zpe® CASE STUDY

Upholding 99.999% Uptime for a Top-10 Engineering School

Providing low-level remote access and automation saves hundreds of hours per month for the university's small IT team

One of the largest universities in the United States fosters academics and research for nearly 40,000 students, staff, and researchers. The university sits among the top 10 schools for engineering, and heavily integrates technology into all disciplines, including engineering, computer sciences, and agricultural studies.

The university received a grant to expand, update, and connect their network of campuses, while enhancing infrastructure and mobility, resiliency, and campus amenities. But having more than 200 on-campus buildings presents a challenge. The campus is home to academic facilities as well as a hospital, airport, 60,000-seat sports stadium, and dozens of leased spaces for local businesses. This makes the university equivalent to a small city, and its network infrastructure is what keeps it all connected.

Their small IT team was responsible for maintaining more than 10,000 management devices, most of which were long past EOL and frequently failing. They needed a refresh, but with a solution that could also reduce the hundreds of hours they spent every month on travel and on-site work. To maximize their day-to-day efficiency, they required a solution that could overcome these operational gaps:

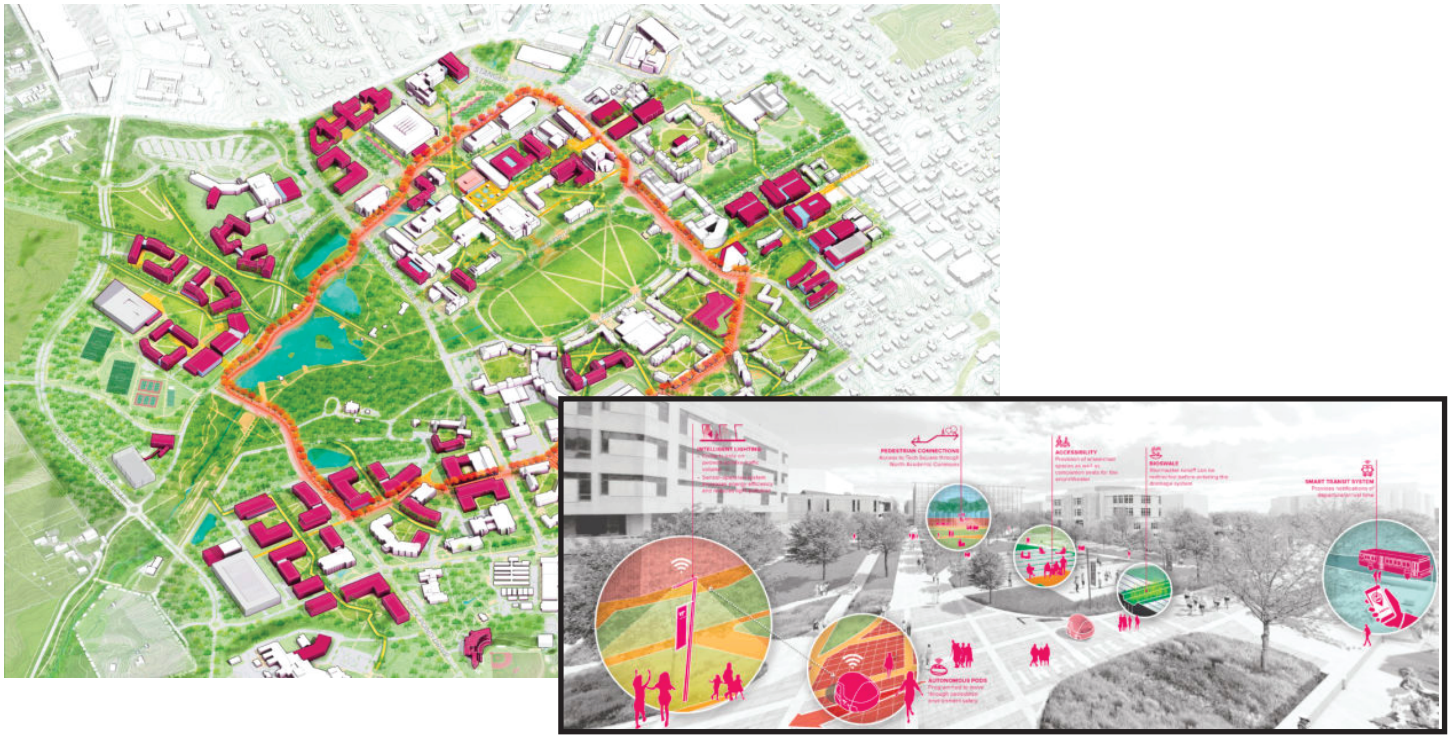
- Reducing the 100-150 hours of monthly travel times, by giving engineers the ability to fully access their stack remotely
- Reducing the 80-120 hours of monthly on-site work required to maintain the 99.999% SLA, by automating manual jobs such as patching and firmware upgrades
- Expanding their management headroom and use-case adaptability, by migrating to IPv6 and reducing the existing 6RU device stack

Read on to see how Nodegrid hardware and software solved these problems.

Background

The university is one of the largest in the United States. It sits among the nation's top 50 schools for research expenditures, and heavily integrates technology into all disciplines, including engineering and agriculture. The university serves more than 35,000 students, along with thousands of faculty members and researchers.

To cater to these students and staff, the university's main campus is home to more than 200 buildings that sit on over 2,500 acres of land. These buildings include research labs, study halls, and dormitories, as well as a hospital, airport, and 60,000-capacity sports stadium, in addition to leased spaces for local shops and businesses. Adjacent to campus is a nearly 2,000-acre agricultural research farm where crop studies and experiments take place.

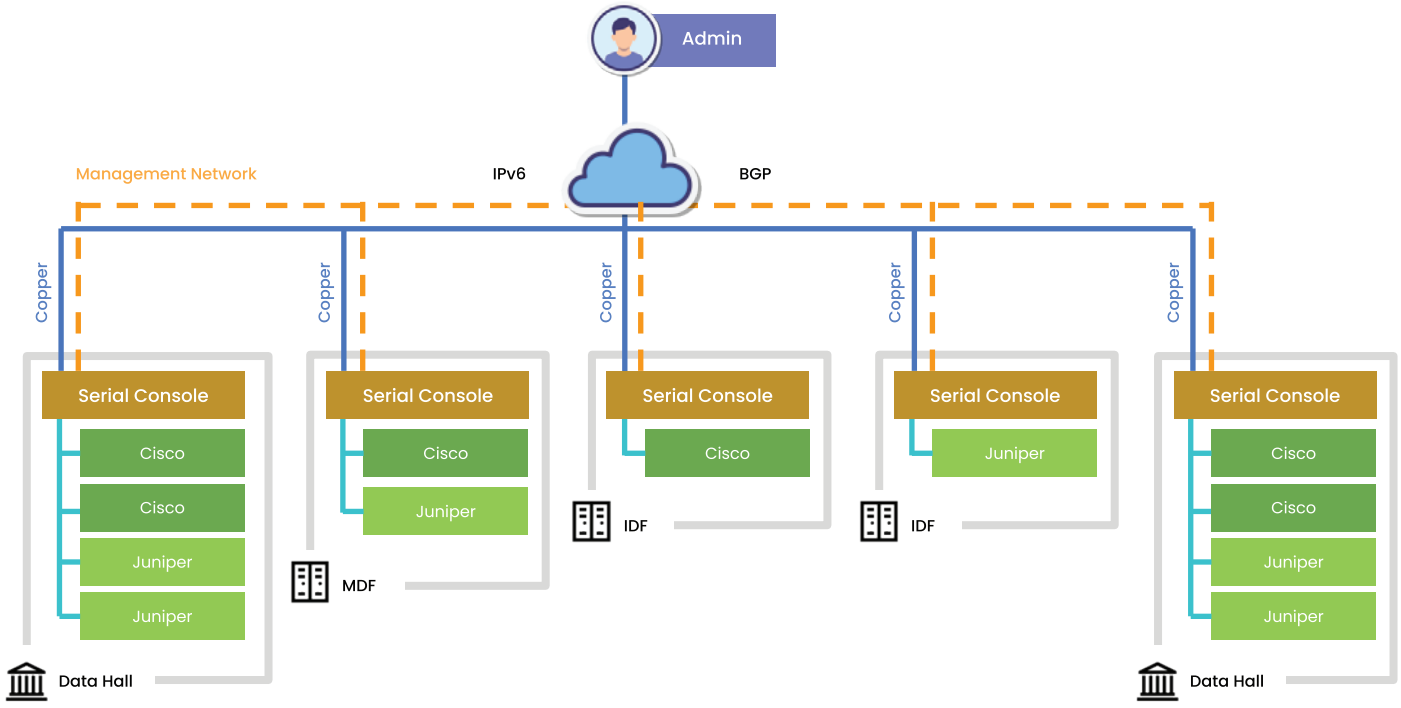


This wide footprint essentially makes the university its own city, and its network infrastructure bears the burden of keeping it all connected. This was proving to be a challenge as the university's equipment began to show its age and required too much attention from the small IT team.

Problem and Gaps

Part of the university's mission is to improve the quality of life for people around the world, by turning students into problem-solvers. Their technology-integrated academics and research fostered this goal. Their aging network management infrastructure, on the other hand, was on the brink of collapsing connectivity for everyone. This would have devastating consequences, as it would bring everyday academics, valuable research activities, and on-campus commerce to a halt.

It was time for the university to improve the quality of life for its own students, faculty, and businesses. Their IT teams were all too familiar with the overarching problem: their management infrastructure was well beyond EOL — it was in disrepair and in need of a refresh.



Being a forward-thinking university, they didn't want to simply replace their existing equipment with updated gear and inevitably face the same problem in years to come. Instead, they wanted to lay a foundation that could take them well into the future and allow them to use emerging technologies, including automation.

This required them to overcome three significant gaps.

Gap 1: Inefficient Management at Scale

In addition to its data centers and remote sites, the university is home to more than 200 buildings that hold hundreds of MDF and IDF closets. To manage these closets and connected devices, each engineer spent an average of ten hours per month on travel alone. This meant their 10-15 engineers were losing 100-150 hours every month to traveling, on top of fuel costs.

Gap 2: Too Much Focus on Operations

The university's serial consoles and other management devices were well past EOL and constantly in need of maintenance, troubleshooting, and repair. Teams needed specialized knowledge to keep each device in working order, and were also under pressure to frequently patch and update these devices to combat the growing threat landscape. Coupled with their infrastructure's lack of support for automation, these factors put in jeopardy the university's five-nines SLA (99.999%) and required each engineer to perform manual, on-site work for an average of eight hours per month (80-120 hours collectively). By having to focus too much of their efforts on operations, teams were unable to quickly respond to support tickets and feature requests from users.

Gap 3: Too Many Devices

The campus is essentially a small city, and the university's network infrastructure is made up of roughly 10,000 devices that are exposed to the Internet. These include switches, routers, servers, Wi-Fi access points, IoT/OT, and more. But their existing out-of-band infrastructure only supported IPv4. New users and devices were coming online, but the university had little room for expansion and was within months of exhausting available IP addresses. Their management stack was too large, as it required separate devices for out-of-band, cellular failover, firewall, routing, and switching. Not only was this using valuable IP, but it was also too rigid to fit in space-constrained locations.

The theme for the university was scale and diversity of implementations. Because they had such a large network to serve as well as a variety of networking use cases, filling these gaps would require a solution that could:

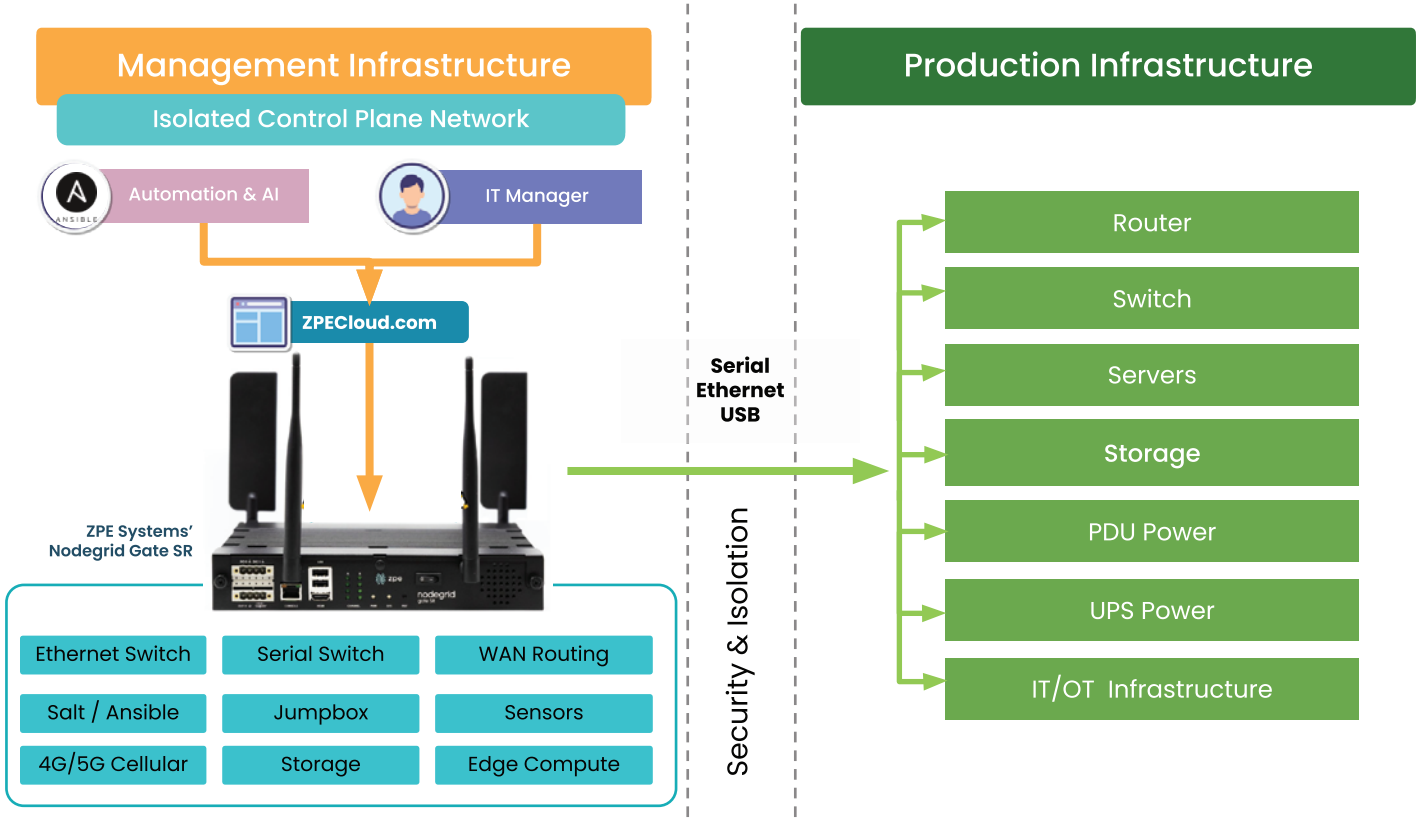
- Allow teams to access and manage at least part of their stack from a central location, without having to frequently dispatch on-site teams
- Eliminate the need for specialized knowledge and manual work, to help teams reduce the time required just to keep the lights on
- Support IPv6 and a variety of network functions, to ensure more than adequate IP headroom and deployment flexibility

Solution

The university deployed the full family of Nodegrid devices across their campus. In data center locations, they used the Nodegrid Serial Console (NSC) family, and for remote locations they used the Nodegrid Services Router (SR) family. The SC family provides high density serial ports for out-of-band management at scale. The SR family includes the Net SR, Gate SR, Bold SR, and Link SR, which provide WAN and LAN Ethernet and 4G/5G connectivity for remote locations, and collapse six devices into one to address space and power constraints at each MDF/IDF.

This solution filled the shortcomings of their existing infrastructure and aligned with the university's forward-thinking mission. Nodegrid laid the foundation for IT teams to solve their underlying problem, and also delivered additional capabilities — including automation — that would help them improve the campus-wide quality of life well into the future.

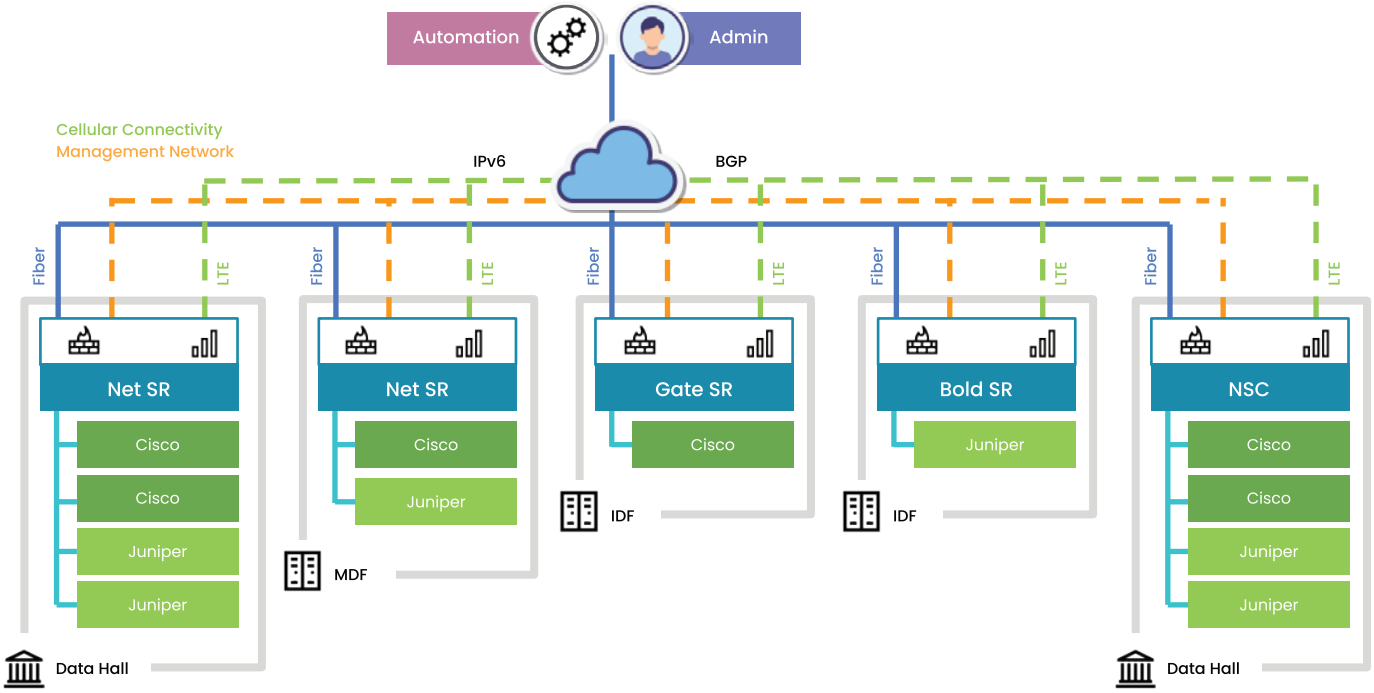
Their deployment includes a separate management network that is completely independent and isolated from the production infrastructure. This best practice is illustrated in the diagram below. On the right side is the production infrastructure that carries all the traffic (bits and bytes); on the left side is the isolated out-of-band management network. This separate control plane can be used for IT administration and also to execute automation scripts. This separation helps them quickly repair and patch production infrastructure — without the anxiety of breaking things — and also recover to the last-known good configuration in case of bad patches.

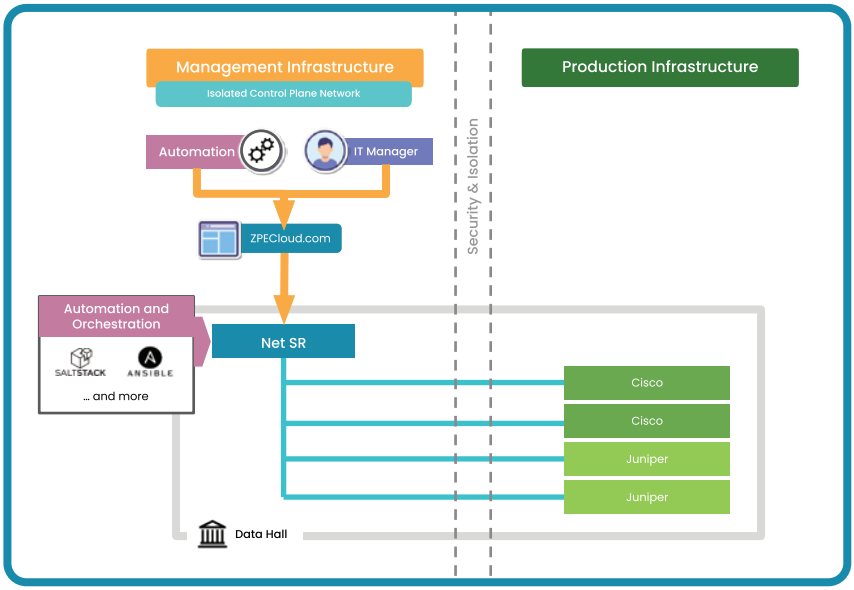


Here's a snapshot of the Nodegrid hardware and software they deployed:

Nodegrid Serial Console Plus

The Nodegrid Serial Console features up to 96 serial ports in a 1RU form factor. This maximizes management access while minimizing the device footprint, which is ideal for the university's data center operations where space must be used efficiently. It also features two SFP ports and additional USB ports for managing local network devices, and cellular and Wi-Fi capability that provide backup connectivity for management and production networks.





Zoomed View

Separation of Management Infrastructure and Production Infrastructure for security, isolation and fast remediation

Nodegrid Net Services Router

Nodegrid Services Routers come in various form factors up to the 1RU Net SR. The Net SR is a modular device that can be outfitted with up to five expansion cards for management, networking, cellular, computing, and storage, which allows teams to tailor the device exactly to their use case. The university deployed the Net SR in converged branch and MDF locations, including at their hospital, airport, stadium, and large buildings on campus.

Nodegrid Bold SR, Gate SR and Link SR

The Nodegrid Bold SR, Gate SR, and Link SR are incrementally smaller than the Net SR, but feature multiple serial and ethernet interface types, and cellular/Wi-Fi connectivity. The university deployed these devices at their space-constrained remote branch, MDF/IDF, and edge locations, including in research labs, dormitories, agricultural sites, and IoT/OT sites.

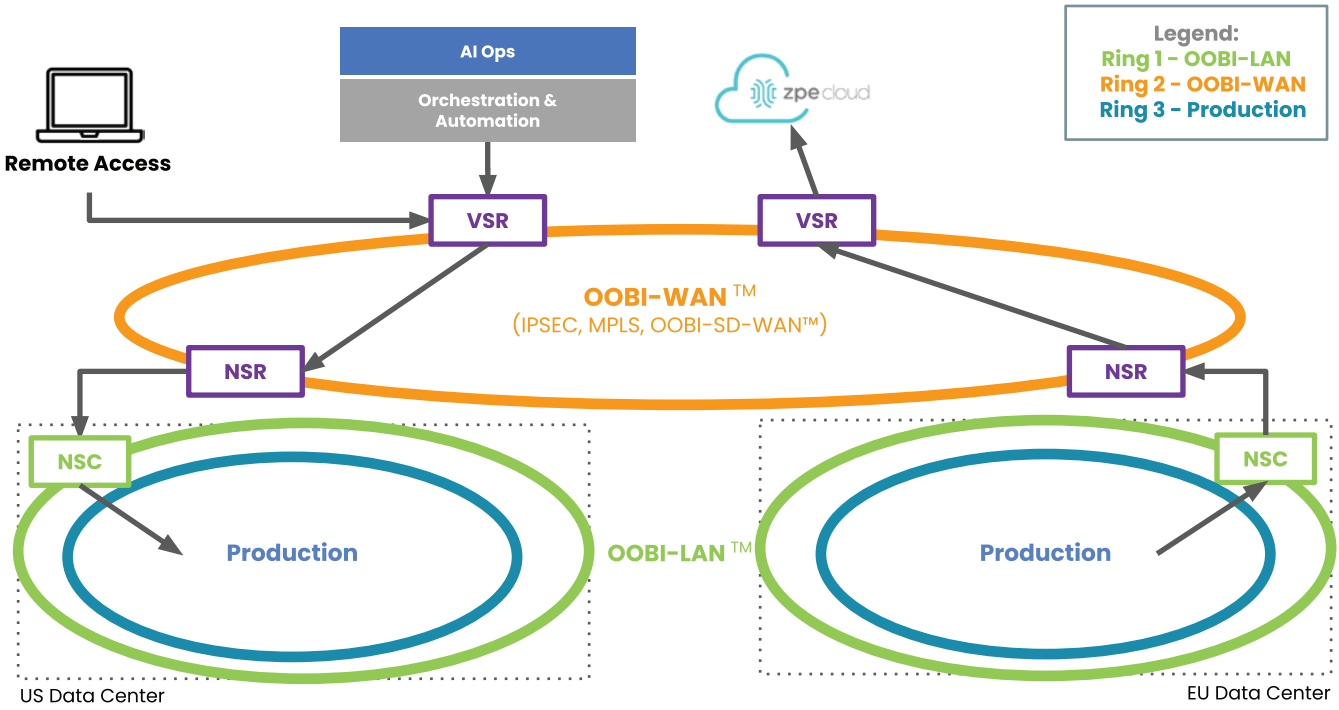
Nodegrid OS

At the heart of the solution is Nodegrid OS. This Linux-based operating system comes standard on all Nodegrid devices, and allows teams to overcome the vendor lock-in limitations of typical infrastructure solutions. Nodegrid OS enables out-of-band management for all connected devices, features a hypervisor for running containers and VMs, and accommodates any automation and orchestration solutions. Paired with the Intel CPUs onboard Nodegrid devices, Nodegrid OS allowed the university's IT teams to gain centralized remote access to their infrastructure, consolidate many functions (out-of-band, cellular, SD-WAN, security/NGFW) into one appliance, and automate Day 0 to Day 3 operations, all on a system that fully enables IPv6.

ROI and Benefits

With scale and use-case diversity dictating the deployment, Nodegrid was the university's solution that they could flex into every data center, research lab, dorm room, and agricultural site, as well as into every critical infrastructure location including the hospital, airport, stadium, and even the president's remote office. The modular, multi-function hardware and open Nodegrid OS provided:

- Centralized access to all connected infrastructure, regardless of vendor, for ease and consistency of management
- Integration with third-party and custom automation solutions, for zero touch provisioning and automated operations
- Full IPv6 support and integration of in-band and out-of-band features, including virtualization, to maximize IP headroom and minimize device sprawl



Prior to Nodegrid, the university's small IT team had no means of remotely accessing and managing their infrastructure. Their device stack was large, non-integrated, and well past its EOL date. Engineers were constantly on call, and were often needed in many places around the clock. They spent more than 200 hours every month traveling and performing manual, specialized work just to keep operations on the cusp of their 99.999% SLA requirement. And despite their careful management of IP addresses, their management infrastructure only supported IPv4 and would soon be incapable of accommodating new users and devices.

As they deployed Nodegrid, they immediately came into operations that were a far cry from their usual experience of juggling manual, time-consuming jobs across campus. Nodegrid aligned with their problem-solving philosophy to help them quickly realize the following results and benefits:

- One-hour travel times — Nodegrid's remote access granted engineers the ability to perform low-level tasks within all connected devices, meaning that they could simply log into their web browser to gain instant access to their infrastructure, which practically eliminated travel times.

- One hour on-site — Because Nodegrid enables low-level access to connected equipment and supports automation, the only on-site work necessary involved connecting cables, as engineers could automatically apply config updates, install patches, and remediate common operational issues.

- 6-to-1 device reduction — Nodegrid's extensibility, both of software and the hardware itself, allowed the university to reclaim up to 5RU in various locations, as they hosted routing, cellular, switching, firewall, out-of-band, and jump box tools on a single Nodegrid device.

- Unlimited growth — Nodegrid fully supports IPv6, which means the university no longer needs to worry about whether they'll have room to bring new users and devices into their management network.

- Ongoing time and cost savings — Nodegrid enables automation across environments and vendor devices, which allows the IT team to work toward lights-out management and save additional time and money on operations.

Nodegrid's centralized remote access and management capabilities reduced the IT team's monthly travel times to one hour per engineer. This near 10x savings is possible through what's called the Double-Ring Architecture, which surrounds production infrastructure with out-of-band control planes for both the LAN and WAN. From the NOC, engineers can use their web browser to securely access and control their production and management infrastructure, whether they need to cycle power for a hanging server or completely rebuild devices using a golden image. The only time engineers need to travel is when network cables are accidentally unplugged, or when hardware needs to be replaced/installed.

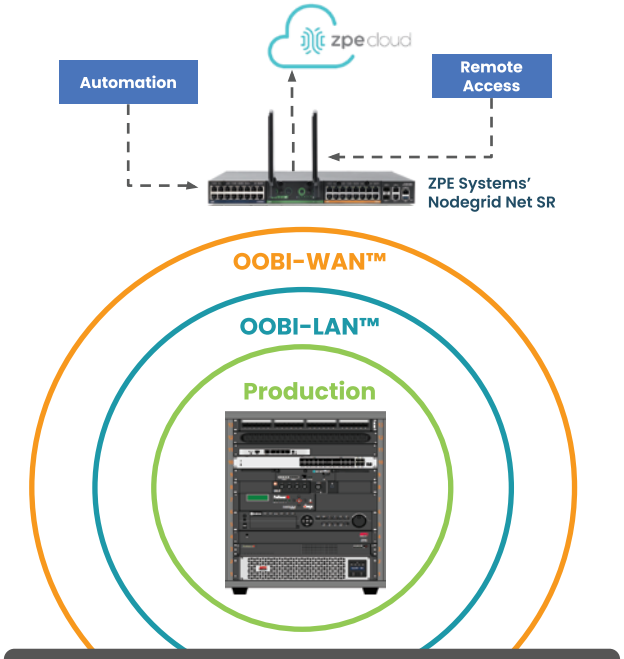


Image: OOBI-LAN and OOBI-WAN control planes are the Double-Ring Architecture, which allow for isolated control and automation of production and management equipment.

As for on-site work and ongoing operations, each engineer now spends only one hour on-site every month. With Nodegrid able to connect to many types of endpoints via serial, ethernet, or USB — and Nodegrid OS's ability to push automation scripts to legacy and otherwise unsupported device types — the only on-site work needed is physical device installation. From there, Nodegrid devices establish a secure Internet connection, retrieve config files, activate licenses for hosted services, and fully build environments. This enables true zero touch provisioning and maintenance. Engineers can automate patching and updating, so they can comfortably uphold their 99.999% SLA and focus on optimizing digital services for university patrons.

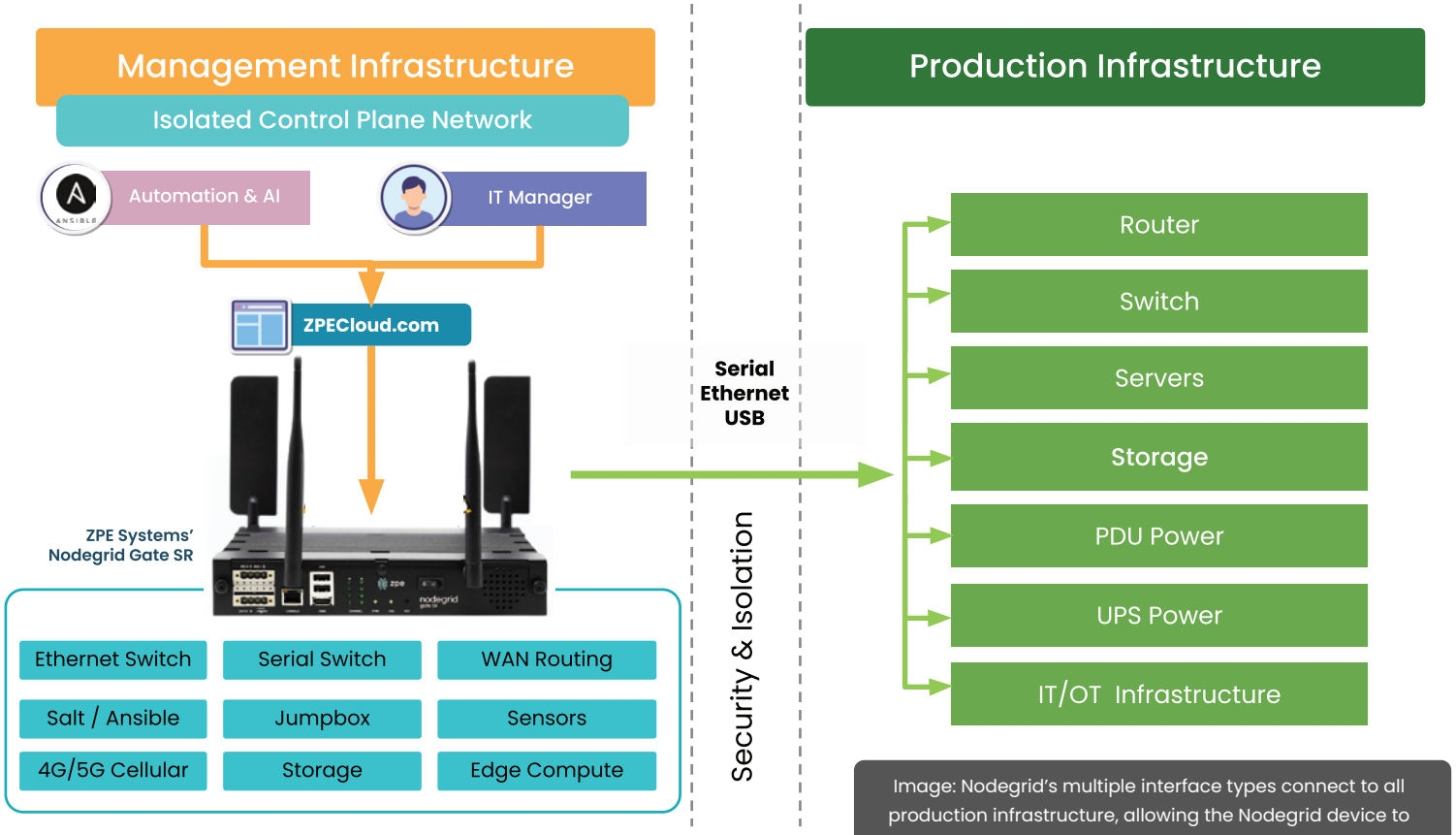
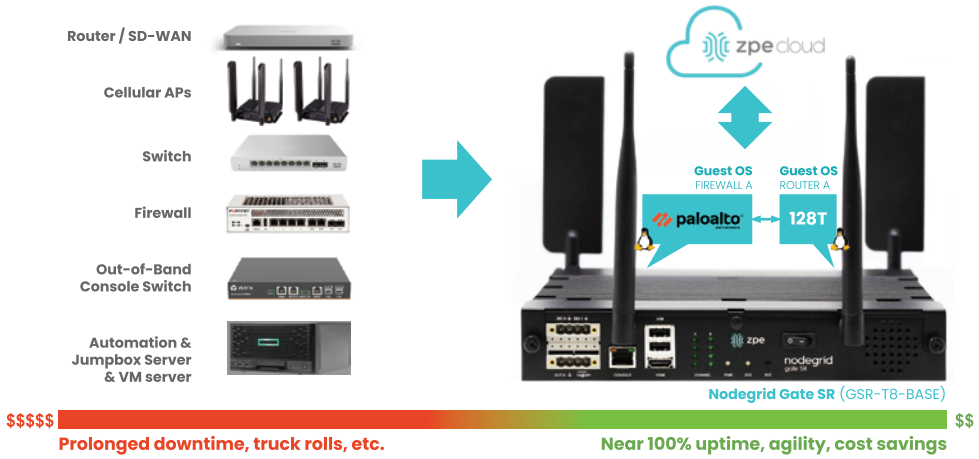


Image: Nodegrid's multiple interface types connect to all production infrastructure, allowing the Nodegrid device to push automation scripts to target devices.

The IT team used Nodegrid to cull their management stack, which had previously required separate devices for routing, cellular, switching, firewall, out-of-band, and jump box tools. The modular Net SR allowed them to tailor port counts and types (up to 96) for larger sites such as the hospital, airport, and stadium, while the rest of the SR lineup was deployed throughout MDFs, IDFs, and remote locations. These devices packed all 6RUs' worth of capabilities from their previous stack into a 1RU or smaller Nodegrid appliance, which saves power and cooling costs, as well as rack space. Nodegrid also provides plenty of leftover computing power and onboard resources for running additional functions. This allows their agricultural site, for example, to run data thinning of crop yield information, or their hospital to integrate AI for improving patient care.

Image: Nodegrid devices consolidate many functions into a 1RU or smaller appliance.



With the university continuing to expand its management network, Nodegrid provides them with crucial IPv6 support and automation. IPv6 provides plenty of room for thousands of additional devices that can help improve life for those on campus — from adding Wi-Fi access points for more connectivity, to IoT cameras and devices for security, to OT sensors for collecting more valuable engineering and agricultural data. Nodegrid's support for automation also enables the university's IT team to extend their capabilities without expanding their headcount, so they can build more automated processes and achieve a lights-out approach to keeping operations running.

ZPE Systems' Nodegrid lays the foundation for flexible network management, so IT teams can solve existing problems and enable themselves for the future of automation and AI. Large and small institutions around the world are realizing that improving their own quality of life has a network effect for those they serve, both on and off campus.

Visit our **Network Automation Blueprint** page to get your copy of the reference architecture used by the university, and set up a **Nodegrid demo** to walk through your digital transformation.