch locations to an infrastructure-as-a-service model, taking advantage of the principles proven out in the cloud.

This attempt has been rightfully labeled as NaaS (network as a service) although it simply acted as the first chapter in our innovation agenda to redefine consumption of IT infrastructures at the enterprise edge.



The first piece of the puzzle - delivering a wired and wireless network completely as-a-service by utilizing these innovation principles - was our entry into the market. This allowed us to validate our cloud software and data models, and enabled the development of our AI applications. Across deployments of all sizes, we were able to prove our customer outcomes with a full tech stack design, delivery and lifecycle management of secure connectivity.

Here are a few examples of how Nile is helping them reclaim time, reduce business risk and redirect resources:

- **Eliminate network related IT tickets: proactively resolve deviations in service quality**
“Nile sensors continuously monitor and test for any potential issues. We learn if & how users might experience connectivity issues before they happen.”
- *Lunar Energy*
- **Up to 25x faster external issue resolution: automatically identify and visualize root cause**
“It has always been a big mystery when a particular cloud or research application is inaccessible. We went from spending 40 hours on troubleshooting to 1.5 hours.”
- *Stanford University, Computer Science Department*
- **No touch software maintenance: orchestrate rollouts with pre/post-validation**
“Knowing that Nile is managing updates and security patches – and testing them before they’re pushed out – gives me peace of mind. We have our weekends back.”
- *Uniphore*
- **Continuous security compliance: guarantee zero trust isolation for each device**
“As part of renewing our cyber insurance, the carrier reviewed our network security posture. With our Nile network, we actually lowered our premium.”
- *SDI*
- **Built-in system care and upkeep: automate additions, replacements and refresh**
“We wanted to move away from the traditional ‘break-fix’ model for our infrastructure. Nile prevents us from being held hostage by maintenance tasks.”
- *University of Denver*

Centralized orchestration of Nile’s Access Service across many tenants was validated in the real world. This all happened while legacy product vendors were trying to figure out what NaaS truly is; and according to Gartner’s definition above, they are not even close.

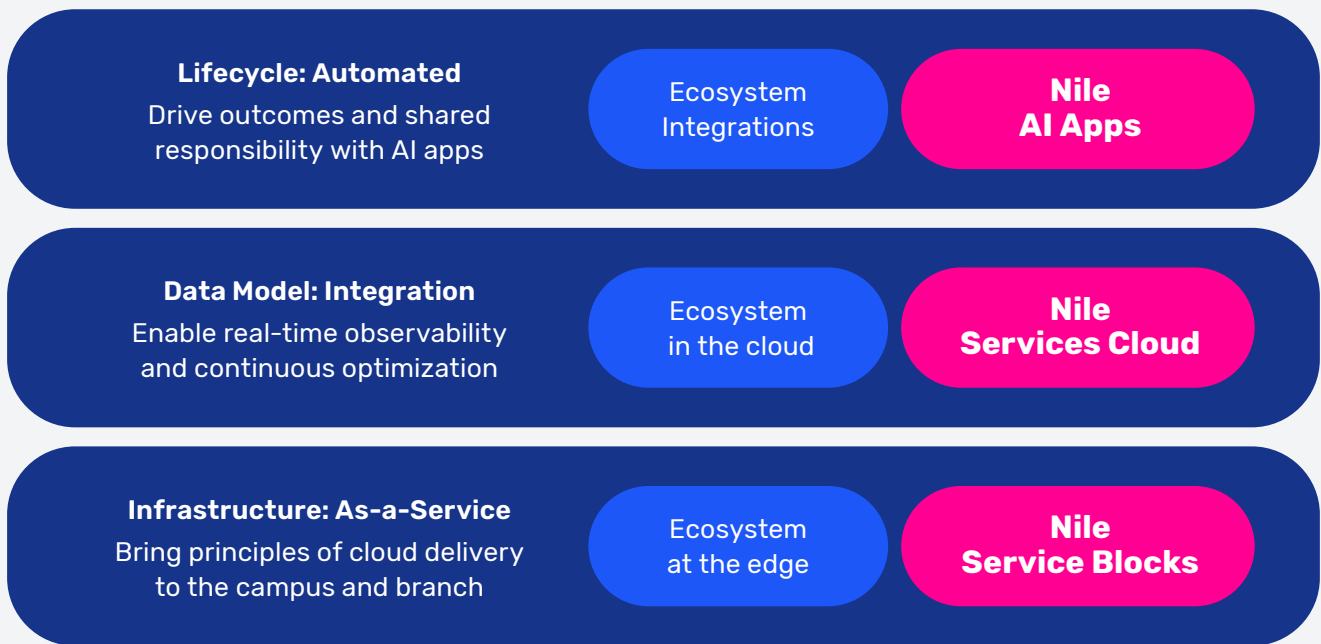
Now, it is time to complete this picture and highlight how Nile is integrating AI Networking principles into its solution architecture.

It starts with the novel idea that an enterprise networking technology vendor has to share the responsibility of outcomes with enterprise IT leaders, by offering a **service level guarantee** for network capacity, wireless coverage and overall system availability across all its customer deployments. With the Nile Access Service, violations in the promised %99.95 service level guarantee across any site translate to monthly credit paybacks.

Here are the Nile architecture components:

- **Nile Service Blocks:** Edge network infrastructure, designed and delivered by translating infrastructure-as-a-service (IaaS) principles of the cloud to secure wired and wireless connectivity at the enterprise campus and branch.
- **Nile Services Cloud:** Powered by comprehensive data collection from the Nile Service Blocks, Nile Services Cloud enables real-time observability and continuous optimization, by utilizing both model-centric and data-centric AI.
- **Nile AI Applications:** Taking advantage of the integrated data model within the Nile Services Cloud, they not only provide full control and visibility to IT admins, end users and Nile's production engineering team - but they also help orchestrate the network lifecycle management via simple and intuitive interfaces.

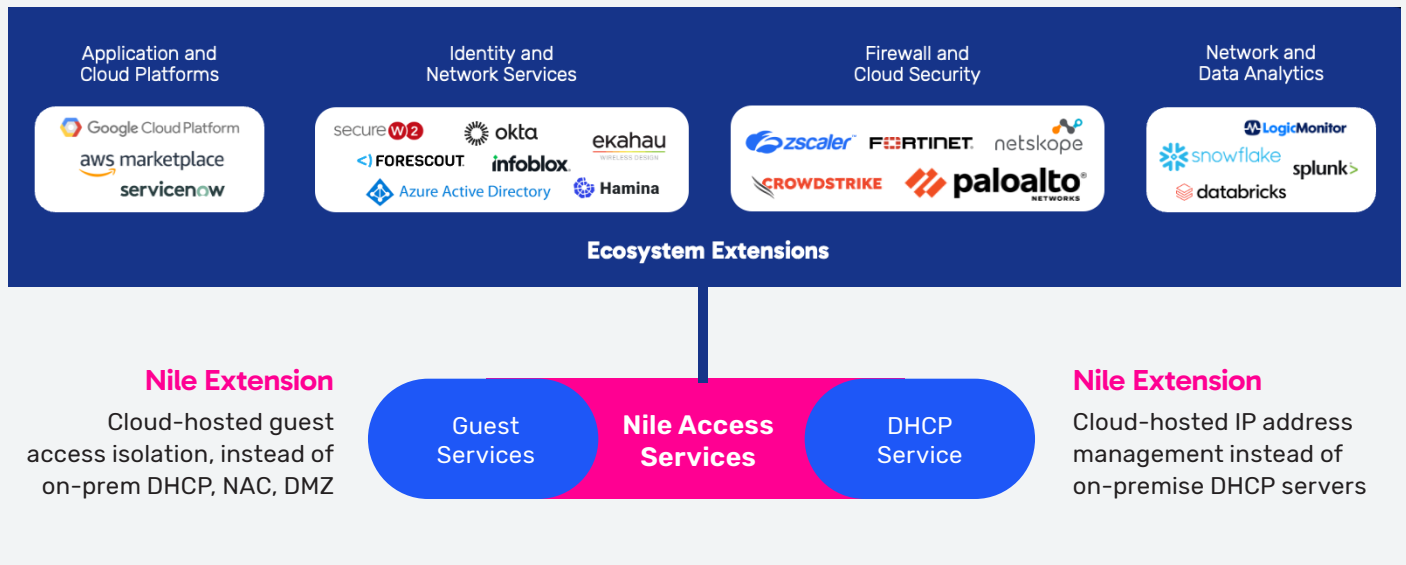
Next-Gen Enterprise Networks with the Nile Access Service



With a modern cloud-native technology architecture, Nile Access Service reduces complexity in building extensions on top of its core elements.

Technology partners in our ecosystem get to build on a solid foundation, with every Nile network using the same cloud software release and standardized infrastructure design, eliminating "snowflake" deployments. This enables Nile ecosystem partners to rapidly build and easily streamline support for highly differentiated solutions, and prevents surprises as they tackle joint customer deployments. Since the Nile Access Service integrates 10+ traditionally separate enterprise network products and services into a single solution, there's no need for technology providers to build integrations with disparate components.

Open Ecosystem with Extensions



In order to accelerate adoption of the Nile Access Service, we also provide native extensions as optional add-ons to the core service: Nile Guest Service and the Nile DHCP Service.

Nile Guest Service

This extension by Nile is a cloud-based service to enable secure connectivity for guests across Nile Access Service deployments. It is designed to improve your cybersecurity posture across IT infrastructure by completely isolating guest traffic from internal corporate resources.

With the Nile Guest Service, IT teams no longer need to maintain on-premises infrastructure support for guest users as it automatically isolates guest traffic by tunneling it to the closest Nile point of presence (PoP). It gets deployed quickly and easily, in as little as one click, within an existing Nile Access Service instance.

This completely eliminates the need for IT admins to manually configure on-premises firewall, DHCP, DMZ, and NAC infrastructure to segment guest traffic from internal traffic. Since it routes all guest traffic directly to the Nile PoP in the cloud, completely isolating it from corporate resources, Nile is responsible for and handles all law enforcement inquiries regarding DMCA.

Overall, the operational burden and the associated total cost of ownership in managing and maintaining secure guest access across campus, branch and remote sites are radically reduced.

Nile DHCP Service

This extension by Nile is a cloud-based service to streamline dynamic IP address management at cloud-scale and security, eliminating the need for on-premises DHCP servers.

Nile DHCP Service eliminates the operational burden of manually managing DHCP infrastructure and servers across campus, branch and remote locations. Given it is a cloud-based service, it automatically scales as connectivity demands change up across the distributed enterprise.

As it automates IP management resource allocation, it easily onboards a high volume of BYOD and IoT devices. It provides IT admins a unified view plus one-touch setup as they provision zero trust network segments within their Nile Access Service. It comes with automated infrastructure security controls, eliminating the potential for any tampering and phishing attacks.

Recap: Nile Solution Architecture

As we bring laser focus to guaranteed outcomes for enterprise networks, it is important to not lose track of the key business initiatives that Nile Access Service ultimately benefits:

- Improving real-estate and team productivity – with digital edge solutions such as video conference rooms and physical security systems.
- Ensuring privacy of your enterprise data and security of their IT infrastructure – as they adopt cloud-native SaaS solutions.
- Treating enterprise data as a key asset to drive intelligence – with new data analysis and generative AI initiatives.
- Carefully tackling a balancing act between innovation, privacy/compliance and cost – with a migration to private and public clouds.

Our customers would rather have their infrastructure turn into an invisible hero behind the scenes, in support of what's important to them in this list and more.

In their journey, Nile Access Service represents a new era for enterprise networks and IT organizations that depend on them.

For IT leaders, an as-a-service model makes next-gen enterprise networks available to any organization, eliminating budget and time gaps in their innovation cycle.

For IT teams, we go beyond monitoring to enable a truly automated operational model. Nile self-observes and self-optimizes based on real-time data capture from the network. Closed loop automation powered by AI eliminates the resource and expertise gaps as they scale their infrastructure operations. Complexity in manual design, installation, configuration and maintenance of individual network elements across disjointed products stops being the norm.

As we define the new innovation principles for enterprise networks, we firmly believe that it is simply too late for enterprise IT organizations to expect any real progress from legacy network infrastructure vendors. Time has proven multiple times in the past that this degree of innovation does not come overnight with simple rebranding or product acquisition. Making real progress requires us to rethink the foundational architecture for enterprise networks.

While legacy architectures stagnate, thanks to its cloud-native software delivery model, Nile Access Service has been designed to constantly evolve to align with business demands for digital innovation. We put next-gen networks within reach for enterprise IT organizations of any size, irrespective of any of their existing budget, knowledge or resource limitations.

Nile Service Blocks: Foundation for the Nile Access Service

Enabling consumption of wired and wireless access networks as infrastructure as-a-service at the enterprise campus and branch.

Nile's Service Block for wired and wireless access networks integrates traditionally separate 10+ products and services into a single solution. The Nile networking hardware as part of the Nile Service Block is purpose built to be fully orchestrated from the cloud and is powered by cloud-native software that enables comprehensive network data collection across all layers.

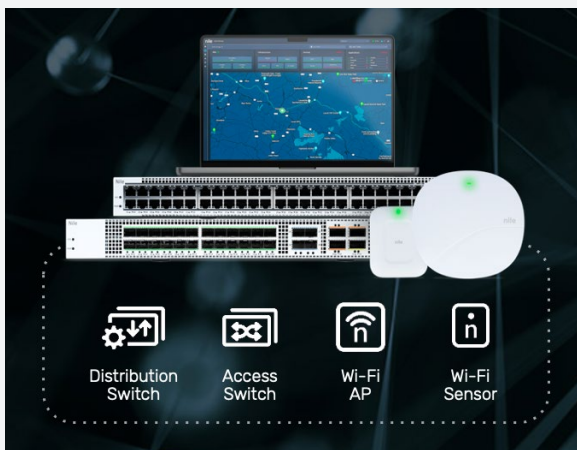
Such instrumentation utilizes deterministic system design and continuous collection of 1000+ data points across all aspects of the edge infrastructure. The

networks are deployed with standardized design and configuration within the wired and wireless network underlay. They are always installed with high density and high resiliency design principles.

This standardized design eliminates "snowflake" installs and relevant complexity for ongoing network operations.

It integrates physical / virtual sensors to enable continuous data collection from the service block. It extends zero trust networking principles to the enterprise campus and branch by enforcing L3-only user / device isolation on hardened hardware - enabled with TPM security inside and MACSec encryption in the control path.

Nile Service Block for Wired and Wireless LANs



Vertically integrated infrastructure, purpose built to be delivered as-a-service



Deterministic system design

with high-performance hardware and built-in redundancy



Campus zero trust security

to enforce L3-only device isolation on hardened hardware



Comprehensive data collection

with deep instrumentation and physical/virtual sensors at every layer

Nile Service Block is purpose built for end to end automation via software thanks to its single integrated modern cloud software architecture and unified data format across the tech stack. Similar to the IaaS principles in the cloud, Nile Service Block is supported with agile software development cycles with in-service maintenance.

To better understand how the Nile Service Block is designed, consumed and operated, it is useful to compare against how things used to be.

In the 1990s, it was about connecting personal computers to each other. And, switches were born. One of the big reasons behind Cisco's tremendous growth. In the 2000s, we have made it possible to stay connected with laptops. Wi-Fi access points arrived. To simplify enterprise deployments, Wireless LAN controllers were born. Companies like Aruba took advantage.

In the 2010s, with the arrival of smartphones and tablets, Wi-Fi became a necessity for businesses of all sizes. Cloud portals were born to ease management across many sites.

Then, with enterprise connectivity service more devices and applications at every corner, we tried to ease troubleshooting of quality issues with AI summarized notifications and alerts.

Besides the technology architecture, purchasing a wired and wireless access network is not necessarily easy either.

- First, you needed to survey your space and plan the network design. Then, you would review your vendor's product categories, such as Wi-Fi 6 access points and stackable access switches.
- Next, you would select a specific model within each category. Each model has different features, so you had to pick one that fit your needs.
- After choosing the right models for access points and switches, you would add the right SKU for each, along with accessories and cloud management subscription.

With the Nile Access Service, we have fundamentally changed this 30 years of complex innovation and consumption model. With Nile, these 10+ steps are replaced by a single all inclusive service that you can sign up to in one step. Day -1/0/N network operations are automated in software, and there is no need to manually manage the lifecycle of countless hardware products, software releases and support contracts.

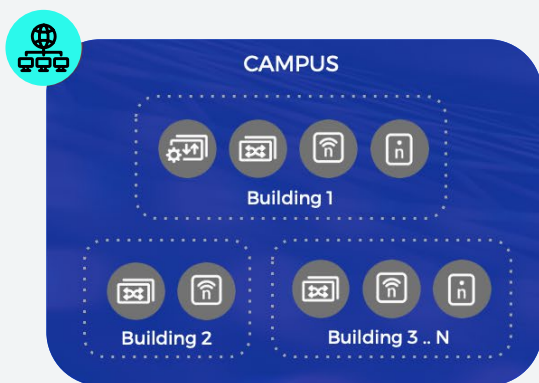
As you operate your Nile Service Block, you become a tenant of the Nile Access Service, and start consuming your next-gen access network as-a-service, on a per site or per building basis.

Each of our customers enjoy guarantee in service quality within their buildings: if there are SLA violations, they receive payback in their upcoming monthly billing cycles. Payment terms of the service can be monthly or annually, and do not require any upfront capital expense. You have the flexibility to add new sites/buildings to your existing contract at any time.

As opposed to legacy enterprise network architectures, there is no difference in design, install or maintenance of the Nile Service Blocks across different size locations. Campus and branch network deployments rely on the same cloud based orchestration, instead of the separate network management solutions. There are no performance or security compromises that are commonly observed in controller-based or controllerless Wi-Fi network implementations.

Enterprise-Wide Deployment

Different Size and Type of Service Blocks for Different Sites



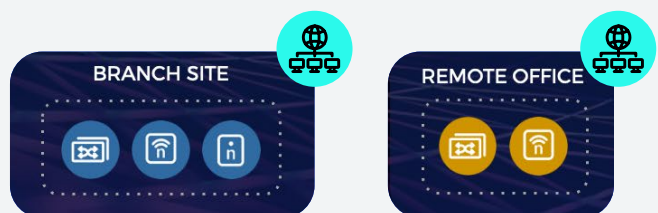
Multiple building campus

scaling up to 30k users per block,
and multiple blocks per campus



Fully cloud orchestrated

instead of manual configuration
per network element & per site



Multiple site branch / remote

scaling down to a few access points
and wired switches as required

The service pricing is designed to align with enterprise IT budget priorities. Per employee per building pricing allows you to save during the months where there are not a whole lot of folks showing up at work. Per square foot per building pricing enables you to stick a number on a per month basis independent of connected employees in the building, bringing predictability of spend next to your real-estate costs.

Deterministic System Design

Within a Nile Service Block, Wi-Fi 6 APs with four radios are installed in salt-n-pepper redundancy, including an embedded sensor. A physical Wi-Fi sensor infrastructure is also installed for continuous evaluation of the service quality. Access switching with 5 Gbps PoE+ ports and redundant distribution switching with 40 Gbps uplinks act as the backbone.

The topology and design of each Nile Service Block is automatically generated based on the site survey and performance requirements for the install location at hand.

Here are some of the unique capabilities of the Nile Service Block when it comes enabling deterministic system design across any campus or branch location:

No product catalogs for network elements: never select SKUs again
No dedicated hardware selection at each site: blocks horizontally scale
No configuration for network elements: eliminating "snowflakes"
No console ports or CLI: blocks are activated with a mobile app
No configuration for physical / virtual sensors: orchestrated from the cloud
No configuration for network protocols: dynamic per topology
No configuration for traffic forwarding rules: dynamic per topology
No configuration for network QoS: automatic with DPI

Campus Zero Trust Security

Nile Service Block enforces L3-only isolation on hardened hardware for all user and device sessions. By eliminating L2 VLAN based policy enforcement, it radically reduces the amount of complexity that's involved in translating zero trust security policies within the enterprise campus and branch networks. By speaking the language of the internet - IP - its policy management orchestration directly aligns with cloud based security solutions.

Here are the unique capabilities of the Nile Service Block when it comes to enabling campus zero trust security for wired and wireless connectivity:

Tamper proof hardware with secure boot, always with the latest security patch
Encrypted management and control plane, each network element validating the other
"Default: deny" Every device must be authenticated and authorized, before IP address
No VLANs or ACLs for policy enforcement, preventing lateral movement of malware
Each connected device is completely isolated from any other in layer 3
Sessions are continuously verified with first hop security and device fingerprinting
Centralized encryption and external firewall enforcement protects north-south flows
Microsegmentation within device and user groups protects east-west flows

Comprehensive Data Collection

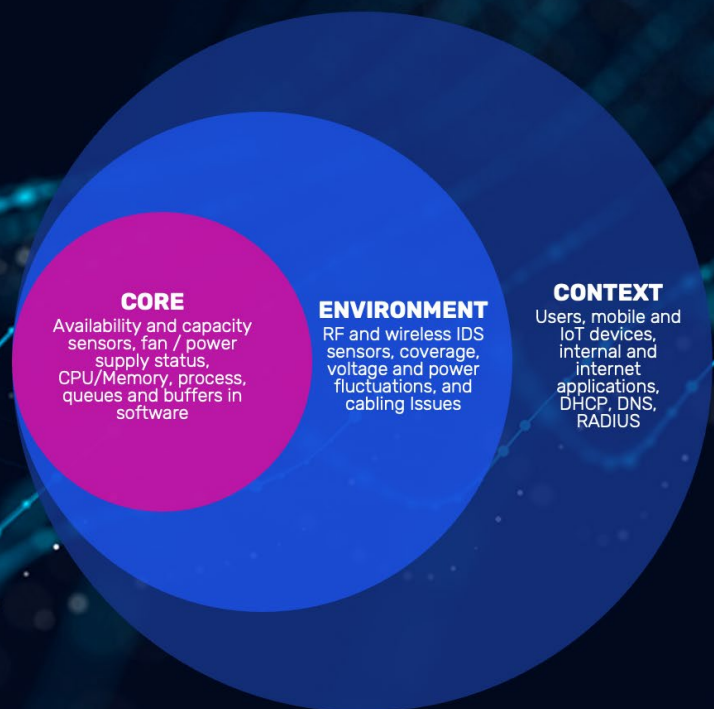
Data is the fuel required to start automating traditional lifecycle management, and it is the secret ingredient that extracts intelligence out of the network. Nile Service Blocks are purpose designed to help convert enterprise networks into a collection of data sets to automate its operations. Nile Service Blocks make it possible to create an integrated data model across all aspects of the enterprise network deployments in the Nile Services Cloud.

This includes continuous collection of telemetry data from all types of network elements within the core of the infrastructure, environmental data from external IT infrastructure components, and contextual data from users, devices, applications and associated network services.

Here are the unique capabilities of the Nile Service Block when it comes to enabling comprehensive data collection:

Physical sensors and dedicated AP radio to enable continuous and on-demand testing
Virtual sensors in every network element to augment continuous testing
User and IoT experience as "sensors" to augment data collection
Deep instrumentation to collect metrics, events and logs from every network element
Wi-Fi air quality data across every RF link, and across sensors and APs
Environmental data: power/voltage fluctuations, cabling issues, RF interference
Latency and availability data for RADIUS, DHCP, DNS network services
Latency and availability data for popular enterprise and internet applications

Converting an Enterprise Network into a Collection of Data Sets to Automate Its Operations



Recap: Nile Service Blocks

Acting as the foundation of the Nile Access Service, Nile Service Blocks make it possible to extend cloud delivery principles to the enterprise edge for wired and wireless network deployments. With a deterministic system design, they make it possible to drive closed loop automation for traditionally manual network operations via the Nile Services Cloud.

Elimination of traditional policy management constructs with VLANs and static ACLs and its unique capability to integrate L3-only policy enforcement, extends zero trust networking principles to the enterprise campus and branch. This radically simplifies policy provisioning for IT admins utilizing Nile AI applications.

By avoiding “snowflake” deployments - different network element level configurations, software releases, installation best practices, etc - for wired and wireless networks, it makes it possible to collect

“clean” data from the infrastructure and act as the fuel for model- and data-centric AI functions that are an essential part of the Nile Services Cloud.

With the Nile Service Blocks, we are changing the way we think about enterprise network design, installation, security, and ongoing operations.

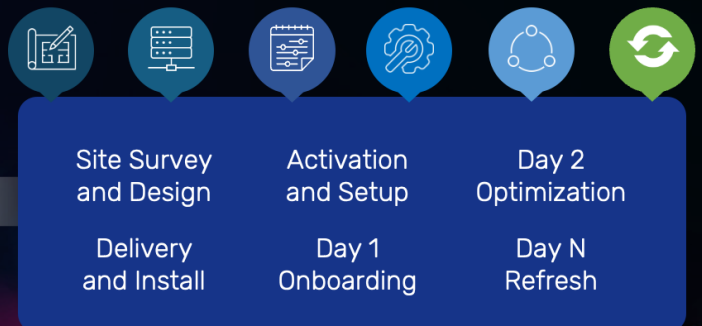
Enabling real-time observability and continuous optimization for the Nile Service Blocks deployed within campus & branch IT infrastructure

Customers of the Nile Access Service, across different enterprise campus and branch locations, are not using one product here, and another one there. Acting as tenants of a single service, all components of their enterprise networks have completely transitioned over to Nile.

Innovating with Hardware & Software is **Not Enough** “Shift Left” – Incorporate Operations Into the Technology



Traditionally, hardware and software innovation came at the expense of, or without caring for, operational burden to IT



Nile Services Cloud: Driving Closed Loop Automation with AI

This single and integrated solution deployment across all our customer tenants gives Nile a great amount of data points to be able to validate layers of our technology architecture. It allows the creation of the Nile Services Cloud that is powered by an integrated data model to “shift left” and integrate traditionally manual network operations from day -1 to day N into our technology architecture.

With Nile Services Cloud, hardware and software innovation within the Nile Service Block for secure wired and wireless connectivity does not come at the expense of operational burden for enterprise IT teams.

The multi-tenant data store is built within the Nile Service Cloud with the capability of handling volume, variety and velocity of data from different data sources. This comprehensive data collection enables a variety of closed loop automation capabilities, going beyond AI generated summaries of network management reports. The goal with closed loop automation driven by the Nile Services Cloud is to completely eliminate manual tasks for IT admins - and not just summarize their task list.

Nile Services Cloud utilizes comprehensive set of data sources across hardware installation, software status and lifecycle management services:

- Design data: Floorplans, building materials, and attenuation modeling
- Build data: Network closet locations and specifications of the physical space
- Install data: Fulfillment logs and photos from the pre- and post-installation
- Telemetry data: Real-time data collection from the Nile Service Block
- Management data: Granular network telemetry via physical/virtual sensors
- Consumption data: User profiles, device fingerprints, and application patterns

Data stores within the Nile Services Cloud include:

- Relational data store that stores management information
- Metric data store that stores telemetry data from network elements
- Event data store that stores events from network elements
- Log data store that stores raw logs from network elements
- Raw data store that stores other types of data - text, images, audio and video.

This scalable data structure enables various analytics capabilities:

- Streaming analytics that process streaming data in real time
- Batch analytics that process data at rest and provide descriptive statistics
- AI/ML models that continuously learn from data to recognize patterns

By unifying disparate data sources into a scalable analytics engine, Nile gains comprehensive insight into network state and user needs.

The integrated data model transforms reactive network management from reactive to closed loop automation.

It boosts network availability by using AI models to detect anomalies like cabling errors and power fluctuations in real-time. It automatically reroutes traffic around issues to maintain uptime. For optimal performance, Nile Services Cloud continuously adapts Wi-Fi parameters to align with user experience needs. To strengthen security, the system profiles network behavior to isolate and block malicious traffic.

By infusing its network service with AI, Nile also achieves new levels of operational efficiency. Its automated design capability leverages AI to optimize access point placement based on signal requirements, building layouts, and application needs. For installation, Nile detects issues like suboptimal mounting to ensure flawless deployment quality.

The system accelerates root cause analysis by constructing a topological understanding of network

dependencies. This allows it to suppress downstream effects and pinpoint true root causes while reducing alert noise. AI-powered software upgrades minimize disruption by automatically rerouting traffic and rolling back in case of adverse effects.

In summary, with an integrated data model within the Nile Services Cloud, Nile AI optimizes network availability, performance, security, and operations via autonomous real-time optimization, behavioral analysis, topology mapping, and predictive intelligence.

Nile Services Cloud elevates enterprise networks from static plumbing to intelligent and adaptive infrastructures.

Powered by its integrated data model, here are the market defining and unique capabilities of the Nile Services Cloud.

Nile Services Cloud

Driving Unique Innovations for AI Networking with an Integrated Data Model



Design Pipeline:

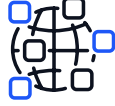
Orchestrated site survey, design and install

Nile's design pipeline fully automates planning, designing and installing of Nile Service Blocks.

It's unique capabilities as part of the Nile Services Cloud include:



Automate network site survey and planning given user, devices and app requirements



Auto-generate bill of materials (BOM), network topology and installation work orders



Installer mobile app with automated work orders for service delivery partners



One touch activation of the Nile Wi-Fi access points, switches and physical sensors



Eliminate poor installs by automatically validating against topology & design

Digital Twin:

Virtual replica of the service block

Digital twin faithfully replicates the physical topology of the Nile Service Block and helps track service quality against coverage, capacity and/or availability performance guarantees.

It's unique capabilities as part of the Nile Services Cloud include:



Simplified full stack system orchestration instead of traditional manual configuration



High fidelity virtual representation of the deployed network architecture



Automated comparison of the network snapshot to its ideal design state



Automated insights on overall network health and individual network elements



Automated troubleshooting in case of network related or external issues

Defense Hub:

Edge to cloud security for the service block

Defense Hub enables edge to cloud zero trust security for the Nile Service Block.

It's unique capabilities as part of the Nile Services Cloud include:



802.1x auth for users, SSO auth for BYOD, and dynamic device profiling for IoT devices



Dynamic policy orchestration per user / device and with external security systems



Bring Your Own Key (BYOK): Encrypt your data in the Nile cloud with your own keys



Wireless IDS that's always on, taking advantage of dedicated radios on the Nile APs



CSA Star Level One, ISO 27001, and SOC Type II certifications for security compliance

Smart Agents:

Real-time data collection at high efficiency

Smart agents continuously monitor all aspects of the Nile Service Block, including network element telemetry data, environmental conditions such as power, cabling status, etc. Smart agents orchestrate this data collection via software and hardware sensors within the Nile Service Block, and tackle post-processing within the Nile Services Cloud.

It's unique capabilities as part of the Nile Services Cloud include:



Orchestrate physical & virtual sensors to test for coverage, capacity and availability



Automatically adjust testing scope based on popular end user apps in the network



Per second collection of system logs & instrumentation data from network elements



Deep instrumentation to capture data on user, device and app experiences Eliminate poor installs by



Snapshots of network state before-and-after software upgrades & security patches

Cognitive Decisions:

Automation to maintain best practices state

Cognitive decisions analyzes the collected data using streaming analytics and AI/ML to proactively detect deviations in system, user, device, and application status from baseline performance. It is designed to make sure that a Nile Service Block can automatically maintain its best state at all times.

It's unique capabilities as part of the Nile Services Cloud include:



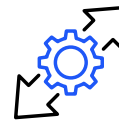
Streaming analytics to process real-time data for root cause analysis and notifications



Batch analytics that process data at rest and provide descriptive system statistics



Pattern recognition and predictions with AI/ML models based on real-time data



Automated transmission of inferred decisions to on-premises network elements



Designed to self-improve with hitless upgrades to on-prem microservices software

Recap: Nile Services Cloud

Acting as the brains behind the Nile Access Service, Nile Services Cloud drives closed loop automation for traditionally manual network operations. When reviewing the details behind the third layer of our solution architecture, Nile AI applications, you will get to see clear examples of how Nile Services Cloud utilizes model- and data-centric AI to integrate traditionally manual network operations within the wired and wireless network tech stack.

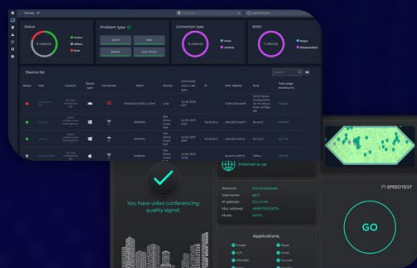
Thanks to the deterministic system design and comprehensive data collection enabled across the Nile Service Blocks, Nile Services Cloud moves enterprise networks beyond “cloud management portals”. Powered by its integrated data model, instead of relying on cloud just for the sake of easing network management, it acts as the secret ingredient in enabling cloud-like service delivery at the enterprise edge, across campus and branch networks.

Nile AI Applications: Radically Simplified Lifecycle Management

Providing full visibility and control to IT admins while completely automating and offloading traditionally manual network operations.

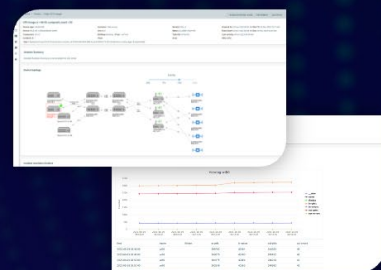
Today, Nile Access Service is now serving millions of square feet of space across the Nile customer base. This translates to meta data collected from billions of user sessions, across millions of devices, and thousands of end user applications.

Shared Visibility and Control With Nile AI Apps for Lifecycle Automation



Nile Copilot

For IT teams and end users to monitor service outcomes and securely onboard user & IoT devices



Nile Autopilot

For Nile’s customer success and production engineering teams to offload network operations

This metadata is “clean” thanks to the deterministic system design across Nile Service Block deployments, and ready to power automated workflows across the edge infrastructure. Within the Nile Services Cloud, an integrated data model is formed thanks to comprehensive data collection, labeling, and analysis. Digital twins of the Nile Access Service deployments come to life within the Nile Services Cloud, with Nile AI Applications providing the visual interfaces to gain visibility and control.

As of today, Nile AI Applications come in two categories highlighted below. These apps radically improve how easy and how fast system installers, IT admins, end users, and Nile’s customer success and production engineering teams interact with the Nile Access Service.

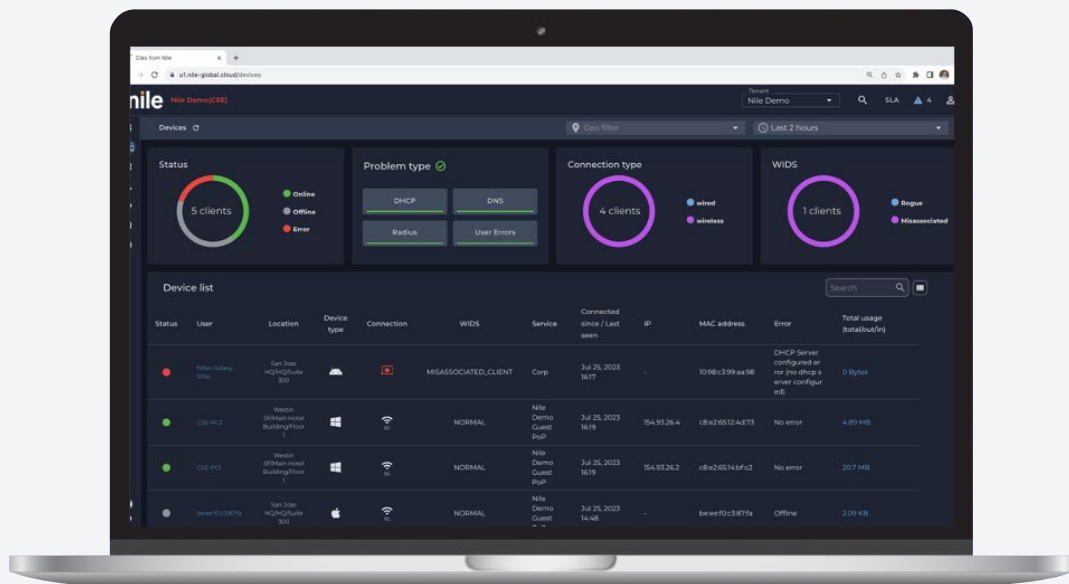
Similar to how ChatGPT takes advantage of the OpenAI cloud and data models to create a radically simple human interface to its generative AI capabilities, these apps are crafted on top of the Nile Services Cloud to drive business and IT outcomes for Nile customer environments.



Nile Copilot for IT admins

Nile Copilot enables IT administrators to orchestrate their Nile Service Block, and gain visibility and control. It offers the industry's first intent based provisioning of an enterprise network with one touch installation and system-wide orchestration of desired setup in a few clicks.

Orchestrate Your Nile Network with the Nile Copilot for IT Admins



Radically simplified provisioning

- Setup full stack wired and wireless network in a few clicks
- Integrate with external IT systems and network services
- Provision network segments in L3 with zero trust isolation

Embedded zero trust security policies

- Implement user and device authentication policies
- Approve or deny device access to zero trust segments
- Provision rules and steps for guest user authentication

Full stack control and visibility

- Monitoring for coverage, capacity, and availability SLAs
- Essential insights on system, user, device and app health
- Device profiling data, real-time tests, wireless IDS and more

Nile Copilot for End Users

With a personalized snapshot of the network status and performance, Nile Copilot also provides end users the ability to validate their service quality and accomplish much more:

- Allow users to test the performance of their devices and popular enterprise apps
- Keep users informed about network, Internet and popular cloud app availability
- Enable users to self-diagnose the quality of their connectivity and compare with others
- Allow users to submit IT tickets with a snapshot of their location and test results
- Enable users to onboard IoT devices and provide network access credentials for guests

Personalised View Into Service Quality with the Nile Copilot for Users

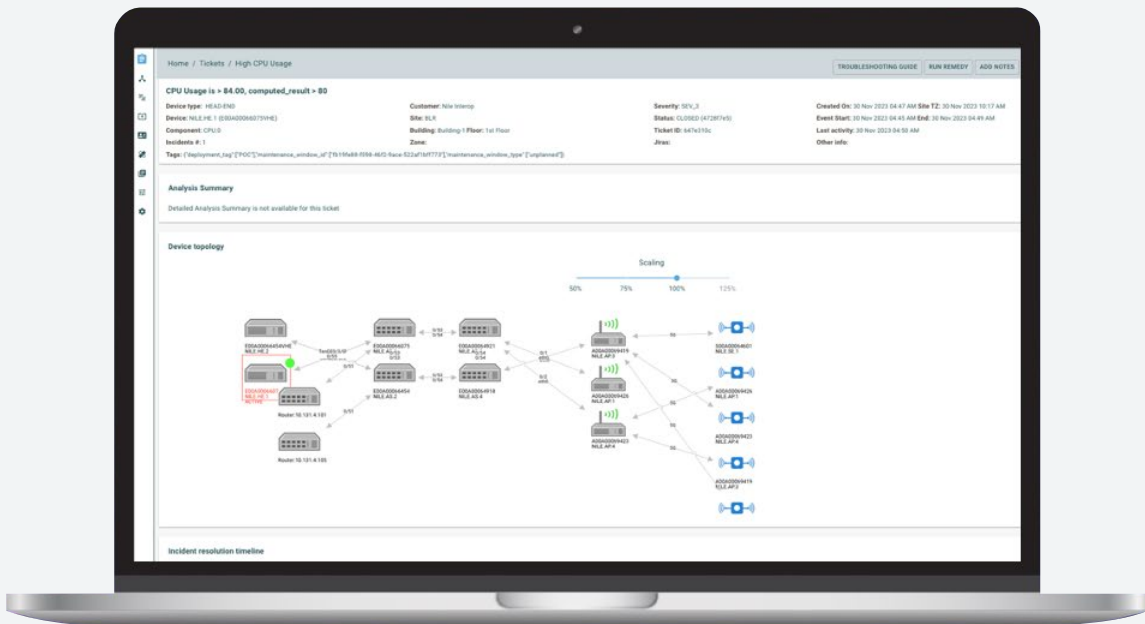


Nile Autopilot

Taking advantage of the same integrated data model within the Nile Services Cloud, Nile Autopilot is designed for Nile production engineering and customer success teams to automate traditional enterprise network operations.

With Nile Autopilot, network operations center (NOC) functions are offloaded, enabling IT teams to focus on critical IT initiatives that deliver higher ROI - compared to manual workflows for network maintenance and troubleshooting.

Automate and Offload Network Operations with the Nile Autopilot



Offload day -1/0 operations

- Automate network topology and bill-of-material creation
- Manage work orders to Nile partners for on-premises install
- One touch install and cloud-based activation of all elements

Offload day 1/N operations

- Validate installs in real-time given standardized system design
- Automatically visualize current on-premises system install
- Drive root cause analysis with automated support tickets

Offload system maintenance

- Predict potential software issues with automated resolution
- Orchestrate software release and security patch updates
- Automate network moves/adds/changes and refresh

Recap: Nile AI Applications

To see both Nile Copilot and Nile Autopilot applications in action, make sure to check out our [on-demand webinar, Nile Discovered](#). In this webinar we run through a total of 8 demonstrations that cover the following use cases:

- Nile Copilot to orchestrate wired and wireless network activation and setup
- Nile Copilot to craft zero trust network segments for policy enforcement
- Nile Copilot to gain complete visibility to user, device and app experiences
- Nile Autopilot to enable deterministic design & install with closed loop automation
- Nile Autopilot to enable predictive maintenance for wireless coverage issues
- Nile Autopilot to enable predictive maintenance for wired link issues
- Nile Autopilot to automatically detect and resolve software issues in network elements
- Nile Autopilot to fully automate software upgrades across the Nile Access Service

Bringing the power of Nile Access Service to light, Nile AI Applications pack a punch in its ability to drive outcomes across the enterprise wired and wireless network - while providing radically simple and intuitive interfaces for IT admins, their end users and Nile production engineering teams.

At the heart of their operation lies the power of the Nile Services Cloud, automating traditionally manual network operations across the Nile Service Block installations.





nile

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