VIRGINIA IT AGENCY

2024 Network Infrastructure Report

Virginia Information Technologies Agency

vita.virginia.gov

November 2024

THIS REPORT

The Virginia IT Agency (VITA) is submitting the network infrastructure report, pursuant to Item 79(E) of the 2024 Appropriation Act, which provides:

> The Virginia Information Technologies Agency shall provide a network infrastructure report to the House Appropriations Committee, Senate Finance and Appropriations Committee, and Joint Legislative Audit and Review Commission by November 1 of each year. The report shall indicate whether the Commonwealth's network infrastructure is adequate to meet the needs of state agencies, and if not, identify any needed upgrades. For each network infrastructure upgrade identified, the report shall specify the estimated cost and whether the upgrade is to the portion of the network maintained by the Virginia Information Technologies Agency or another state agency.

This report covers December 2023 to October 2024. This report details the progress since the last report and the network infrastructure needs of state agencies. VITA thanks policymakers for this opportunity to report on this important subject.

INTRODUCTION

VITA provides information technology (IT) infrastructure services to the Commonwealth's 67 executive branch agencies and a workforce of over 65,000 state employees, equipping and empowering executive branch agencies to serve Virginia's 8.6 million residents. The large Commonwealth network not only provides agency services but also segregates traffic for each agency to provide the necessary security and privacy requirements.

Network infrastructure forms the foundation for almost all government interactions with Virginians. But a network is not viable or useful if it does not enable convenient, reliable, and secure customer usage. Network infrastructure therefore includes not only the network circuits and related hardware but also the software that helps run and maintain the Commonwealth's network and the security services and controls that provide a secure platform and guard against threats, making it possible both for agencies to protect their systems and data and for users to access those resources. Accordingly, this report includes discussion of network, security, and cloud technologies and initiatives that improve network redundancy and resiliency or that fulfill essential network security functions.

This year's network report describes multiple initiatives that have bolstered network resiliency, redundancy, reliability and overall performance. These efforts include voice and data modernization, building a zero-trust security framework, private and public cloud migrations, and performance and network monitoring.

REPORT

Modernization is essential to foster an agile, secure, and high performing IT landscape. Network modernization efforts improve efficiency and effectiveness of communication networks, including opportunities to lower costs, and ensure security and reliability of data and voice services.

New Voice Service

Microsoft Teams Enterprise Voice is a new service offering aimed at reducing cost for voice services. It allows users with Office 365 G5 licensing to make and receive phone calls on their Microsoft Teams client for desktop and mobile. No physical phone is required. Through this service, agencies may reduce their monthly telecommunications expenses compared to current costs for voice services.

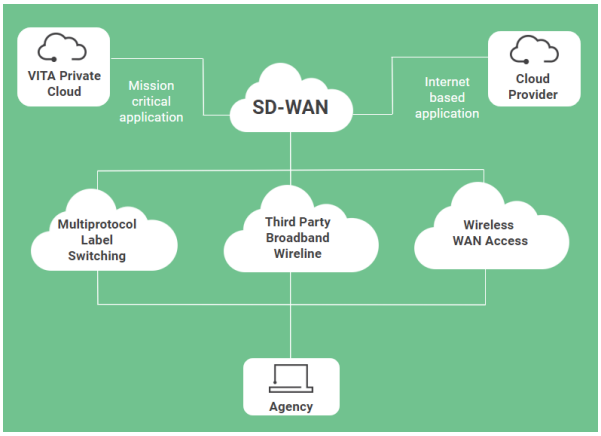
Managed Software Defined-Wide Area Network (SD-WAN)

VITA, our supplier, and agency partners have made tremendous progress in implementing SD-WAN capability for every executive branch agency. SD-WAN allows organizations to leverage many network transportation methods to securely connect users to applications. SD-WAN software responds to real-time network conditions, integrates intelligence at the network edge to identify traffic patterns or bottlenecks, and directs applications and services along paths that support their unique performance and security needs, offering improved agility and control.

What is SD-WAN? *SD-WAN stands for Software-Defined Wide Area Network. SD-WAN uses software to route network traffic to allow agencies to efficiently manage and optimize their network operations*

SD-WAN brings several benefits to agencies, including enhanced application reliability, capacity, and network security, all without sacrificing performance. When implemented together with adding a lower-cost broadband circuit or other connections, SD-WAN can result in significantly increased bandwidth and performance.

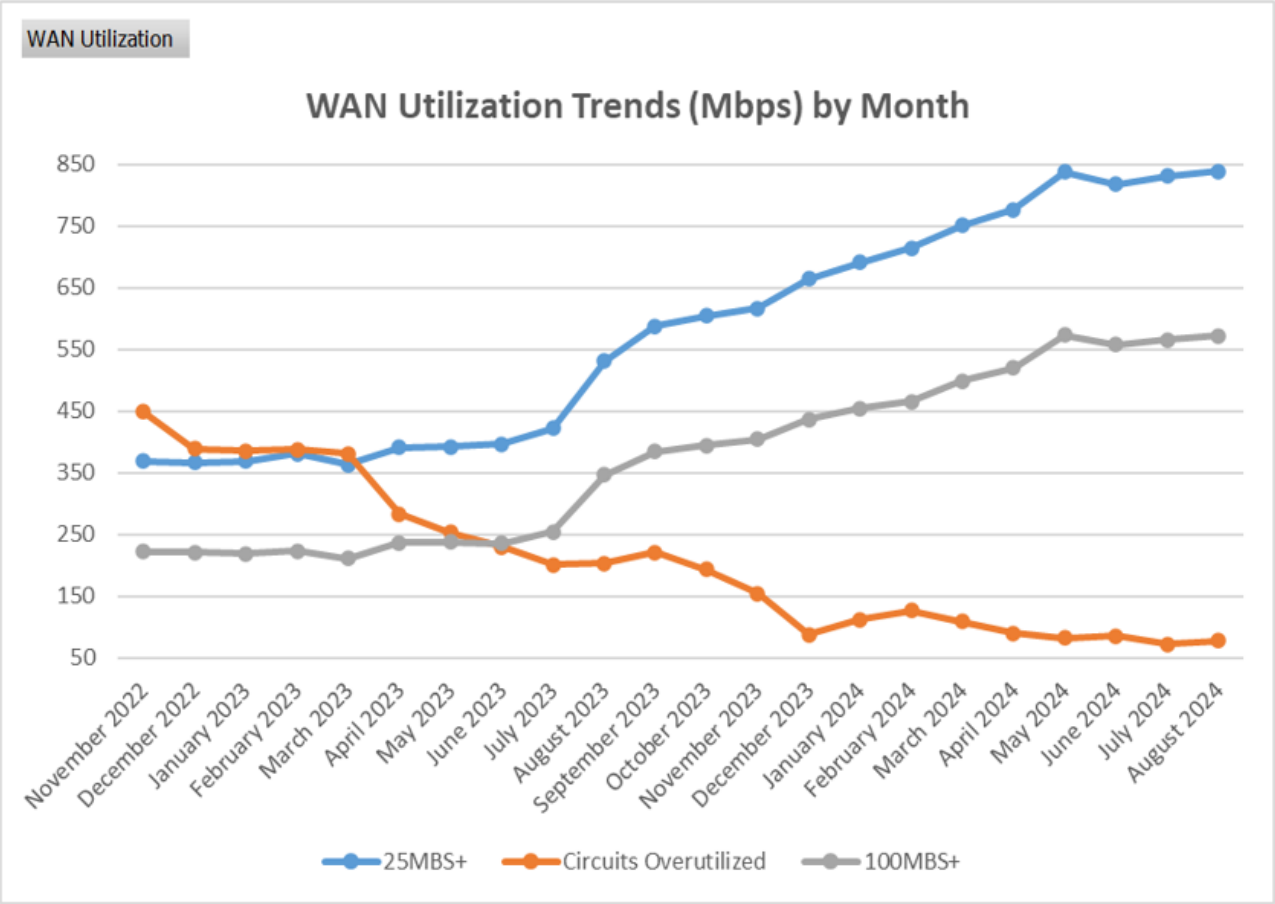
Table 1. Managed SD-WAN



VITA and other state agencies have taken advantage of this technology with circuit upgrades, wireless access devices and broadband circuit installations. Currently 1,049 out of 1,171 (89.6%) of sites have had SD-WAN installed and 543 (46.4%) of these sites have a secondary broadband circuit installed as well.

Network utilization reports show that this modernization has had a real effect. There has been a significant reduction in reports of congested (or overutilized) network circuits (known as "hot site reports") decreasing from 391 in February 2023 to 83 in August 2024 – a 79% reduction. (See Appendix A for the August 2024 hot site list, together with the costs to bring those sites up to the recommended circuit bandwidth.)

To take full advantage of SD-WAN, agencies may require funding to acquire broadband circuits or other connections that enable network optimization. As the project moves forward, there may be cases where construction costs are necessary to provide modern circuits to agency facilities.



Capital Ring Upgrade

VITA continues to work on upgrading the communications ring connecting many of the executive branch buildings in the Capital area. Dense wavelength-division multiplexing (DWDM) is a fast and flexible optical fiber multiplexing technology that enables different data streams to be sent over a fiber optic network, increasing capacity on existing fiber networks. DWDM serves as a modern replacement for the older Synchronous Optical Networking (SONET) technology, which is more resource-intensive to provision and to upgrade. DWDM increases the bandwidth of fiber networks, enhances productivity, and

improves the overall experience. VITA anticipates implementation of DWDM in the coming months.

Cloud Connectivity Strategy

The current Verizon Cloud Connection service option, Secure Cloud Interchange (SCI), has significant drawbacks. SCI requires all traffic to route to and from the state's main data center (the QTS data center in Eastern Henrico), rather than more directly to the destination. SCI also depends on the Managed Security Services (MSS) supplier for VITA security compliance and is difficult to provision. The SCI service leverages the QTS MPLS circuits for connectivity to the cloud exchange and therefore requires coordination with both the MSS supplier and the Server, Storage, and Datacenter (SSDC) supplier to establish an agency connection to each cloud.

VITA is working to leverage SD-WAN and Software Defined Interconnect (SDI) technologies to each Cloud Service Provider (CSP) to support future agency demand and facilitate the goal of migrating data to the cloud. SDI features a no-touch provisioning process that will significantly lower access costs by sharing circuit capacity and enables connectivity in minutes rather than weeks. Other benefits include eliminating the need to route all traffic through the QTS data center, end-to-end visibility with defined levels of service (through Service Level Agreements or SLAs) and leveraging the existing SD-WAN framework.

Building a Zero Trust Security Framework

Today's state government network is a complex environment, featuring over 1,700 sites and data and applications increasingly transitioning to the cloud. Robust cybersecurity for the Commonwealth's network and data is an essential part of providing network infrastructure services.

The Commonwealth's security posture will be enhanced by moving to a zero-trust framework. Benefits of zero trust include a reduction of cyber risk by reducing the network attack surface, limiting the ability of attackers to expand out from an initially compromised system, and operational efficiencies for policy management.

Zero trust does not refer to any single security technology. Zero trust is a security approach or framework that does not automatically trust any user or device inside a network; instead, users and devices are continuously verified. These best practices approach will protect the Commonwealth's IT resources from the next generation of cyber threats and provide a secure architecture and best practices for cloud, artificial intelligence, and third-party services regardless of what network a system is on. Improvements to remote access, content filtering, privileged access management, identity and access management and multi-factor authentication all play a pivotal role in establishing a zero-trust environment.

VITA is working to update the Commonwealth security model to zero trust. Specific improvements along the road to zero trust are discussed below.

Single Sign-On and Multi-factor Authentication:

Single Sign-on (SSO) relieves the burden of needing to remember passwords for multiple applications and streamlines access. SSO also helps the enterprise monitor access and speed deployment of new applications.

The Okta platform provides the Commonwealth's enterprise single sign-on solution. The Okta platform enables multi-factor authentication (MFA) for all users and systems, comprising nearly 800 application integration instances and supporting both internal state government users and external users, such as local government. VITA continues to improve this environment to support agency requirements while increasing the Commonwealth's security posture. This year, for example, service upgrades to enforce MFA for sensitive systems such as Electronic Health Records were implemented. Work continues on further enhancements, such as automation.

Combining Okta with the Privilege Access Management (PAM) system, CyberArk, has strengthened MFA enforcement, reduced stolen credentials, and improved security.

VITA SSO services, and the security measures (such as MFA) that these services provide, are key to the Commonwealth's zero trust strategy. These SSO services also enable agencies to comply with strict, sector-specific requirements, such as payment card industry (PCI) requirements and Health Insurance Portability and Accountability Act (HIPAA) standards.

Identity and Access Management

A network is not useful unless people can access the right resources on the network. Identity and access management (IAM) is an area of security that can involve multiple technologies and processes and aims to help the right people and devices access the right resources at the right time.

SailPoint IdentityNow is a modern identity security solution that provides a centralized way to see and control every user's access to resources across hybrid IT environments, while ensuring regulatory compliance. Implementing SailPoint IdentityNow as the executive branch identity governance solution allows agencies to view access roles and policies for all users and objects across the Commonwealth's complex environments. IdentityNow automates access provisioning, monitors for inappropriate access, and enforces policies based on roles and activities. It also facilitates automated access reviews, reports, and historical views for auditing and compliance purposes. The executive branch's integration is underway, with the goal being a seamless end user experience.

Key Commonwealth systems (such as Cardinal) have been integrated with IAM technologies to enhance the data quality and consistency of employee identities, accounts, and attributes. Data from those systems is then incorporated into automated

processes, such as account onboarding and offboarding. VITA is in the process of enhancing the data feeds with additional identity attributes, which will further improve the effectiveness of the IAM program.

PRIVATE & PUBLIC CLOUD SERVICES

People referring to “the cloud” typically mean the “public cloud,” where external cloud providers (Amazon Web Services, Microsoft, etc.) deliver cloud resources (such as storage and computing power) as a fully managed service. Public cloud services are provided to agencies through the COV Cloud program. Private cloud refers to situations in which a single organization controls the underlying infrastructure to deliver the IT resources in a cloud-like manner, which has been made possible for the Commonwealth thanks to virtualization and the migration of the Commonwealth’s datacenter to the QTS datacenter in Eastern Henrico. Both public and private cloud improvements are discussed below.

COV Cloud

The Commonwealth continues to transition workloads to the cloud. In order to realize the benefits of the cloud, VITA is modernizing cloud service management and executing a strategy to transition to a “consumption” based model, instead of the previous “resource unit” model. This change, which transitions customers away from paying for resources, whether used or not, to paying for only what is consumed, positions the Commonwealth to fully leverage cloud capabilities, including cloud native services, solution flexibility, scalability, and more granular and controlled costs.

For overall management, VITA has implemented the CloudScend tool, which provides a consolidated view of services across multiple cloud platforms and enables automated provisioning of cloud resources, agency self-service and management, improved cloud billing information, and cloud resource utilization and planning. CloudScend replaces “resource unit” billing with consumption-based billing, thus bringing true cloud advantages to fruition.

To ensure competition and value from cloud services, VITA released a request for proposals (RFP) to transform how public cloud services are provided in the Commonwealth, covering the multi-cloud environments currently operated or requested by agencies. VITA is working to transition from a single managed cloud services (MCS) provider supporting all cloud environments to a model with additional supplier diversity (ideally a different provider managing each cloud). The RFP is on track to award management of the Azure cloud environment in October 2024, while Amazon Web Services (AWS) and Oracle cloud environments remain with the current supplier.

Private Cloud Improvements

VITA's current private cloud server offerings are based on fixed, predetermined configurations at a fixed cost per month. This pricing model has proven to be problematic, resulting in many servers being more powerful than required (known as being overprovisioned). Overprovisioning means agencies are paying for computing resources (virtual memory capacity and processor power) that are not being used. By changing to a consumption-based billing model, VITA will enable agencies to properly scale their servers and provide them with a monthly cost savings.

Financial operations (FinOps) are a management practice that promotes shared responsibility for an organization's cloud computing infrastructure and costs, thus maximizing the business value of cloud and enabling timely data-driven decision making. Consumption-based billing with FinOps management aligns with the public cloud billing model, simplifying and standardizing billing, and offers flexibility to agencies to turn down workloads when they are not needed.

Ransomware Protection

VITA completed a pilot of its ransomware solution called Cyber Vault. The Cyber Vault Solution (CVS) creates a secure "vault" that is kept separate from the network (known as being "air-gapped"), where agencies can maintain mission-critical business data and technology configurations that can be used to recover from a cyberattack. Daily data snapshots are saved and vaulted over consecutive days to enable data recovery to the point before an intrusion. (Data vaulted using this solution is separate from the current daily backups that run on managed agency servers and data stores.) The data saved by CVS, once vaulted, is immutable – it cannot be altered. The use of such an "air gapped" system makes vaulted data impervious to attack and protects saved data by virtually isolating it from the network.

Cyber Vault is now being readied for production and will enable subscribed agencies to recover from vaulted critical business data by un-vaulting isolated data and recovering clean data at a past point of time – demonstrating a viable defense against ransomware and other cyberattacks.

PERFORMANCE AND NETWORK MONITORING

The successful buildout of network capabilities adds complexities to managing and monitoring the network. VITA has an end-to-end monitoring initiative to isolate, identify, and remediate issues impacting network performance and improve network capacity, reliability, architecture, and operational capability, thereby creating a better user experience.

Network Monitoring Tools

Beginning in 2023, VITA partnered with Cisco and suppliers to implement a proof-of-concept model with the Thousand Eyes tool. VITA has been working diligently to provide agencies with comprehensive visibility into their entire network infrastructure. Thousand Eyes provides more data for analysis, which will be available to agency customers if desired.

Application Monitoring

Past network reports have discussed the complexity of network troubleshooting and how problems perceived by users as network issues may not actually be caused by a problem with the network. In some cases, applications themselves are responsible for latency and performance deficiencies. Working with Cisco, an application diagnostic tool has been procured to debug issues and provide an inside-out analysis of an application after troubleshooting has indicated a potential application issue. Although this tool requires significant resources, it has provided agencies important insights on specific upgrades needed or other issues within their application stack.

Uninterruptible Power Supply (UPS) Service

Past network reports also have discussed the importance of reliable power to network services. In June 2024, VITA released a new offering of a simple rack uninterruptible power supply (UPS) service. The goal is to eliminate urgent service tickets and equipment repairs in the event of power outages, thus minimizing damaged hardware and increasing availability at affected locations.

UPGRADES AND ASSOCIATED INVESTMENTS NEEDED

While VITA is making crucial improvements to ensure the reliability and performance of the Commonwealth's network infrastructure, further upgrade work would enhance these efforts. Investments needed encompass upgraded network circuits, expanding redundant networking, circuit modernization, strengthening network access and security, facilitating private and public cloud migrations, streamlining data center elimination, optimizing disaster recovery, bolstering ransomware protection, and elevating performance monitoring.

Upgrading network circuits for agency sites

Additional funding would enable agencies to take full advantage of the capabilities of SD-WAN by procuring broadband circuits or other lower-cost, higher-capacity connections, enabling network traffic optimization through SD-WAN. Current network improvement

efforts may identify locations where construction costs are necessary to provide modern circuits to an agency facility.

Where network circuit utilization is showing oversaturation, and where current circuit size does not meet VITA's recommended network bandwidth-per-user standard, upgrading is recommended to reduce congestion and to meet the standard. (Appendix A includes estimated costs for upgrading remaining congested circuits.) VITA is implementing SD-WAN at every agency to leverage cost efficient broadband circuitry compared to MPLS circuits. As stated, as each agency and location are evaluated for bandwidth upgrades, agencies can choose from broadband, MPLS, or wireless enhancements. Some agencies may need construction funding to extend service to specific locations.

Expanding redundant networking

Redundant network connections provide multiple paths for traffic. This ensures an organization's uninterrupted online presence, even in the event of a failure of one connection or part of a network. Redundant network connections also can boost performance through improved traffic routing and management. For critical sites identified to VITA, such as hospitals and traffic operations centers, VITA and agencies have already worked together to ensure redundant network connections. This is accomplished by utilizing two or more circuits or implementing broadband backup to traditional circuits. The definition of critical sites could be broadened to include:

1. Every agency headquarters, given that all agencies depend on the network for their business, and
2. Every site where agencies and members of the public interact in-person in a way that cannot be fully replaced by online transactions, such as Department of Motor Vehicles offices.

VITA recommends agencies review the locations in need of redundant network connections and consider adding redundancy if appropriate. For example, in light of delay in moving the last couple of critical agency applications off the mainframe, VITA's RFP for the 2024 mainframe contract added requirements for circuit redundancy and diversity.

Circuit modernization

In line with initiatives such as SD-WAN, overutilization of circuits should be fully remediated. SD-WAN can decide the best route (circuit) to be used, but where one of the circuits fails, the remaining circuit may not be able to accommodate the business workload. For example, a site may have had a T1 circuit (1 MB throughput) and then added, via SD-WAN, a 100 MB broadband circuit. If the broadband circuit fails, the T1 circuit does not have the necessary capacity to support the agency's business. Progress has been made through current network modernization efforts, but future investment in modernizing circuits should seek to ensure their capacity aligns with workloads. Priority

should be given where outdated technologies reside (such as T1s), or where site location buildouts are needed, all within agency business support models.

Network access and security

Agencies' ability to take advantage of the many network access and security services that are being rolled out depends on agency planning and budgeting. For example, to enable authentication to external users for an application, licenses and ongoing support must be part of the project.

On an enterprise level, VITA's ongoing efforts with zero trust implementation are based on organic growth of existing products and continued roll out of products such as SailPoint and Okta. Continued funding for these efforts is necessary to create enterprise services in these areas, but this investment does not necessarily increase Commonwealth spend – in many cases, the results of the modernization effort will reduce overall Commonwealth costs.

Additional implementation opportunities will be driven by tool replacements, new implementations of software, integration of new suppliers, and product updates that will enable a zero-trust model.

Private and public cloud services public cloud migrations

To continue migrating workloads to the public cloud, VITA needs to continue to reduce reliance on any physical data center and ensure a secure cloud architecture is in place.

Many security services – such as logging and data inspection, workload backups, application availability, and disaster recovery services – can be delivered within the public clouds, as outlined above. The current RFP to replace the Managed Security Provider (MSP) will initially address these solutions. Although an investment by VITA, enterprise services such as SDI and SD-WAN will enable a lower cost to agencies for cloud adoption and usage.

As VITA continues to transform public cloud services in the Commonwealth, through initiatives such as the modernization of managed cloud services, it is imperative that VITA internalizes the necessary skills to not only oversee and govern the changing environments but to have the technical knowledge to own and lead the services going forward. Additional resources to serve as service owners as well as architects are needed for VITA to align these changing and expanding services with the agencies' vision.

Eliminate Secondary Data Center

Initiatives are in flight to eliminate the secondary data center and reduce footprint in the primary data center. The driver behind eliminating the secondary data center is the migration of servers to the cloud. Agency investment in application modernization and enabling cloud migrations may require additional funding. Additionally, the core

infrastructure services within the primary data center will need to be engineered for cloud failover as well.

Modernized Disaster Recovery

To modernize disaster recovery services, the Commonwealth must have the ability to failover to other production sites. These sites can include physical and/or public cloud data centers. This requires VITA to design and build a robust network infrastructure to provide resilient communications pathways to the alternative sites for use in case of a disaster declaration. VITA is currently architecting a robust multi-cloud connection strategy complete with applicable security controls. VITA anticipates reporting on the necessary associated investment next year.

Ransomware Protection

Production implementation of the ransomware service, the Cyber Vault Solution, will raise a question of what data will be chosen for protection. Protected data may be selected agency application data or the entire enterprise backup environment. Such decisions and the adaptation of cloud processing and backup methodology will drive future funding requests.

Performance Monitoring

With the objective of an end-to-end network support, it is recommended that VITA and agencies have the ability to assemble a team focused on the many parts of the network(s) and to work with accountable parties to remediate known/foreseeable issues. Ensuring the proper tools are used to diagnose and monitor in the complex COV network is essential. Additionally, staffing a team that can identify, escalate, and address security issues is increasingly important. VITA will continue to work on building a comprehensive Network Operations Center (NOC) team.

CONCLUSION

The comprehensive initiatives undertaken to enhance network infrastructure and related security and services show the Commonwealth's commitment to modernized technological capabilities. These efforts are essential to meet the evolving demands of public service delivery while ensuring data security and disaster recovery readiness. By identifying and acting on areas of improvement, the Commonwealth is poised to advance its IT landscape and ensure efficient, secure, and reliable services to citizens and customer agencies.

APPENDIX A - August 2024 Hot Sites with Recommended Bandwidth and Cost

Agency	Device Name	Location	Current Speed	Recommended Circuit Bandwidth	SD-WAN with Broadband (monthly cost to reach recommended bandwidth)	Utilization - 95 Percentile	Utilization In - 95 Percentile	Utilization Out 95 Percentile	Utilization In - Maximum	Utilization Out - Maximum
COM	COM-080-RTV-1	900 NATURAL RESOURCES DR,STE COM -080,CHARLOTTESVILLE,VA	50.00 M	200 M	$775.00	87.78%	87.78%	30.00%	99.24%	89.54%
	COM-064-RTR-1	600 N 5TH ST, RICHMOND,VA	100.00 M	300 M	$775.00	81.50%	81.50%	63.10%	91.49%	84.67%
	COM-082-RTV-1	2001 MAYWILL ST, RICHMOND,VA	50.00 M	200 M	$775.00					
DBH	DBH-011-RTR-1	26317 WASHINGTON ST, PETERSBURG,VA	150.00 M	400 M	$1,330.00	75.71%	75.71%	12.73%	84.49%	36.50%
DBS	DBS-001-RTR-1	514 E BEVERLEY ST, STAUNTON,VA	6.14 M	20 M	$410.00	83.63%	83.63%	16.86%	99.38%	97.33%
DHP	DHP-001-RTR-1	9960 MAYLAND DR,STE DHP-001,HENRICO,VA	200.00 M	500 M	$1,330.00	77.91%	69.44%	77.91%	97.63%	91.17%
DJJ	DJJ-109-RTR-1	304 ALBEMARLE DR, CHESAPEAKE,VA	20.00 M	50 M	$500.00	87.28%	87.28%	15.08%	195.72%	97.17%
	DJJ-066-RTR-1	26 WINE ST,STE DJJ -066,HAMPTON,VA	1.54 M	10 M	$410.00	70.62%	70.62%	20.49%	98.72%	34.71%
	DJJ-114-RTR-1	2405 COURTHOUSE DR,BLDG 2B10,VIRGINIA BEACH,VA	20.00 M	50 M	$500.00	70.52%	70.52%	16.58%	97.60%	33.59%
	DJJ-059-RTR-1	150 SAINT PAULS BLVD, NORFOLK,VA	20.00 M	50 M	$500.00	70.08%	70.08%	13.35%	97.63%	34.45%
DMV	DMV-001-RTV-1	2300 W BROAD ST,STE DMV -001,RICHMOND,VA	155.00 M	500 M	$1,330.00	89.29%	89.29%	43.89%	98.09%	86.11%
	DMV-089-RTR-1	1 FORT LEE, FORT LEE,VA	1.54 M	10 M	$410.00	80.38%	80.38%	23.71%	98.32%	55.29%
DOC	DOC-118-RTR-1	10060 HUSKE RD, STONY CREEK,VA	1.54 M	10 M	$350.00	96.95%	96.95%	34.54%	98.77%	94.00%
	DOC-047-RTR-1	30A W WATER ST, HARRISONBURG,VA	4.61 M	20 M	$491.00	94.95%	94.95%	49.41%	98.15%	87.12%
	DOC-034-RTR-1	479 CAMP NINE RD, RUSTBURG,VA	3.07 M	10 M	$350.00	94.18%	94.18%	24.89%	97.92%	66.28%
	DOC-127-RTR-1	960 PRISON RD, BOYDTON,VA	3.07 M	10 M	$350.00	93.47%	93.47%	44.27%	96.93%	99.31%
	DOC-007-RTR-1	471 MAIN ST, WARSAW,VA	4.61 M	20 M	$563.00	93.30%	93.30%	25.24%	97.88%	84.07%
	DOC-031-RTR-1	101 S MAIN ST, WOODSTOCK,VA	1.54 M	10 M	$350.00	92.92%	92.92%	32.78%	97.23%	60.16%
	DOC-021-RTR-1	11 WATER ST, FRONT ROYAL,VA	1.54 M	10 M	$350.00	92.41%	92.41%	33.61%	98.31%	68.60%
	DOC-135-RTV-1	137 FUGATE ST, DUFFIELD,VA	4.00 M	20 M	$410.00	92.00%	92.00%	16.71%	97.86%	63.70%
	DOC-002-RTR-1	7 W QUEENS WAY, HAMPTON,VA	6.14 M	20 M	$410.00	91.97%	91.97%	32.23%	97.80%	97.52%
	DOC-089-RTR-1	701 SANDERSON RD, CHESAPEAKE,VA	50.00 M	200 M	$775.00	90.04%	90.04%	42.35%	108.71%	91.13%
	DOC-079-RTV-1	18155 AL PHILPOTT HWY, RIDGEWAY,VA	4.61 M	20 M	$410.00	89.63%	89.63%	15.56%	96.16%	98.87%
	DOC-115-RTR-1	100 FAIRVIEW DR, FRANKLIN,VA	1.54 M	10 M	$350.00	88.13%	88.13%	30.73%	98.63%	65.96%
	DOC-106-RTR-1	130 FINLEY GAYLE DR, MARION,VA	50.00 M	200 M	$775.00	87.75%	87.75%	32.52%	97.54%	84.56%
	DOC-121-RTR-1	329 DELLBROOK LN, INDEPENDENCE,VA	50.00 M	200 M	$775.00	86.97%	86.97%	35.91%	97.72%	88.52%
	DOC-084-RTR-1	2003 W MAIN ST, RADFORD,VA	6.00 M	20 M	$410.00	84.81%	84.81%	21.40%	98.20%	95.24%
	DOC-056-RTR-1	155 GRASSY HILL RD,STE DOC-056,ROCKY MOUNT,VA	6.00 M	20 M	$410.00	84.77%	84.77%	22.43%	97.06%	87.91%
	DOC-101-RTR-1	1349 CORRECTIONAL CENTER RD, DILLWYN,VA	50.00 M	200 M	$775.00	84.36%	84.36%	28.55%	84.85%	81.78%
	DOC-024-RTR-1	751 MILLER DR SE, LEESBURG,VA	4.61 M	20 M	$410.00	84.19%	84.19%	20.10%	96.80%	62.76%
	DOC-072-RTR-1	32 BRIDGE ST S, MARTINSVILLE,VA	6.00 M	20 M	$410.00	83.93%	83.93%	28.90%	85.20%	77.48%
	DOC-091-RTV-1	2892 SCHUTT RD, BURKEVILLE,VA	50.00 M	200 M	$775.00	83.77%	83.77%	44.07%	85.00%	78.77%
	DOC-010-RTR-1	31285 CAMP RD, HANOVER,VA	6.14 M	20 M	$410.00	83.08%	83.08%	26.52%	87.10%	74.77%
	DOC-073-RTR-1	4740 EISENHOWER AVE, ALEXANDRIA,VA	6.14 M	20 M	$410.00	82.55%	82.55%	18.13%	99.09%	96.06%
	DOC-020-RTR-1	30 ASHBY ST, WARRENTON,VA	4.61 M	20 M	$410.00	82.30%	82.30%	18.48%	98.74%	74.96%
	DOC-138-RTR-1	247 GILMER ST, LEBANON,VA	6.00 M	20 M	$410.00	81.92%	81.92%	20.14%	96.90%	65.23%
	DOC-009-RTR-1	5244 OLDE TOWNE RD, WILLIAMSBURG,VA	6.14 M	20 M	$410.00	81.62%	81.62%	29.51%	86.76%	79.76%
	DOC-026-RTR-1	418 S MAIN ST, EMPORIA,VA	6.14 M	20 M	$410.00	80.00%	80.00%	28.79%	96.68%	99.11%
	DOC-033-RTR-1	107C TURNPIKE RD, BEDFORD,VA	4.61 M	20 M	$410.00	79.07%	79.07%	32.24%	97.15%	90.29%
	DOC-140-RTV-1	85 MINE RD, STAFFORD,VA	10.00 M	40 M	$500.00	76.85%	76.85%	5.72%	99.87%	23.71%
	DOC-041-RTV-1	3402 KENNEL GAP RD, OAKWOOD,VA	50.00 M	200 M	$775.00	75.28%	75.28%	31.19%	76.58%	83.82%
	DOC-122-RTR-1	1213 E CLAY ST, RICHMOND,VA	7.00 M	20 M	$410.00	75.24%	75.24%	13.79%	92.98%	22.42%
	DOC-058-RTR-1	2510 HOUGTON AVE, SOUTH BOSTON,VA	6.00 M	20 M	$410.00	74.89%	74.89%	19.87%	75.52%	66.75%
	DOC-027-RTV-1	20 S ROANOKE ST, FINCASTLE,VA	6.00 M	20 M	$410.00	74.74%	74.74%	45.58%	84.80%	89.44%
	DOC-066-RTV-1	211 NOR DAN DR,STE DOC-066,DANVILLE,VA	10.00 M	40 M	$500.00	73.98%	73.98%	22.02%	98.39%	93.47%
	DOC-018-RTR-1	6866 EVERGLADES DR, RICHMOND,VA	50.00 M	200 M	$775.00	73.87%	3.76%	73.87%	8.05%	76.48%
	DOC-099-RTR-1	1522 PRISON RD, DILLWYN,VA	50.00 M	200 M	$775.00	73.39%	73.39%	26.02%	84.89%	57.07%

APPENDIX A - August 2024 Hot Sites with Recommended Bandwidth and Cost

	DOC-095-RTV-1	21360 DEERFIELD DR, CAPRON,VA	100.00 M	300 M	$775.00	72.93%	72.93%	40.64%	97.18%	89.86%
	DOC-108-RTR-1	650 BARNFIELD RD, WARSAW,VA	50.00 M	200 M	$775.00	72.41%	72.41%	18.85%	84.48%	63.52%
	DOC-085-RTR-1	2841 RIVER RD W, GOOCHLAND,VA	50.00 M	200 M	$775.00	72.34%	72.34%	29.62%	84.47%	52.47%
	DOC-083-RTR-1	690 FALLS RD, VICTORIA,VA	50.00 M	200 M	$775.00	71.30%	71.30%	61.04%	85.01%	86.31%
	DOC-097-RTV-1	3500 WOODS WAY, POWHATAN,VA	50.00 M	200 M	$775.00	71.05%	71.05%	67.96%	99.14%	88.79%
	DOC-055-RTR-1	320 W MAIN ST, WYTHEVILLE,VA	4.61 M	20 M	$410.00	70.69%	70.69%	21.97%	90.85%	84.69%
	DOC-098-RTR-1	920 OLD RIVER RD, BLUEFIELD,VA	50.00 M	200 M	$775.00	70.62%	70.62%	24.23%	97.42%	75.73%
DOT	DOT-026-RTR-1	17493 RAILROAD AVE, CAPRON,VA	1.54 M	10 M	$350.00	98.36%	98.36%	15.55%	98.81%	88.43%
	DOT-006-RTR-1	22448 HILLTOP DR, MC KENNEY,VA	1.54 M	10 M	$350.00	97.74%	97.74%	27.55%	98.91%	67.48%
	DOT-159-RTR-1	3288 TROUTDALE HWY, MOUTH OF WILSON,VA	1.54 M	10 M	$350.00	96.78%	96.78%	21.31%	98.33%	53.32%
	DOT-198-RTR-1	66882 D WOODROW BIRD MEMORIAL HWY, ROCKY GAP,VA	6.00 M	20 M	$508.00	85.06%	85.06%	15.77%	96.89%	111.09%
	DOT-007-RTR-1	16101 GOODES BRIDGE RD, AMELIA COURT HOUSE,VA	6.14 M	20 M	$508.00	75.12%	75.12%	9.87%	100.54%	29.42%
	DOT-350-RTR-1	11655 W JAMES ANDERSON HWY, BUCKINGHAM,VA	10.00 M	40 M	$500.00	70.10%	70.10%	9.16%	97.72%	23.29%
DSS	DSS-152-RTR-1	605 PINE ST, HILLSVILLE,VA	1.54 M	10 M	$350.00	94.19%	94.19%	38.81%	97.81%	88.96%
	DSS-164-RTR-1	14010 BOYDTON PLANK RD,STE DSS-164,DINWIDDIE,VA	4.61 M	20 M	$508.00	82.20%	82.20%	23.88%	97.13%	70.60%
	DSS-054-RTR-1	494 N MAIN ST, WOODSTOCK,VA	4.61 M	20 M	$508.00	77.73%	77.73%	5.79%	97.24%	78.50%
	DSS-149-RTR-1	105 E CENTER ST, GALAX,VA	3.07 M	10 M	$350.00	75.39%	75.39%	14.12%	100.80%	67.78%
ITA	ITA-001-RTV-1	2214 ROCK HILL RD,STE ITA -001,HERNDON,VA	3.07 M	10 M	$350.00	62.91%	62.91%	15.58%	97.68%	99.62%
JYF	JYF-002-RTR-1	2207 COLONIAL PKWY, WILLIAMSBURG,VA	50.00 M	200 M	$775.00	62.31%	62.31%	23.86%	90.36%	42.89%
MME	MME-001-RTR-1	3405 MOUNTAIN EMPIRE RD, BIG STONE GAP,VA	50.00 M	200 M	$775.00	56.55%	24.84%	56.55%	133.57%	125.49%
MRC	MRC-001-R1	3 MOAT WALK,STE MRC -001,FORT MONROE,VA	10.00 M	40 M	$500.00	51.54%	51.54%	44.71%	96.77%	89.34%
TAX	TAX-002-RTR-1	600 E MAIN ST,STE TAX-002,RICHMOND,VA	300.00 M	800 M	$1,800.00	49.19%	49.19%	14.39%	83.72%	84.89%
VDH	VDH-068-RTR-1	606 DENBIGH BLVD, NEWPORT NEWS,VA	1.54 M	10 M	$350.00	47.63%	47.63%	18.63%	97.31%	48.31%
	VDH-004-R1	7740 SHRADER RD,STE VDH-004,HENRICO,VA	20.00 M	50 M	$695.00	45.93%	45.93%	25.76%	71.32%	70.46%
	VDH-129-RTR-1	5 COUNTY COMPLEX CT, WOODBRIDGE,VA	1.54 M	10 M	$350.00	45.79%	45.79%	7.87%	97.67%	47.04%
	VDH-130-RTR-1	9311 LEE AVE, MANASSAS,VA	10.00 M	40 M	$500.00	41.89%	41.89%	0.75%	136.36%	10.56%
	VDH-148-RTR-1	1550 TOMCAT BLVD, VIRGINIA BEACH,VA	1.54 M	10 M	$350.00	37.52%	37.52%	14.96%	84.14%	47.08%
	VDH-109-RTR-1	201 FRANCIS MARION LN, MARION,VA	10.00 M	40 M	$500.00	35.77%	35.77%	17.61%	97.84%	209.13%
VEC	VEC-067-RTR-1	1300 GREENSVILLE COUNTY CIR, EMPORIA,VA	3.07 M	10 M	$350.00	33.01%	33.01%	6.19%	97.18%	30.00%
	VEC-076-RTR-1	233 COMMONWEALTH BLVD W,STE VEC-076,MARTINSVILLE,VA	5.00 M	20 M	$410.00	30.24%	30.24%	4.63%	55.06%	9.58%
	VEC-075-RTR-1	761 CLAYPOOL HILL MALL RD, CEDAR BLUFF,VA	6.14 M	20 M	$508.00	25.45%	25.45%	9.19%	40.14%	15.78%
VSP	VSP-144-R1	600 INDEPENDENCE PKWY, CHESAPEAKE,VA	10.00 M	40 M	$500.00	23.56%	23.56%	6.37%	74.26%	12.54%
	VSP-142-R1	2943 PETERS CREEK RD NW,STE VSP,ROANOKE,VA	10.00 M	40 M	$500.00	22.30%	22.30%	8.42%	58.55%	16.72%
	VSP-001-RTR-1	7700 MIDLOTHIAN TPKE,STE VSP -001,RICHMOND,VA	200.00 M	500 M	$1,330.00	21.42%	21.42%	10.11%	97.25%	39.81%
	VSP-404-RTR-1	3804 LOREN DR, FREDERICKSBURG,VA	5.00 M	20 M	$508.00	21.17%	21.17%	3.07%	71.68%	12.05%
	VSP-414-R1	515 S MAIN ST, AMHERST,VA	10.00 M	40 M	$500.00	17.02%	17.02%	5.12%	97.44%	15.68%
				Monthly Total:	**$47,262.00**					
				One-time setup charge:	**$41,541.50**	* one-time SD-WAN line activation setup charge of $500.50 per location				