



*Infrastructure Engineering*  
*WAN-LAN Infrastructure Engineering and Provisioning*

VISN 7 Picture Archive and Communications System (PACS)

Version 2.0  
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**VA**



**U.S. Department of Veterans Affairs**  
Office of Information and Technology  
*IT Operations and Services*

**Revision History**

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05/29/2018	Initial draft	1.0	Michael Seaman

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## 1 EXECUTIVE SUMMARY

The Department of Veterans Affairs Veterans Integrated Service Network 7 (VISN-7) composed of eight VA Medical Centers (VAMC) is deploying an upgrade to their Picture Archive and Communications System (PACS) and require a tightly integrated voice recognition system for supported disciplines. The PACS design intends to have the primary database hosted at the Augusta Georgia VAMC and a secondary database at the Birmingham Alabama VAMC.

Currently the eight VAMC have six deployments of VistaRAD and two commercial PACS all operating in an autonomous design processing over 800,000,000 images a year. The network traffic from these autonomous systems presently does not traverse the VA WAN. There are limited instances where the National Tele-Radiology program reads images across the WAN however no significant WAN traffic from PACS exists today.

The project has defined the requirement for WAN capacity to support 25Mbps of PACS Imaging traffic. The goal is to support Radiologist reading images from anywhere at any time as the standard of interoperability between VISN-7 VAMCs. Community Based Outpatient Clinics (CBOCs) shall also have PACS local image viewing capability. The new PACS system will expand the imaging modalities and image fidelity thereby increasing the overall volume in terms of image size, complexity and support for new technology.

The VIAN-7 Radiologist Reading stations shall consist of  $\pm 25$  workstations with dual 12 Mega-Pixel (MP) displays and  $\pm 150$  workstations with dual 6 MP displays. The CBOC reading stations consist of  $\pm 46$  workstations and a single 6 MP monitor.

Remote CBOC sites shall be evaluated to determine the actual circuit speed necessary to meet image download expectations; "Some display speed loss is allowed at remote sites depending on the bandwidth at those sites and slowness induced by firewalls, but response time shall be less than five seconds".

The VAMC affected by this upgrade follow:

- 1) Atlanta VAMC: 1670 Clairmont Road, Decatur, GA 30033
- 2) Augusta VAMC-Uptown Division: 1 Freedom Way, Augusta, GA 30904 (Charlie Norwood).
  - Downtown Division: 950 15th Street, Augusta, GA 30901
- 3) Birmingham VAMC: 700 S. 19<sup>th</sup> Street, Birmingham, AL 35233
- 4) CAVHCS VAMC-West Campus: 215 Perry Hill Road, Montgomery, AL 36109-3798
  - East Campus: 2400 Hospital Road, Tuskegee, AL 36083-5501
- 5) Charleston VAMC: 109 Bee Street, Charleston, SC 29401-5799 (Ralph H. Johnson)
- 6) Columbia VAMC: 6439 Garners Ferry Road, Columbia, SC 29209-1639 (Wm. Jennings Bryan Dorn)

7) Dublin VAMC: 1826 Veterans Blvd, Dublin, GA 31021 (Carl Vinson)

8) Tuscaloosa VAMC: 3701 Loop Road, East, Tuscaloosa, AL 35404.

## **2 WAN CAPACITY EVALUATION**

The WAN capacity evaluation shall be derived from imaging data capacity estimates by modality furnished by the VISN-7 project team. To conduct a capacity evaluation it is necessary to set standard design criteria for the PACS traffic flow between the Medical Centers PACS databases, Medical Center reading stations and between CBOC reading stations and between primary tier (1) and secondary tier (2) storage. The capacity evaluation shall discover the highest expected volume occurring during the first shift. The capacity recommendation for the first shift shall be sufficient to support the remaining shifts. The following standard traffic flows shall be evaluated.

1. The Augusta Downtown and CAVHAC East Campus did not provide any imaging data that could be used to develop a recommendation for WAN circuit speed or capacity.
2. PACS images from each VA Medical Center shall be stored in a local PACS database. It is estimated that 50% of these images shall be read by a local Radiologist and the remaining be read remotely. Once the images are read they will be uploaded to primary tier (1) storage located at the Augusta VA Medical Center.
3. All PACS images shall be uploaded to the primary tier (1) storage for VISN-7 located at the Augusta VAMC. It is estimated 50% of these images shall be read by a Radiologist within VISN-7 or across the WAN.
4. All images being read from CBOCs shall be downloaded from primary tier (1) storage located at the Augusta Medical Center. It is estimated that 50% of the image volume; (53 Tera-Bytes) shall be downloaded by the 50 CBOCs requiring that CBOCs have WAN capacity to support the download requirement.
5. All tier (1) storage shall be replicated in real time from Augusta primary tier (1) storage to Birmingham secondary tier (2) storage.
6. Images being read at any location shall require 1 or 2 prior patient studies that are stored within tier (2) storage, thereby increasing the overall capacity need to support reading stations.

At times Ad-Hoc image transfers between reading stations and any VISN 7 PACS may be necessary to serve patient needs. For the purpose of this evaluation Ad-Hoc transfers are not included within the WAN circuit sizing as no estimates are provided and Ad-Hoc. If however Ad-Hoc image transfers become a normal practice then the conclusions from this WAN evaluation will need to be updated to reflect the Ad-Hoc behavior.

Table 1 and 2 provide the RAW data used to perform calculations to determine the capacity for the WAN circuits necessary to transfer the daily estimated tier (1) and (2) image workload and VA Medical Center and CBOC reading of images during an 8 hour shift.

**TABLE 1:**

1. The current capacity supporting imaging flows is 42Mbps for the VA Medical Centers and 70Mbps for Charleston and Birmingham. (Line 11). These capacities are also redundant thereby doubling the overall capacity to 84Mbps and 140Mbps respectively.
2. Each of the PACS can replicate (egress from the PACS) to Augusta tier (1) PACS storage using the current WAN circuit sizes within a shift, (Line 12). The minimum time needed to replicate all tier (1) imaging is .34 hours and the maximum is 3.10 hours.
3. Tier (2) replication, ingress to Birmingham and egress from Augusta exceeds replication within an 8 hour shift, (Line 16). Tier (2) egress from Augusta is estimated to 21.37 hours and ingress to Birmingham of 12.82 hours. These two sites will require an increase in WAN circuit speed to support this replication.
4. Augusta and Birmingham are the only two Medical Centers that require additional capacity to support tier (1) and tier (2) replication traffic, (Line 18). Upgrading the WAN circuits to 1Gbs speed permits all replication to complete within 6.41 hours.
5. Augusta and Birmingham configured with a 1Gbs WAN circuit offers the ability to replicate within a single shift, (Line 22)

**TABEL 2:**

6. CBOC reading station will be downloading images of varying sizes through the operating hours. Where each CBOC is currently operating on a 10Mbps WAN circuit and by adding 20Mbps of capacity to support new application services will yield the download times indicated. It should be noted that all but two image modalities experience a download time of 5 minutes or less and two experience a download time of 9 minutes and 21 seconds. This is estimated as worst case situation and may actually be better than our models estimated.

**TABLE 3:**

7. The CBOC reading stations require a 30Mbps circuit to support a single radiology reading station. VISN-7 CBOCs are primarily configured with 10Mbps. Several are provisioned with 45 Mbps and 100Mbps circuits. The recommendation to support a reading station is for a CBOC with 10Mbps to upgrade to a single 30Mbps Metro-E WAN circuit.

**TABEL 1 VISN 7 MEDICAL CENTER PROFILES**

1		Tuscaloosa	Dublin	Columbia	Charleston	CAVCHS	Birmingham	Augusta	Atlanta
2	Percent of Total	1.59%	4.16%	14.51%	13.74%	6.00%	12.70%	20.62%	26.67%
3	The following ROWS are converted from bytes to bits to be compatible with WAN circuits where all thae math utilizes bits								
4	Total Traffic by Site (Mb)	11,311,392	29,581,047	103,144,034	97,663,789	42,670,706	90,271,491	146,589,814	189,580,958
5	Total Week Day by Site (Mb)	51,415	134,459	468,837	443,926	193,958	410,325	666,317	861,732
6	Total Tier 1 Replication traffic to Augusta (Mb)								2,564,652
7	Total Tier 2 Replication to Birmingham (Mb)								3,230,969
8	Present WAN Circuit speed in (Mbs)	300	500	300	500		500	300	300
9	Montgomery					300			
10	Tuskegee					300			
11	QOS Profile Imsging Queue 14% of the circuit speed in (Mbs)	42	70	42	70	42	70	42	42
12	At 42 Mbs the time to transmit the total of Line 5	0.34	0.53	3.10	1.76	1.28	1.63		5.70
15	Tier 1 Replication time							16.96	
16	Tier 2 Ingress to Birningham and Egress from Augusta						12.82	21.37	
18	WAN Circuit size needed To support the estimates	No Change	No Change	No Change	No Change	No Change	1Gbs	1Gbs	
20	QOS Profile Imsging Queue 14% of the 1 Gbs circuit speed in (Mbs)						140.00	140.00	
22	At 140 Mbs the time to transmit the Tier 2 Replication						6.41	6.41	

**TABEL 2 IMAGE MODALITY DOWNLOAD SPEED**

	Imaging Modality	Average Image size in MB	Download Time in Minutes and seconds
			<b>30Mbps</b>
	<b>Imaging Queue of 14%</b>		<b>4,200,000</b>
<b>1</b>	Computed Tomography	275	02:35
<b>2</b>	Magnetic Resonance Therapy	200	01:53
<b>3</b>	Digital X-Ray	30	00:17
<b>4</b>	Ultrasound		00:00
<b>5</b>	US non Vas	40	00:23
<b>6</b>	Vascular Ultrasound	550	05:10
<b>7</b>	Mammography	996	09:21
<b>8</b>	Mammography (Estimated Future Growth)	996	09:21
<b>9</b>	Nuclear Medicine		00:00
<b>10</b>	NM (No X-Ray)	15	00:08
<b>11</b>	PET/CT & SPECT/CT	281	02:38
<b>12</b>	Vascular Intervention Radiology	600	05:38
<b>13</b>	Densitometry	50	00:28
<b>14</b>	Biopsy	32	00:18
<b>15</b>	Dental		00:00
<b>16</b>	Fluoro and Minor Procedures	100	00:56
<b>17</b>	Non-Radiology	150	01:25

**TABEL 3 CBOC WAN CIRCUITS**

	<b>Atlanta VAMC CBOCs 14</b>	<b>Existing Circuit</b>	<b>WAN Circuit needed to support CBOC reading Station</b>
1	Austell	10	30
2	Blairsville	10	30
3	East Point	10	30
5	Ft McPherson	100	30
6	Fulton County	10	30
7	Gwinnett County	10	30
8	Henderson Mill	10	30
9	Lawrencville	10	30
10	Newman	10	30
11	Oakwood	10	30
12	Rome	10	30
13	Stockbridge	10	30
14	Trinka Davis	10	30
15	Arcadia	10	30
17	<b>Augusta Georgia VAMC CBOC's 3</b>		
18			30
19	Aiken	10	30
20	Athens	10	30
21	Statesboro	10	30
23	<b>Birmingham Alabama CBOC's 9</b>		
25	Annistin.Oxforb	10	30
26	Bessemer	10	30
27	Birmingham	10	30
28	Childersburg	10	30
29	Gadsden	10	30
30	Guntersville	10	30
31	Huntsville	100	100
32	Jasper	10	30
33	Shoals Area	10	30
35	<b>CAVCHS 5</b>		
37	FT Rucker	10	30

		Existing Circuit	WAN Circuit needed to support CBOC reading Station
	<b>Atlanta VAMC CBOCs 14</b>		
38	Maxwell AFB	10	30
39	FT Benning	10	30
42	<b>Charleston 6</b>		
44	Beaufort	10	30
45	Goose Creek	10	30
46	Hinesville	10	30
47	Myrtle Beach - Market Common	100	100
48	Savannah	10	30
49	Trident	10	30
50	Trident Specialty Care	10	30
53	<b>Columbia 6</b>		
55	Anderson		30
56	Greenville		30
57	Orangeburg		30
58	Rock Hill		30
59	Spartanburg		30
60	Sumter		30
62	<b>Dublin 7</b>		
64	Albany	10	30
65	Brunswick	45	45
66	Macon	10	30
67	Macon Vet Center	10	30
68	Milledgeville	10	30
69	Perry	30	30
70	Tifton	10	30
72	<b>Tuscaloosa</b>		30
74	Selma	10	30

### 3 RECOMMENDATIONS

The WAN Evaluation identified several short comings that require upgrades. Two Medical Centers; (Augusta and Birmingham) require their WAN circuits to be upgraded to Metro-E 1Gbs.

The CBOCs with a 10Mbps or slower WAN circuit that will be reading images require a WAN circuit of 30Mbps.

The preferred circuits are Metro-E provisioned with the correct bandwidth and QOS profile.