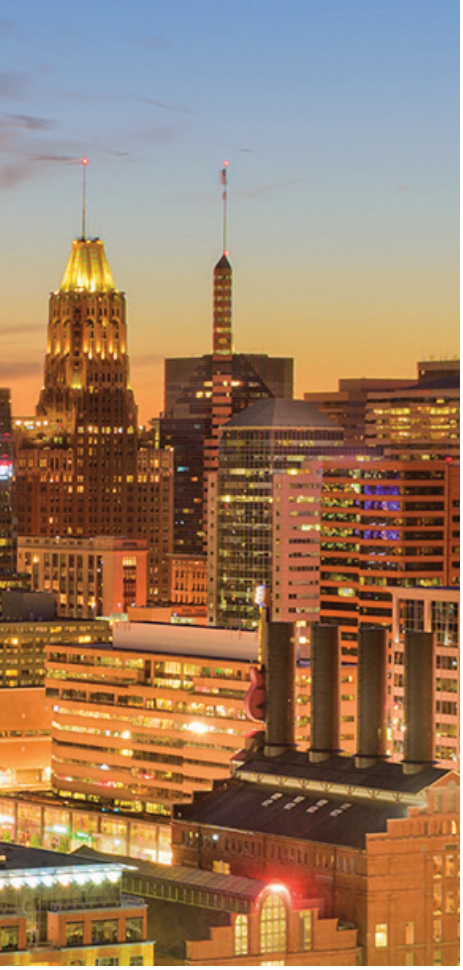
Maryland
DEPARTMENT OF INFORMATION TECHNOLOGY

networkMaryland™

VALUE & ROI ANALYSIS



networkMaryland™

EXECUTIVE SUMMARY

The networkMaryland™ is a state managed network leveraging over 3,300 miles of state/partner owned fiber and state owned equipment to provide its subscribers a highly available, secure, and scalable portfolio of network communication services. The network currently connects over 950 sites from 128 state and local government organizations with 390 Gbps of provisioned bandwidth.

DoIT has been investing in this infrastructure since 2003, but the real growth in a fiber rich infrastructure began in 2012, bringing high broadband capacity to every county in Maryland. This enabled the connection capability of every K-12 school and community college in the state to a secure, high broadband network. DoIT has continued to make strategic investments in expanding networkMaryland™, enabling DoIT to cost effectively and securely host additional Cloud services, a statewide VoIP service, direct peering with key SaaS providers (ie; Google, Amazon, YouTube, etc), Security Services, and even providing fiber connections to many of the Maryland FiRST public safety communications towers and supporting e911 service expansion. Such a capability had previously been impossible due to high cost and service availability constraints in these remote areas.

This document details the approach taken to make a financial quantification of the overall value of networkMaryland™ to identify what the state saves annually by managing its own robust communications infrastructure. The approach was to compare the costs of a functionally equivalent fully leased infrastructure, including leased circuits and dark fiber against the actual costs of the program. The difference between the two represents the annual savings to the state. The analysis yielded a staggering $111M in annual savings. Table 1 provides a summary of the financial analysis.

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Annual Value ROI Summary

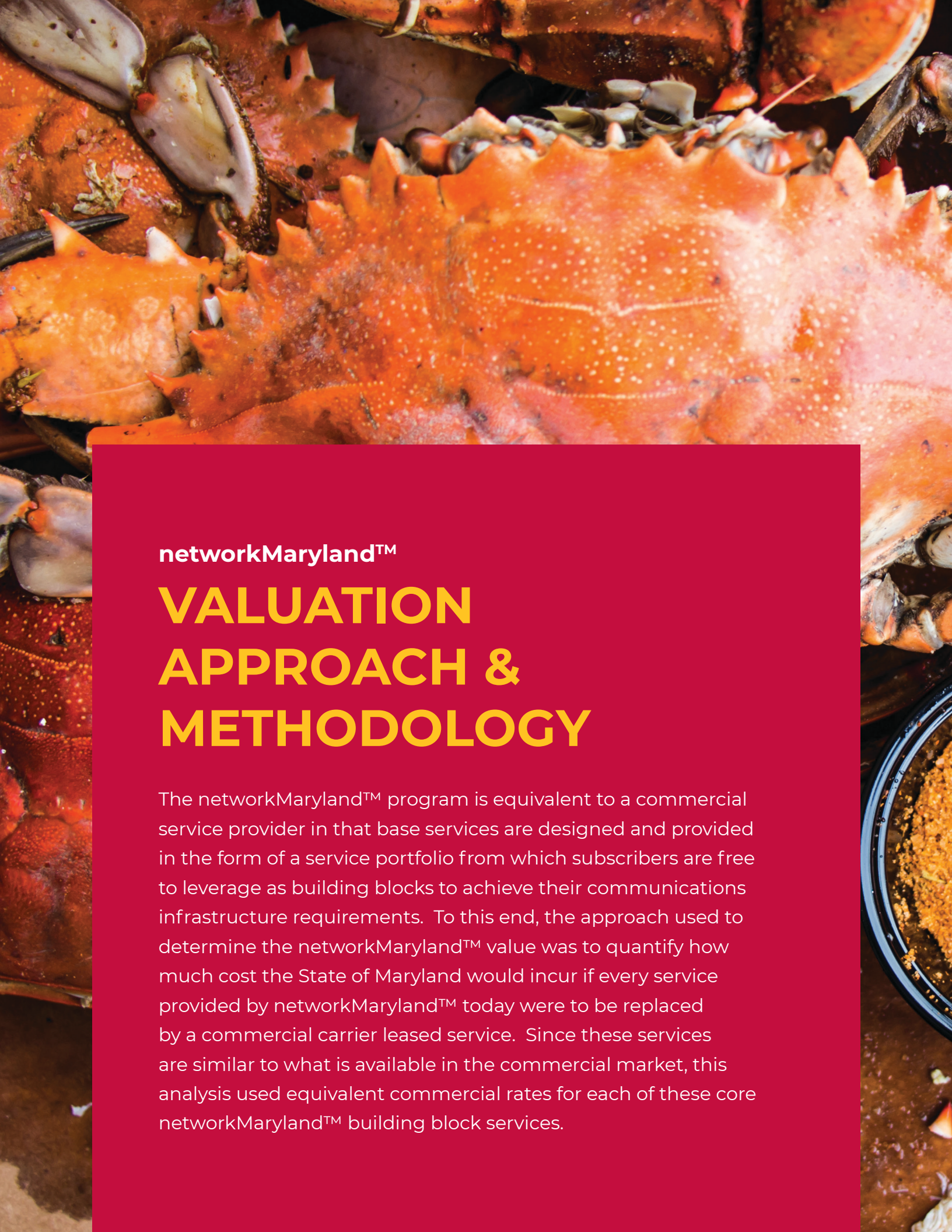
Table 1

ANNUAL SAVINGS TO STATE = TOTAL VALUE - OPERATING EXPENSES	
NMD Annual Services Value	$126,268,769.04
NMD Annual Program Expenses	$14,500,000.00
Annual Value to State	**$111,768,769.04**

This approach used conservative numbers in assigning value. It does not take into account that in many places where networkMaryland™ provides a service, an equivalent broadband capacity or service is actually not available from alternative providers. Consequently, this valuation represents the lower range of what the state saves with networkMaryland™.

871%

Annual ROI



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VALUATION APPROACH & METHODOLOGY

The networkMaryland™ program is equivalent to a commercial service provider in that base services are designed and provided in the form of a service portfolio from which subscribers are free to leverage as building blocks to achieve their communications infrastructure requirements. To this end, the approach used to determine the networkMaryland™ value was to quantify how much cost the State of Maryland would incur if every service provided by networkMaryland™ today were to be replaced by a commercial carrier leased service. Since these services are similar to what is available in the commercial market, this analysis used equivalent commercial rates for each of these core networkMaryland™ building block services.

DoIT networkMaryland™

PROGRAM SERVICES VALUATION

networkMaryland™ provides several "services" that subscribers can request through the network services request process.

Base Services

LAYER 2 CIRCUITS
Ethernet Everywhere (EE)

SwGI
Statewide Government Intranet

INTERNET
Direct Internet Access services

VPRN
Virtual Private Routed Network (Layer 3 VPN services – any to any communication). The "Enterprise" project created several DoIT specific VPRN instances to support shared services such as Active Directory, DNS, GIS, WLAN/Guest access, and NOC monitoring. In addition, the Enterprise project converted many agencies still leveraging a "hub and spoke" architecture to a much more robust "mesh" architecture using VPRN services.

In addition to the "provisionable" base services, there are dark fiber optic cabling "circuits" that are made available to subscribers. This dark fiber service is ONLY available to specific subscribers but is leveraged by large programs such as the statewide FiRST (700 MHz radio systems) and several county governments.

Each of the described services has an equivalent of like services available from commercial service providers, and quotes or contract rate sheets from private industry were used to determine the equivalent service value.

The services provided by DoIT under the networkMaryland™ program have been divided into two basic categories. The first category are the services that are "orderable" by subscribers under the networkMaryland™ network service request process and are considered networkMaryland™ base services. These are services that are available to any subscribing entity. The second service category represents assets belonging to or controlled by DoIT that are made available to specific partner organizations that are not available to all subscribers. Currently this category consists only of dark fiber services but could include optical services and wireless services in the future. Table 2 provides the resulting summary values of the services provided under the networkMaryland™ program.

Table 2

TOTAL ANNUAL MARKET VALUE OF DoIT SERVICES	
NMD Base Service Value	$122,924,916.24
DoIT Dark Fiber Service Value	$3,343,852.80
	$126,268,769.04

networkMaryland™

BASE SERVICES VALUATION

As detailed above, networkMaryland™ offers four flavors of "base services" to its subscribers. Reports were pulled directly from the current networkMaryland™ circuit database in ServiceNow that detailed the total number of active circuits and their associated subscribed bandwidth. Each service was then valued based on like service costs from the private industry. The summarized results are detailed in Table 3. The total base service offerings are currently valued at $10.2M/monthly or $122.9M /yr.

Table 3

SERVICES VALUE SUMMARY

Circuit Type	Total BW (mbps)	%BW	$/mnt/mb	Monthly Value	Annual Value
ISP	155872	43%	1.91	$297,715.52	$3,572,586.24
Layer 2	32625	9%	3.21	$104,726.25	$1,256,715.00
mgmt*	8		56.75	$454.00	$5,448.00
Print*	5		56.75	$283.75	$3,405.00
SecaaS*	3400		56.75	$192,950.00	$2,315,400.00
SwGI*	2000	48%	56.75	$113,500.00	$1,362,000.00
Voice*	4		56.75	$227.00	$2,724.00
VPN	0		56.75		
VPRN	167988		56.75	$9,533,319.00	$114,399,828.00
Wireless*	10		56.75	$567.50	$6,810.00
Total BW	361912			**$10,243,743.02**	**$122,924,916.24**

*Dedicated VPRN

BASE SERVICES EVALUATION

INTERNET SERVICES

Internet services are services that provide direct access to the global Internet to its subscribers. There are two major categories of Internet Services available for lease/purchase in the commercial market:

RESIDENTIAL BROADBAND

BUSINESS GRADE TRANSIT SERVICES

While additional variants can exist, the major categories represent the majority of the services available. Residential broadband are those services that are designed to provide Internet access to residences. These services can typically operate between 25Mbps and 1Gbps and are asymmetric in nature in that download bandwidth is typically higher than upload bandwidth capacity in a 4:1 ratio or higher. Additionally, these services are highly oversubscribed and do not offer service level agreements to their customers. The services are best effort in nature and the available bandwidth to any single customer fluctuates wildly depending on current usage patterns within the network. These services are typically offered at a flat subscription cost per month and are sometimes coupled with usage limits in terms of total transferred data where users that transmit above the maximum amount result in either lower performance or additional costs incurred.

The second category of Internet Services are business grade services designed to support business access to the global Internet. These services are typically coupled with strict service level agreements in terms of availability as well as performance. These services can be provided in bandwidths between 1Gbps and 100+Gbps. These services are highly reliable and are engineered by the carrier to ensure full bandwidth availability at all times for transit services within their network infrastructure. Costs structures for these services are usually tiered in that costs per Mbps decrease as bandwidth ordered increases. These business grade services are more closely related to the services provided by networkMaryland™ to its subscribers. As such, business grade commercial Internet services were used to develop a cost model for the networkMaryland™ services.

BASE SERVICES EVALUATION

INTERNET SERVICES

continued

Pricing was obtained for transit Internet services from a recent networkMaryland™ project to add a new 2Gbps ISP service to the infrastructure. Verizon provided a quote based on the rate structure under the state telecommunications contract and was used to develop a base commercial cost/Mb/month to derive the networkMaryland™ ISP service value. The Verizon quote was for $3840/month which calculates out to a cost of $1.91/Mbps/Month. ISP service bandwidth costs decrease as the committed rate increases (for example a 5Gbps service from Verizon is $1.09/Mbps/month). A review of the networkMaryland™ ISP service subscriptions shows that most of the subscriber services are below 1Gbps and the 2Gbps rate from Verizon was considered a viable base rate to evaluate against networkMaryland™ services.

The second step in the valuation of ISP services was to develop a summary of the total subscribed ISP bandwidth provided by networkMaryland™. The CMDB was leveraged to provide this data, yielding a subscribed capacity total of 155,872Mbps based on the 300 current active Internet services (average rate per service ~500Mbps). This total subscribed capacity was then multiplied by the above commercial cost/Mbps/month from the Verizon quote.

155,872Mbps

X $1.91/Mbps/month

$297,716/month

[$3,572,586/yr.]

BASE SERVICES EVALUATION

Layer 2 SERVICES

Layer 2 services operate at the datalink layer of the OSI model and provide a basic point to point service that subscribers can then use to establish their own WAN infrastructure. networkMaryland™ provides Layer 2 services in the form of "Ethernet" services that can connect any subscriber facility/UNI service port to any other facility/UNI service port in the state of Maryland. Layer 2 services are available in bandwidth rates between 1Mbps and 10Gbps and represent ~9% of the total service subscriptions in terms of bandwidth by networkMaryland™ subscribers (32.6Gbps).

networkMaryland™ leverages similar services from Verizon to extend networkMaryland™ to facilities that are not directly on the Maryland fiber infrastructure. To that end Verizon has provided an extensive cost matrix to the State under the current telecommunications contract. The components of these costs under Verizon are comprised of two items:

UNI PORT CHARGE
(dependent on 100M, 1G, or 10G port size)

BANDWIDTH SUBSCRIPTION COST

Verizon also offers several differentiated Quality of Service SLAs associated with the subscribed bandwidth. However DoIT does not currently leverage these enhanced services and as such a clear cost structure was not able to be provided. The cost matrix provided by Verizon provides a specific cost per combination of UNI and subscribed bandwidth. The matrix is detailed in Table 4.

The Verizon costs were then used as a cost basis from which to evaluate the associated networkMaryland™ services. networkMaryland™ provides more granular service rates and as such a direct NMD service to Verizon service comparison was not possible. To provide a cost basis, the Verizon costs were divided into three categories, then for each category, the associated Verizon costs/Mbps/Month were calculated out and averaged to create three categorized Cost/Mbps/Month rates.

0 - 199Mbps	$23.02/Mbps/Month
200 - 999Mbps	$3.17/Mbps/Month
>1Gpbs	$1.39/Mbps/Month

BASE SERVICES EVALUATION

Layer 2 SERVICES

continued

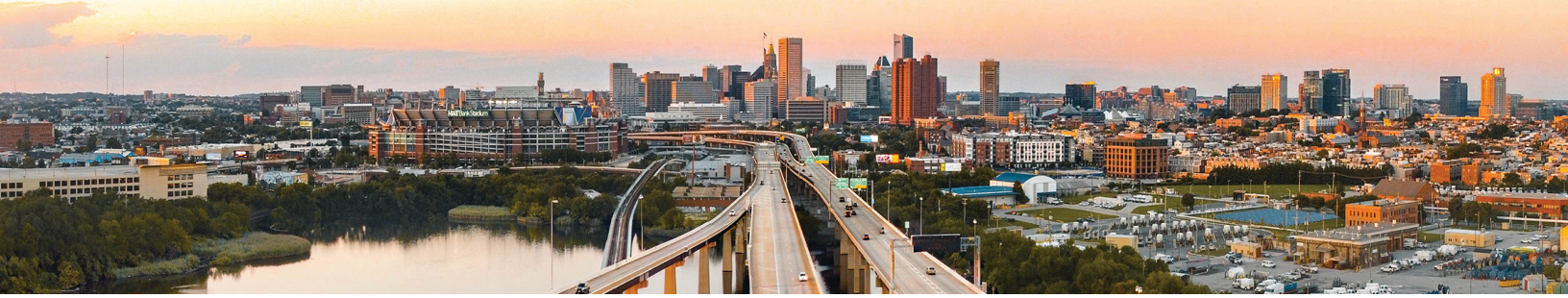
This cost matrix was used to derive a cost for each NMD circuit. The total value of the networkMaryland™ Layer 2 services were calculated to be $104,726/month or $1,256,715/year.

Note: The $3.21 cost/Mbps/month listed in Table 3 (yellow highlighting) for the Layer 2 services is an average based on the $104,567.91 total value divided by total Layer 2 provisioned bandwidth to ensure the summary total was accurately represented.

Table 4

VERIZON EvPL RATES

UNI	VC Speed	Ckt Speed	VZ UNI	VZ MRC	VZ Total Cost/Month	Cost/Mbps/Month	Grouped Avg Cost/Mbps/Month
10	5	5	$372.45	$58.67	$431.12	$86.22	
10	10	10	$372.45	$117.85	$490.30	$49.03	
100	20	20	$372.45	$171.43	$543.88	$27.19	
100	30	30	$372.45	$229.59	$602.04	$20.07	
100	40	40	$372.45	$244.90	$617.35	$15.43	
100	50	50	$372.45	$229.59	$602.04	$12.04	$23.02
100	60	60	$372.45	$235.59	$608.04	$10.13	
100	70	70	$372.45	$267.86	$640.31	$9.15	
100	80	80	$372.45	$306.12	$678.57	$8.48	
100	90	90	$372.45	$344.39	$716.84	$7.96	
100	100	100	$372.45	$382.24	$754.69	$7.55	
1000	200	200	$484.69	$612.24	$1,096.93	$5.48	
1000	300	300	$484.69	$918.37	$1,403.06	$4.68	
1000	400	400	$484.69	$1,000.00	$1,484.69	$3.71	
1000	500	500	$484.69	$1,147.96	$1,632.65	$3.27	
1000	600	600	$484.69	$1,224.49	$1,709.18	$2.85	$3.17
1000	700	700	$484.69	$1,250.00	$1,734.69	$2.48	
1000	800	800	$484.69	$1,306.12	$1,790.81	$2.24	
1000	900	900	$484.69	$1,331.63	$1,816.32	$2.02	
1000	1000	1000	$484.69	$1,331.63	$1,816.32	$1.82	
10000	2000	2000	$2,551.02	$1,962.48	$4,513.50	$2.26	
10000	3000	3000	$2,551.02	$2,496.39	$5,047.41	$1.68	
10000	4000	4000	$2,551.02	$3,030.30	$5,581.32	$1.40	$1.39
10000	5000	5000	$2,551.02	$3,564.20	$6,115.22	$1.22	
10000	8000	8000	$2,551.02	$5,165.93	$7,716.95	$0.96	
10000	10000	10000	$2,551.02	$5,339.09	$7,890.11	$0.79	



BASE SERVICES EVALUATION

VPRN SERVICES

VPRN (Virtual Private Routed Network) services represent most of the services provided by networkMaryland™ both in terms of bandwidth as well as circuit counts. networkMaryland™ provides 171.4Gbps of total subscribed services. The networkMaryland™ VPRN services are analogous to Commercial MPLS L3VPN services. Commercial carriers market this base service in many ways, but they provide any-to-any site connectivity on a "network" layer service (Layer 3) referencing the OSI model. Services costs typically apply a structured cost model with costs/Mbps/month decreasing as subscribed bandwidth increases. The costs, like Layer 2 services, are derived based on a combination of UNI port costs and subscribed bandwidth service rate.

Currently, networkMaryland™ does subscribe to L3VPN services provided by Verizon for a few service sites that are outside of the Maryland state boundaries. The Verizon marketing term for the service(s) is PiP (Private IP). There are only five current services in production. A full rate sheet of PiP services was not available and service costs appear to be very site location dependent based on a review of the current service costs from Verizon. An effective cost/Mbps/Month was calculated on each of the current production services which yielded rates between $51.62 – $1260.33/month. The higher rates were associated with sites in rural areas of West Virginia. There were two aggregation sites (St Paul and College Park) that have 30Mbps services that were used as a basis of estimate for L3VPN services. These services calculated rates of $51.63 (St Paul) and $62.17(College Park)/Mbps/month. These costs were averaged together to yield the $56.75/Mbps/Month that is used to value the networkMaryland™ services.

Although the cost basis sample is low, an additional comparison point was provided by the DoIT contractor Skyline for commercial services that Skyline incurs in support of another program (non-Government rates). These similar services are provided by LUMEN and averaged over $65/Mbps/Month for circuits that are between 200 and 1Gbps service rates. Based on this additional comparison the $56.75 rate was deemed sufficiently accurate for the purposes of this exercise.

Leveraging this derived base service rate, the total networkMaryland™ VPRN services are estimated to be $9,727,801/month or $116,733,612/yr. SwGI services are not included in this service value as they were broken out separately (see below). All other VPRN services listed in Table 2 were combined for this total as the other services (MgMT, Print, SECaaS, Voice, Wireless) are all specialized implementations of a VPRN service.

BASE SERVICES EVALUATION

SwGI SERVICES

SwGI has been separated from standard VPRN services due to an artificially high subscription rate. SwGI is a value-add service to the state of Maryland and to promote its use the service is typically "bundled" with ISP services as a "free" add on. Due to this bundling, subscribed bandwidths often exceed the actual bandwidth needs of the associated organizations and therefore can represent an artificially inflated subscription total. The current total SwGI subscribed service rate is 34,988Mbps (~35Gbps). Due to this "overcounting", a different method was leveraged to determine the SwGI total subscription rate. Utilization reports for one month were leveraged to review the total SwGI bandwidth consumed and then that rate was used to derive a more accurate associated subscribed bandwidth.

As detailed in Table 3, the associated total SwGI bandwidth subscription was reduced from ~35Gbps to 2000Mbps (2Gbps) to represent the usage more accurately. The resulting 2000Mpbs subscribed bandwidth was then valued using the $56.75/Mbps/Month cost basis detailed in the section above to yield a total SwGI service value of $113,500/month or $1,362,000/yr.

SwGI is a closed private routed network that is designed to facilitate inter-agency communications permitting member organizations to both access data and services and present data/applications for consumption over a common infrastructure that is separate from the public Internet. The SwGI service is leveraged to support applications like the State Financial Management Information Service (FMIS), Criminal Justice Information System CJIS/Computer Aided Dispatch, and the Maryland Coordination and Analysis Center (MCAC) video sharing solution. The SwGI solution is a VPRN instance with specialized route policy applied.

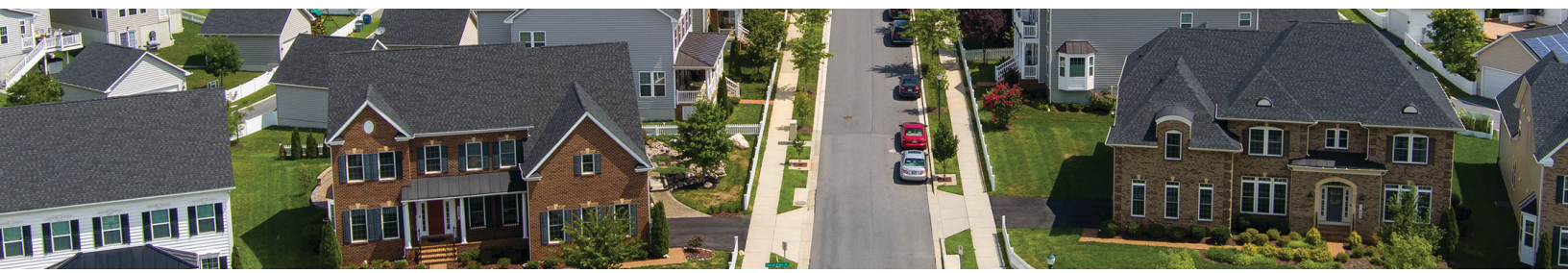
BASE SERVICES EVALUATION

DARK FIBER SERVICES

Dark fiber services in commercial environments are typically available for leasing by customers on a $/linear route mile basis. Customers pay for the linear distance the fiber circuit traverses along its route path between facilities. Commercial rates vary significantly depending on distance and location. A conservative (one of the lower) rate cost of $60/route-mile/month was used to value the networkMaryland™ dark fiber services. As a comparative reference point, two Maryland Counties are leasing out their excess dark fiber services at $100/month per route-mile.

A report was created detailing all of the external fiber circuits currently provided by DoIT. This included fiber circuits supporting various counties as well as the state 700Mhz system (a separate DoIT program). The report resulted in a total of $4,644 route-miles leased across 627 separate fiber circuits. Using the $60/route-mile/month cost basis this resulted in a total value for Dark Fiber provided services of $278,654/month or $3,343,853/yr.

DoIT Dark fiber services provide access to strands of DoIT excess unlit (dark) fiber to organizations outside of the networkMaryland™ program. Fiber assets used directly by networkMaryland™ are not considered part of this service offering as they are used by DoIT internally to provide the services valued in the previous section and would be considered a cost to the delivery of the above services and are simply excluded from this exercise. (They would represent a cost in one section and an equal value in another resulting in a $0 delta.)



DoIT networkMaryland™

PROGRAM COSTS & EXPENSES

The team worked with DoIT staff to categorize and summarize the expenses associated with the networkMaryland™ program. Table 5 provides the high-level overview of the expense summary information compiled.

Table 5

EXPENSES SUMMARY

Annual DoIT Operating Expenses	Amount
Total Leased Services (i.e., Verizon Bill)	$6,000,000
Total NMD Operations Costs	$4,500,000
Pole Attachment Rights	$367,000
Internet Services Costs (Lumen/Others)	$1,795,000
DoIT Personnel Costs	$550,000
Other Facilities Costs	$66,000
Equipment Purchases	$450,000
Vendor OPEX (i.e., support contracts)	$772,000
Total Annual Operating Costs	**$14,500,000**

DoIT networkMaryland™

PROGRAM COSTS & EXPENSES

continued

As detailed in the table, the total expenses are $14.5M/yr. The categories contributing to these expenses are as follows:

$6.0M/yr.	**LAST MILE CARRIER SERVICES**
$4.9M/yr.	**NMD CONTRACTING COSTS** • O&M Contract annual costs (NOC, Maintenance, and Break fix activities) • Fiber Pole attachment and emergency repair efforts
$1.8M/yr.	**INTERNET SERVICES** • Total costs for all upstream transit and peering Internet service bandwidth. This is a compiled cost for LUMEN, Verizon, Comcast, and peering services such as the Equinix peering fabric/LambdaRail/ MDREN
$0.6M/yr.	**DoIT DEDICATED PROGRAM STAFF**
$0.1M/yr.	**FACILITIES COSTS**
$0.5M/yr.	**EQUIPMENT PURCHASES** (DoIT does not use deprecation tables)
$0.8K/yr.	**VENDOR OPERATING EXPENSES** (license & support contracts)

DoIT networkMaryland™

EXCLUSIONS

There are additional value-added services that DoIT provides beyond the above base services, but were not included in the equivalent valuation. DoIT also provides networkMaryland™ VPRN connections to support the following services:

VOICE SERVICES (SIP TRUNKING AND MANAGED VOICE)

SECURITY SERVICES

- Managed Firewall offerings
- Distributed Denial of Service (DDOS) mitigation services
- Vulnerability scanning services
- Remote Access services

CLOUD SERVICES

- AWS direct connectivity
- Single and dual availability zone connectivity
- DoIT Managed Compute/Storage

Valuing these services would require much more time and involvement of other DoIT Service groups. Consequently, the "over the top" services have not been included in this valuation and have been left for the DoIT Service owners to evaluate. Adding these services to the valuation would further increase the total service value of the networkMaryland™ program.