# Network Installation at [redacted]

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## Summary

[redacted] is a manufacturing company that develops accessibility products for children and adults with disabilities. Established in 2013, [redacted] has been manufacturing sensory products for those who have been diagnosed with Autism Spectrum Disorder. Due to the recent popularity of their gel water bead and weighted blanket products, demand for these products has increased dramatically. Unfortunately, their manufacturing facility had been struggling to keep up with production. The manufacturing facility had been experiencing unreliable network connectivity within the plant, which had caused an increase in work backlog and overtime for facility employees. The manufacturing delays had unfortunately trickled down to the customers who rely on these products in the form of slower fulfillment and shipping times. This in turn had caused lost revenue and potential future customers to seek out [redacted] for their sensory-related products.

[redacted] completed construction on a new manufacturing facility in 2021. The new facility houses newer manufacturing equipment that required network connectivity for many of its production processes. Manufacturing processes were being delayed due to the aging and inadequate network infrastructure. A new secure and robust wired and wireless network was needed to help increase the efficiency of production by enabling facility managers to adjust production output on the fly, eliminating the need for manual intervention and increasing overtime for employees. An updated network infrastructure led to faster fulfillment times, which led to happier and repeated business from customers.

[redacted] utilizes Cisco networking equipment in their network environment at their corporate office along with the manufacturing and distribution center. The company has been happy with the Cisco product line and continues to use its technologies in the new

manufacturing facility. The new facility utilizes the Cisco Catalyst 8300 series edge router to use as the Wide Area Network (WAN) connection to the geographically separated locations at [redacted] The Local Area Network (LAN) switches that were implemented in the new facility are the Cisco Catalyst 9200 series switches. These switches ensure a highly available, secure, and fast connection with network devices within the manufacturing facility. Cisco Meraki MR wireless access points are the wireless technology that has been installed in the facility. These wireless access points feature wireless mesh technology that is self-healing so that the signal will adjust to ensure full coverage of the manufacturing facility.

The implementation of the network infrastructure at the new manufacturing plant began with a site survey conducted by two third-party vendors. AT&T is the network provider for [redacted] and verified a location for the network connection to be installed at the facility. [redacted] a local network services provider, conducted a wireless site survey along with a wired cable site survey, to identify locations for wireless access points locations and physical cabling wiring locations. [redacted] provided the network engineering team at [redacted] with a recommended equipment list to purchase. The network engineering team is comprised of one senior network engineer and two junior network engineers. They were responsible for the ordering, configuration, and testing of network equipment both before and after installation at the new manufacturing facility. AT&T was scheduled for installation of the network connectivity and [redacted] conducted the wiring of the network cabling throughout the facility. After the cabling was tested and verified, the network engineering team from [redacted] installed network equipment in the facility. A physical and logical network map was created for the new facility. Connectivity testing of the installed network equipment and performance monitoring started after the

installation. After two weeks of successful monitoring of the network equipment and meeting project objectives, the project was considered successful and complete.

## Review of Other Work

### Review 1

Mitsui Knowledge Industry Co., LTD (MKI) is an IT services company based in Tokyo, Japan. MKI was finishing the construction of a new headquarters building in February 2020. The current headquarters building was running into network connectivity issues from their remote locations, which had limited data transfer and video conferencing capabilities. With the WAN (Wide Area Network) they were using before, network delays were notable due to a number of branches connected to the network and the communication quality problems specific to countries or regions (Cisco, 2021). MKI was committed to providing a secure and robust network that would be scalable with the new headquarters and remote facilities around the world. To solve this problem, MKI implemented Cisco routers employing Multiprotocol Label Switching (MPLS) technology and noticed an immediate improvement in their worldwide communications ability.

> Today, MKI has fulfilled the SLA (Service Level Agreement) covering their business requirements by leveraging Multiprotocol Label Switching (MPLS) and the Internet lines while enabling efficient management of performance and security through the overlay network constructed on the WAN (Cisco, 2021).

[redacted] was looking to solve a similar problem as MKI by incorporating their new manufacturing facility with their current WAN architecture. By installing the Cisco Catalyst 8300 Series Router and MPLS at their new manufacturing location, [redacted] has observed a drastic improvement in connectivity. The faster, reliable, and more

secure WAN connection has enabled [redacted] to increase production and employ new product development processes leading to reduced manufacturing costs.

**Review 2**

The Institute of Education based in Dublin, Ireland, is one of the largest private schools in Ireland. During the COVID-19 pandemic in 2020, the Institute of Education was looking for a fast and secure way to provide remote learning to students during the lockdown. They quickly realized that their current network infrastructure would not be able to handle the influx of connections required by remote learning. The Institute of Education turned to Cisco Catalyst switches to solve this problem.

> One of the biggest concerns at the beginning of the process was the security of our students, staff, and network. We also needed a network that could handle simultaneous live streaming of classes. We knew we needed to upgrade the core wired network, so we selected Catalyst 9200 and Catalyst 9500 switches (Toole, 2021).

Once classes began again in August 2020, the Institute of Education was more than prepared to handle the remote learning of over 1,000 students. The new Cisco Catalyst 9200 Series switches easily handled the demand of live-streaming and remote classes that were conducted over the new infrastructure.

On the very first day of class, everything ran exactly as planned. Now, there can be 1,250 active users on our new, high-capacity network. We have 900 hours of classes being streamed and recorded each week, which is a huge achievement. At the end of our first academic year following the deployment of our new infrastructure, we have had zero outages. We've received great value from the stability of the solution, which was deployed under pressure with minimal time for testing (Toole, 2021).

Much like the Institute of Education, [redacted] was looking for a secure and robust network infrastructure to be installed at their new manufacturing facility. Since installing the Cisco Catalyst 9200 Series switches at their new facility, [redacted] has immediately observed the high availability of their network equipment. This has allowed the company to continue production deadlines and meet the high product demand by its customers.

**Review 3**

SAS International is a leading British manufacturer of metal ceilings and architectural metalwork based in Reading, United Kingdom. SAS International operates three manufacturing facilities throughout the UK and was dealing with an aging network infrastructure that was having continuous wireless connectivity problems.

> The factories and warehouses are challenging wireless environments, not only due to the physical structure of the buildings but also due to the metal ceilings being manufactured and the extensive machinery in use (Warren, 2021).

SAS international found a solution to their wireless connectivity issues by deploying Cisco Meraki wireless access points in their manufacturing locations. They noticed an immediate benefit of upgrading the wireless infrastructure. The robust wireless infrastructure is changing the manual printing and checking of stock by enabling handheld scanners and creating a more efficient and cost-effective product flow. (Warren, 2021).

[redacted] are operating in a similar manufacturing environment as SAS International. Since installing the Cisco Meraki wireless access points in their new manufacturing facility, [redacted] has been able to increase manufacturing capabilities despite the number of machines running constantly throughout the facility. The Cisco Meraki wireless access points have been able to automatically adjust the wireless signal

strength throughout the facility which eliminated any dead zones to enhance the productivity of their employees.

## Changes to the Project Environment

[redacted] originally had three locations: the corporate office, the first manufacturing facility, and a distribution center. The main IT infrastructure is housed at the corporate office, with a private AT&T MPLS connection between all three facilities. The wired and wireless network infrastructure had been refreshed with newer Cisco Systems equipment within the past two years at the corporate office and the distribution center. The wired and wireless network in the first manufacturing facility had not been upgraded because of the increase in the tempo of operations and the inability to properly troubleshoot problems due to product demand. Construction on the new manufacturing facility was completed and new manufacturing equipment was installed in the building. With the completion of this project, a new network infrastructure had been installed in the new manufacturing facility.

The first manufacturing facility ran into problems fulfilling the demand for new orders due to the aging manufacturing equipment and network infrastructure products that were approaching end of life. The addition of manufacturing equipment over the past 3 years without taking the current network infrastructure capabilities into account had proven costly to [redacted] With sporadic and, at times, unreliable network connectivity inside the facility, the production manager had been unable to adjust product flow in demand with past orders. This had caused a work backlog and increased overtime for facility employees. This also has meant product shipments to the distribution center had been postponed, which meant timing for orders to the customer had also been delayed. While not a large percentage of customers had canceled orders, the shipping time of the products has been a chief complaint.

Once the new network was installed, [redacted] observed an immediate change in speed and reliability in the new facility. The installation of the new Cisco router, along with the new MPLS circuit, enabled fast connectivity to all [redacted] locations. This enabled the product design engineers to send large files involving product changes to the manufacturing facility more efficiently. The new Cisco switches that were installed considerably increased the reliability of the network, which enabled the manufacturing machines to increase the output of products while reducing the need for human intervention. The new Cisco Meraki wireless access points installed in the facility allow highly available network connectivity throughout the manufacturing floor, which had been an issue in the previous facility due to the high concentration of manufacturing machines producing wireless interference. This has all been eliminated due to the mesh technology applied in the wireless access points.

The new network infrastructure in the manufacturing facility had several positive short and long-term effects for [redacted] In the short term, the robust network connectivity throughout the facility helped increase the efficiency of production operations. This improved the current product manufacturing times along with reducing the amount of employee overtime needed to fulfill orders. In the long-term, the production manager was able to adjust the production on-demand and with confirmation that the changes have been properly applied. The new network helped cut production and employee costs, improved morale for employees, and achieved faster fulfillment times for the customer.

## Methodology

The ADDIE methodology was implemented as the main process for project management in the new network installation. ADDIE is an acronym for Analysis, Design, Develop, Implement, and Evaluate. Each phase of the process perfectly aligned with the requirements

that were needed for the successful network infrastructure installation at the new manufacturing facility at [redacted]

**Analysis**

The analysis phase began with a site survey of the new manufacturing facility. Two separate companies conducted surveys of the building. AT&T surveyed and successfully identified a suitable location for the installation of the primary WAN (Wide Area Network) connection serving the facility. [redacted] determined the interior cabling and wireless access point locations and finalized the equipment requirements for the 6 IDF and MDF locations. [redacted] provided an equipment purchase list to the network engineering team at [redacted] The purchase list included a Cisco Catalyst 8300 Series router, 7 Cisco Catalyst 9200 Series switches, and 25 Cisco Meraki MR Series wireless access points. [redacted] determined that these network devices would meet or exceed the requirements at the new manufacturing facility.

**Design**

The design phase was completed by the network engineering staff at [redacted] The senior network engineer oversaw this phase of the project but allowed the two junior network engineers to take the lead in designing the new network. The junior network engineering team ordered and received the network equipment and set a plan for configuration. The junior engineers mapped out the IP addressing and VLAN plans to incorporate into the configuration plan. The site survey conducted by [redacted] identified the physical locations for all the networking equipment to be installed.

**Develop**

The development phase started with the network engineering team configuring the network equipment. The latest firmware was installed on each network device. IP addressing and VLAN implementation of each network device was conducted. After configuration was completed, the network engineering team connected each network device in a lab environment. The network engineering team was able to successfully connect to each device, as they were to be implemented and installed at the new manufacturing facility.

**Implement**

The implementation phase began with [redacted] arriving at the new facility and installed the physical hardware in the MDF and all 6 IDFs. [redacted] ran network cabling throughout the facility and ensured each cable was verified and tested. AT&T arrived on site and installed the MPLS WAN connection to the building. After those steps were completed, the network engineering team from [redacted] arrived on site and installed the router, switches, and wireless access points throughout the facility.

**Evaluate**

After the installation of the network equipment and WAN connectivity at the manufacturing facility was complete, the network engineering team began the evaluation phase of the project. The network engineering team verified wireless connectivity throughout the facility and ensured coverage is sufficient for wireless device use. The phone and data network connectivity locally and to remote sites was tested and verified for speed and stability. VLAN data security and access were tested and verified that there was no cross-VLAN network traffic. When the evaluation phase was completed, a physical and logical network map was created for any troubleshooting issues that may arise in the future. Network monitoring was conducted for two weeks after the physical installation had been completed.

Project Goals and Objectives

| | Goal | Supporting objectives | Deliverables enabling the project objectives | Status |
|---|---|---|---|---|
| 1 | Install network infrastructure at the new manufacturing facility | 1.A. Conduct Site Survey | 1.A.i. MDF/IDF locations identified | **Complete** |
| | | | 1.A.ii. Wireless Access Point locations identified | **Complete** |
| | | | 1.A.iii. Network Cabling Locations Identified | **Complete** |
| | | | 1.A.iv. Recommended Equipment identified to be purchased | **Complete** |
| | | | 1.A.v. AT&T Verifies Internet/WAN install location inside MDF | **Complete** |
| | | | 1.A.vi. AT&T and [redacted] to be scheduled for a future installation date | **Complete** |
| | | 1.B. Configuration and testing of equipment | 1.B.i. Order and Receive network equipment | **Complete** |
| | | | 1.B.ii. Configure Router, Switches, and Wireless Access Points | **Complete** |
| | | | 1.B.iii. Test and validate configuration | **Complete** |
| | | 1.C. WAN/LAN Cabling Installation | 1.C.i. Installation of MDF/IDF hardware | **Complete** |
| | | | 1.C.ii. AT&T Cabling/Equipment installation and testing | **Complete** |
| | | | 1.C.iii. Network Cabling installation and testing on-site and in MDF/IDF/WAP locations | **Complete** |
| | | | 1.C.iv. Test and validate cabling installation | **Complete** |
| | | 1.D. Installation and monitoring of equipment at facility | 1.D.i MDF Router and Switch Installation | **Complete** |
| | | | 1.D.ii. IDF Switch Installations | **Complete** |
| | | | 1.D.iii. WAP Installation | **Complete** |

| | | | | |
|---|---|---|---|---|
| | | | 1.D.iv. Verify connectivity for WAN/WLAN/LAN and VLANs | Complete |
| | | 1.E. Finalize install | 1.E.i. Create Logical and Physical Network Map and Label devices | Complete |
| | | | 1.E.ii. Monitoring of network | Complete |

The primary goal of this project was to implement a state-of-the-art network infrastructure at [redacted] newly constructed manufacturing facility. The new network infrastructure now supports data and voice capabilities throughout the manufacturing floor and office area, along with wireless support for both corporate users and visitors or vendors who visit the facility. This network also supports internet access and Wide Area Network (WAN) Multiprotocol Label Switching (MPLS) connectivity back to the corporate office, the new manufacturing, a second manufacturing facility, and the main distribution location for interconnectivity between sites.

The first objective was to have a site survey conducted at the manufacturing location. The Wide Area Network (WAN) site survey was conducted by AT&T. AT&T is the Internet and MPLS provider for all [redacted] locations. AT&T identified the location for the Main Distribution Frame (MDF) and ensured proper cabling to their network was installed. The manufacturing facility site survey was performed by [redacted] which had conducted cabling, installation, and wired/wireless site survey services for [redacted] in previous projects. Network Engineers from [redacted] worked closely with personnel from [redacted] throughout the site survey process. [redacted] identified locations for all 6 Intermediate Distribution Frames (IDFs) and cabling requirements. The wireless site survey identified optimum location placement and antenna types for the

Wireless Access Points (WAP) that were installed throughout the facility. Locations for network cabling within the manufacturing and office areas were identified. After the site survey was completed, [redacted] provided a recommended equipment purchase list for the network installation, which was procured locally by [redacted] through CDW. A completed site survey and an equipment purchase list were provided by AT&T and [redacted] at the end of this phase.

The second objective was to order, configure and test the new router, switches, and wireless access points for the new facility. The configuration of the new equipment was conducted by the network engineering team at [redacted] After the network equipment is received, the network engineering team configured the router to connect with the AT&T network. The network engineering team verified the proper Virtual Local Area Networks (VLANs) for data, voice, manufacturing, and guests were defined on the router. The switches were configured with the proper IP address and VLANs for data, voice, and manufacturing equipment. The wireless access points had VLANs configured for data, voice, manufacturing equipment, and a guest wireless network. The network engineering team followed best practices by the network equipment manufacturer for the configuration of the network equipment, along with standardized security practices. When the network equipment was configured for the new manufacturing facility, the network engineering team conducted a test of all the equipment in a lab environment to verify connectivity. Once testing of the network equipment was successful, the equipment was readied for transport to the new manufacturing facility for installation.

The third objective was to have the Wide Area Network (WAN) and Local Area Network (LAN) cabling installed at the manufacturing facility. AT&T was scheduled for installation and configuration of the WAN cabling at the demarcation point. AT&T tested and verified the

connectivity to the AT&T network. [redacted] was scheduled for installation and termination of the network cabling at and between the MDF, IDF, and WAP locations. [redacted] installed and terminated the data network connections at locations identified during the site survey. [redacted] tested the installed cabling in all locations and verified connectivity. A member of the network engineering team was on-site at the manufacturing facility and assisted with the remediation of installation issues encountered by AT&T and [redacted] AT&T and [redacted] provided a network drawing of installed cabling that was completed after installation.

The fourth objective was to install and test the network equipment at the manufacturing facility. After AT&T and [redacted] completed the network cabling portion of the project, members of the network engineering team from [redacted] transported the network equipment to the manufacturing facility. The network engineering team followed the network drawings provided by AT&T and [redacted] to connect the router, switches, and wireless access points to the identified locations. In the MDF, the router was connected to the AT&T demarcation point and the LAN switches via supplied cabling. The switches were installed in the 6 IDFs and were connected back to the MDF. The WAPs were installed per the specifications of [redacted] wireless site survey map and were cabled back to the MDF or IDF as required. After the physical installation of the network equipment was completed, the equipment was powered on and tested. The network engineering team supplied a laptop computer with ethernet and wireless connectivity, a desk phone, and a wireless phone to test Internet connectivity from the manufacturing facility to the remote locations. The testing was considered successful and passed the following criteria:

The network engineers were able to access the data network and the other remote locations via the laptop on a wired and wireless connection throughout the facility with low latency, the network engineers were able to place and receive phone calls from inside and outside of the organization throughout the facility, the network engineers ensured that data did not traverse VLANs and verifying Access Control Lists (ACL's) are in place and are functional. The network engineers tested the guest wireless network and ensured that the device could access the Internet, but not access any corporate resources.

The fifth and final objective was to finalize the installation. After successfully testing the new network, the network engineering team designed a logical and physical network map for the new manufacturing facility. This included the physical locations of the devices, the physical connections to each device, device labeling, device connection labeling at the MDF and 6 IDFs, IP addresses to be used at the site, and the IP addresses for the separate VLANs being used. The new network map was incorporated with the original network diagrams for [redacted] other locations. The new network map was validated by other members of the network engineering team and was added to the troubleshooting guide used by the team. Network monitoring of the WAN, LAN, and WLAN was conducted for approximately two weeks. This test ensured there were no connectivity or performance issues before being transitioned to the manufacturing operations team.

Project Timeline

| Milestone or deliverable | Projected Duration | Projected Start Date | Anticipated End Date | Actual Duration | Actual Start Date | Actual End Date |
|---|---|---|---|---|---|---|
| Site Survey | 3 days | 3/1/2021 | 3/3/2021 | 2 days | 3/1/2021 | 3/2/2021 |
| Access point locations Identified | 2 days | 3/1/2021 | 3/3/2021 | 1 Day | 3/1/2021 | 3/1/2021 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Cabling locations identified and future install scheduling | 2 Days | 3/3/2021 | 3/4/2021 | 2 Days | 3/2/2021 | 3/3/2021 |
| AT&T Verifies install location and future install scheduling | 1 Day | 3/4/2021 | 3/4/2021 | 1 Day | 3/4/2021 | 3/4/2021 |
| Equipment identified | 1 Day | 3/5/2021 | 3/5/2021 | 1 Day | 3/5/2021 | 3/5/2021 |
| Equipment ordered | 1 Day | 3/5/2021 | 3/5/2021 | 1 Day | 3/5/2021 | 3/5/2021 |
| Receive equipment | 3 Days | 3/7/2021 | 3/7/2021 | 1 Day | 3/6/2021 | 3/6/2021 |
| Configuration of Equipment | 7 Days | 3/7/2021 | 3/13/2021 | 9 Days | 3/6/2021 | 3/14/2021 |
| Testing and Validation of Network Configuration | 2 Days | 3/14/2021 | 3/16/2021 | 2 Days | 3/14/2021 | 3/16/2021 |
| Installation of MDF/IDF Hardware | 1 Day | 3/17/2021 | 3/17/2021 | 1 Day | 3/17/2021 | 3/17/2021 |
| AT&T Installation | 3 Days | 3/18/2021 | 3/20/2021 | 2 Days | 3/18/2021 | 3/19/2021 |
| Network Cabling and MDF/IDF/WAP Cabling Install | 5 Days | 3/17/2021 | 3/21/2021 | 5 Days | 3/17/2021 | 3/21/2021 |
| Validate and Test Cabling | 2 Days | 3/22/2021 | 3/24/2021 | 1 Day | 3/21/2021 | 3/21/2021 |
| MDF Router/Switch Install | 1 Day | 3/24/2021 | 3/24/2021 | 1 Day | 3/24/2021 | 3/24/2021 |
| IDF Switch Install | 1 Day | 3/24/2021 | 3/24/2021 | 1 Day | 3/24/2021 | 3/24/2021 |
| WAP Install | 3 days | 3/24/2021 | 3/26/2021 | 1 Day | 3/24/2021 | 3/24/2021 |
| Verify Network Connectivity in Facility | 2 Days | 3/27/2021 | 3/28/2021 | 4 Days | 3/25/2021 | 3/28/2021 |
| Label Devices | 1 Days | 3/29/2021 | 3/29/2021 | 1 Day | 3/29/2021 | 3/29/2021 |
| Create Logical/Physical maps | 1 Day | 3/29/2021 | 3/29/2021 | 1 Day | 3/29/2021 | 3/29/2021 |
| Monitor Network Connectivity | 14 Days | 3/29/2021 | 4/12/2021 | 14 Days | 3/29/2021 | 4/12/2021 |

The original project timeline was to start on 3/1/2021 and started on time as planned. The site survey of the facility only took two days as opposed to the three days originally planned. [redacted] was able to identify the access point locations quickly and was able to have that completed within a day. This also pushed up the timeline of [redacted] to start the identification of the cable installation a day early on 3/2/2021. The AT&T installation location, identification of network equipment, and ordering of network equipment all occurred on time with the dates originally projected.

The network engineering team from [redacted] received the network equipment a day early earlier than planned on 03/06/2021. This allowed the team to start the configuration of the network devices on the same day. The configuration of the equipment took nine days, which was two days longer than originally anticipated. After configuration was complete, the project continued as planned and the testing and validation of the network devices were complete.

The MDF equipment, IDF equipment, and network cabling installation began on 3/17/2021 and was completed in 5 days as projected on 3/21/2021. On 3/18/2021, AT&T began the installation of the MPLS WAN connection at the new manufacturing facility. They were able to complete the installation and verification in two days, as opposed to the three days that were planned. [redacted] was able to complete the testing and validation of the network cabling and finished in one day on 3/21/2021. [redacted] network engineering team arrived at the facility on 3/24/21 and was able to complete the router and switch installation in the MDF and IDF within one day. The wireless access point installation was also completed in one day on 3/24/2021, two days ahead of schedule. The testing of the newly installed network was able to begin two days early on 3/25/2021 but took a total of four days to complete. This delay in testing did not influence the timeline of the remainder of the project. The labeling of the network equipment and creation of the logical and physical maps was started and completed on 3/29/2021 as planned. The monitoring of the installed network began on 3/29/2021 and was completed on 4/12/2021, finalizing the end of the project.

## Unanticipated Requirements

During the network installation project at the new manufacturing facility, two unanticipated requirements occurred during the implementation. The first unanticipated

requirement was the sudden unavailability of the senior network engineer during the configuration phase of the network devices. The senior network engineer had a family emergency and was only available by phone during the remainder of the configuration, testing, and installation phase of the project. This left the two junior network engineers to complete the configuration and installation of the network devices by themselves. The junior network engineers had not previously had the experience of configuring new routers, switches, and wireless access points in a production environment. During several phone calls, the senior network engineer was able to guide them through the configuration using standardized configuration templates for each network device. The configuration templates were based on previous network device installations at [redacted] standardized security practices, and manufacturer configuration guidelines. Even though this extended the timeline originally planned for this phase of the project by two days, the junior network engineers were able to finish the configuration of the network devices by the planned completion date of 3/14/2021.

The second unanticipated requirement occurred during the testing phase of the network devices at the new manufacturing facility. On 3/25/2021, the manufacturing facility experienced a power outage because an outdoor utility pole was struck by a semi-tractor trailer. This power outage affected numerous businesses in the area. Utility crews were able to restore power within 36 hours of the damage being reported. This event pushed the network testing forward two days but did not influence the overall project timeline.

## Conclusions

After the network installation project, [redacted] now has a secure and reliable network in their new manufacturing facility. When compared to the first manufacturing facility, the new network has enabled the company to streamline its manufacturing processes,

reduce production costs, and reduce shipping times to customers. One of the measurable outcomes was to ensure a low WAN latency to the corporate office. This can be measured over the two-week established monitoring period, where the goal of the latency is to be averaging under 50 milliseconds. This goal was accomplished after conducting a WAN latency test, which showed that the network averaged 35 seconds of latency for the two-week monitoring period.

The network in the old manufacturing facility was unreliable and disconnected frequently, which caused production to slow to a crawl and introduced a large backlog of work which cost the company lost revenue. The network installation project was crucial to prevent unreliable connectivity from occurring throughout the new manufacturing facility. The network switches and wireless access points were monitored for a two-week timeframe and resulted in 100% availability, exceeding the 99.99% availability rate target. With both the WAN connection latency measuring under 50 milliseconds and the switches and wireless access points availability above the 99.99% targeted availability rate, this project has been accepted as successful and completed.

## Project Deliverables

With the network installation project completed at the new manufacturing facility, [redacted] observed an immediate change in the speed and reliability of the new network. The installation of the new Cisco router, along with the new MPLS circuit, enabled fast connectivity to all [redacted] locations. Appendix A provides an overview of the AT&T MPLS network map before and after the installation at the new facility was completed. This enabled the product design engineers at the remote facilities to send large files involving product changes to the manufacturing facility more efficiently. Appendix B shows the MPLS

Latency chart, which reached an average of 35 milliseconds during the two-week monitoring period.

The new Cisco switches and Cisco Meraki wireless access points that were installed considerably increased the reliability of the network, which enabled the manufacturing machines to increase the output of products with zero downtime. Appendix C illustrates the logical network map of the network equipment installed in the new manufacturing facility. The new switches and access points improved network connectivity throughout the manufacturing floor, which had been an issue in the previous facility due to the high concentration of manufacturing machines producing wireless interference. This has all been eliminated due to the mesh technology applied in the wireless access points. Appendix D provides a network availability comparison from the previous manufacturing plant to the new facility.

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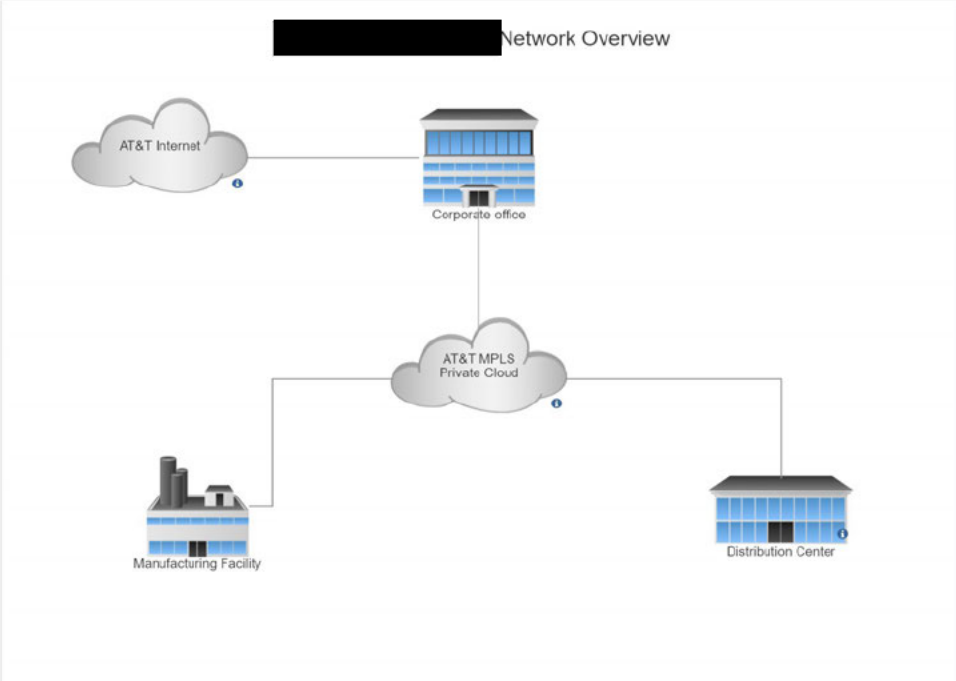
Appendix A

## AT&T MPLS Network Map before and after installation

Before:

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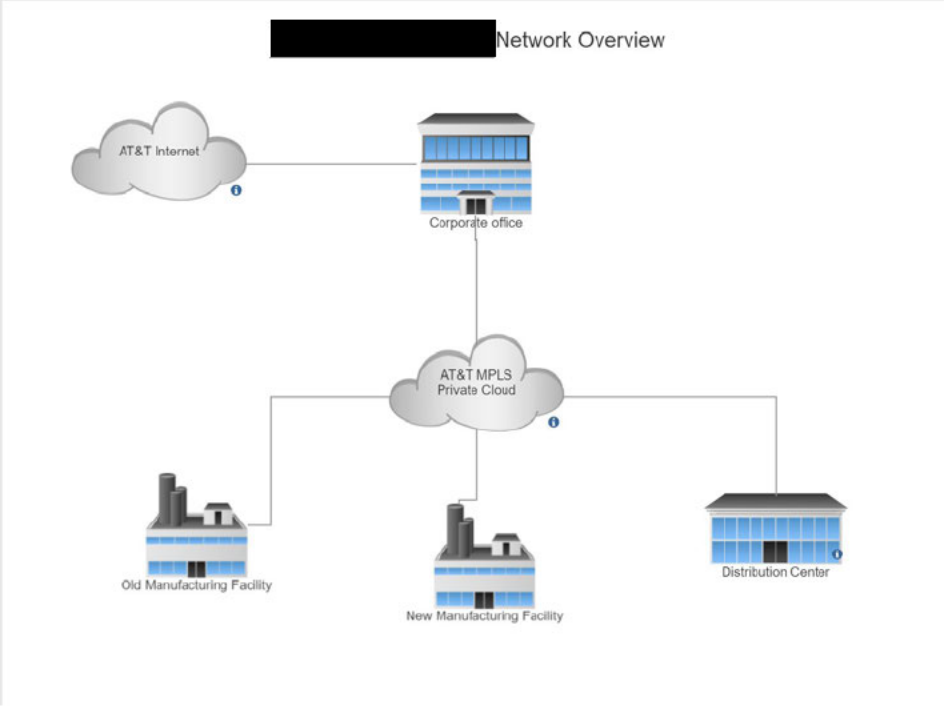
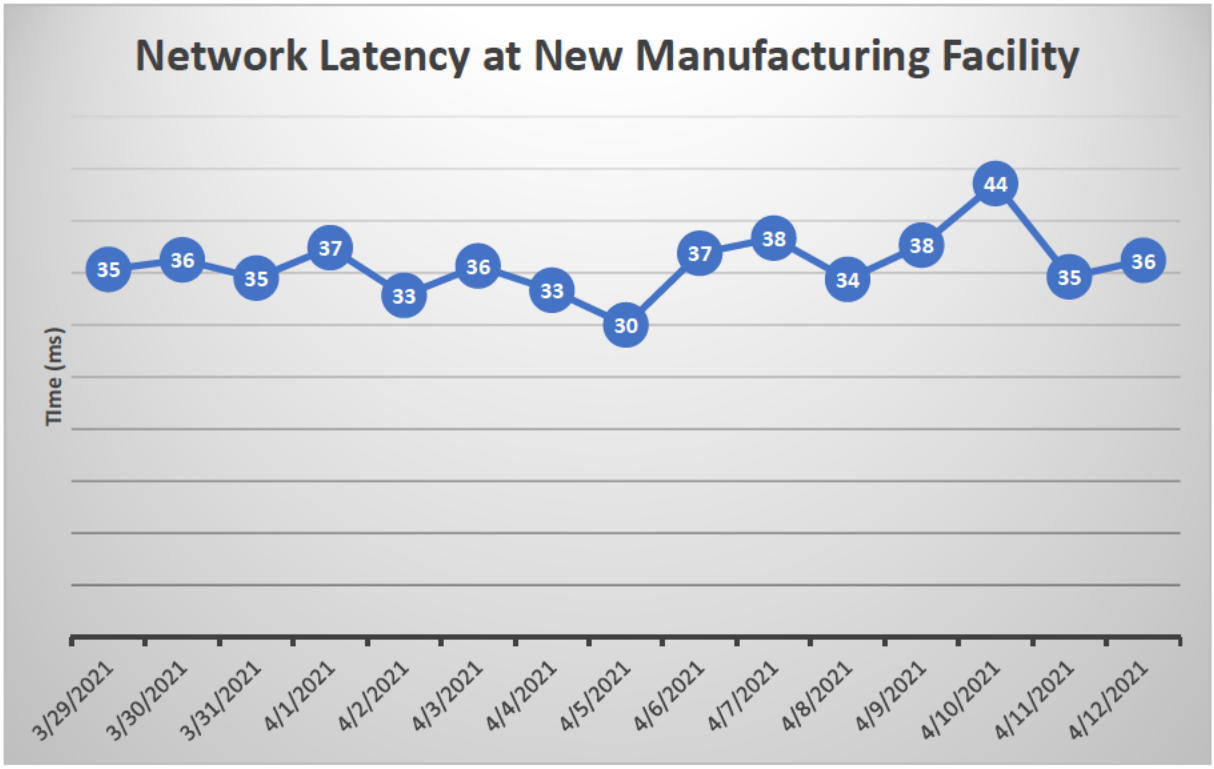


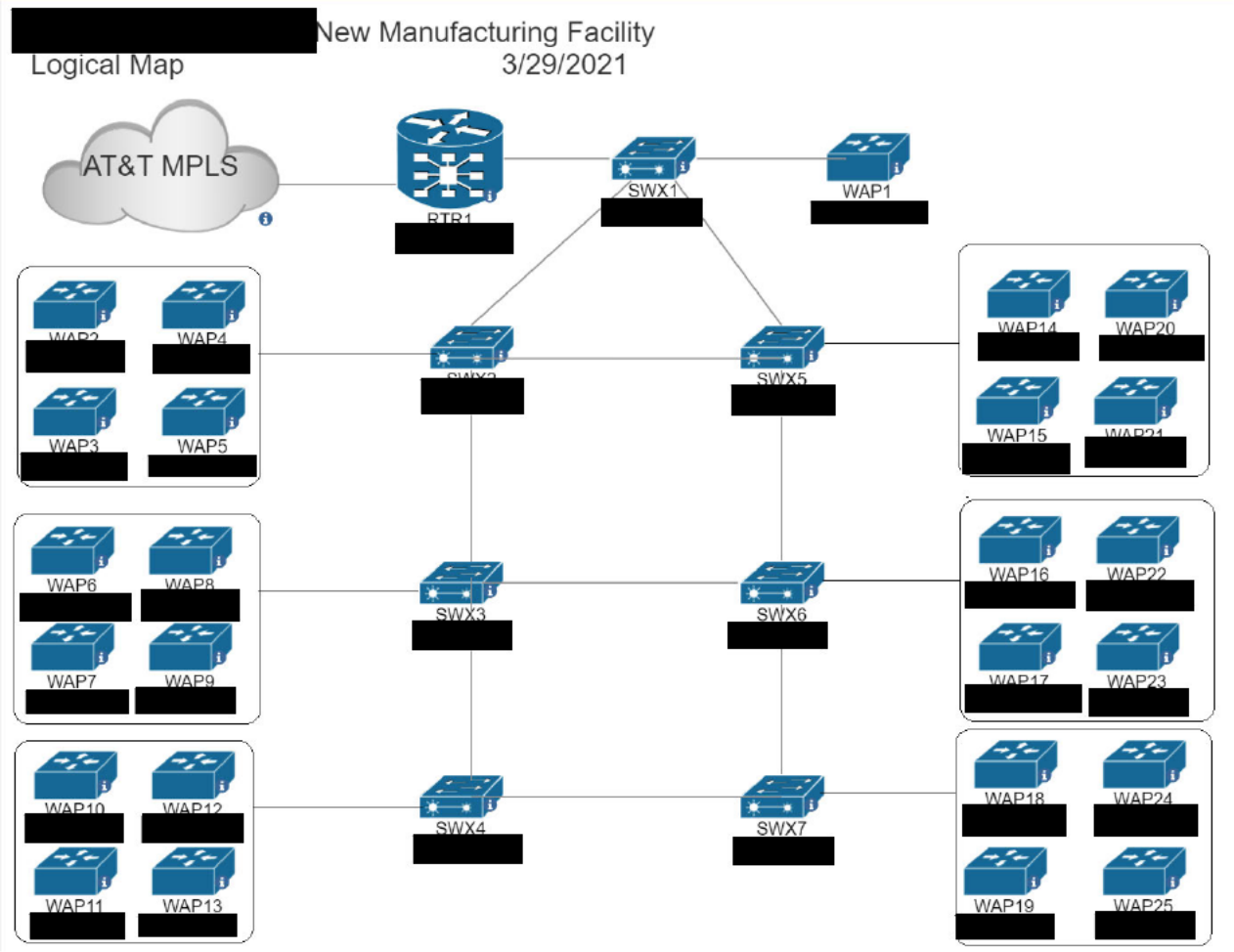
Appendix B

MPLS Latency Chart



Appendix C

## Logical Network Map



Appendix D

## Network Availability Chart