

Virtual Student Labs

A K-12 Solution

Summary

Many school districts have moved to a one-to-one environment where students are provided their own Chromebook, Mac or Windows laptop / device. These devices can run most of the local educational software and web-based applications that are used daily, but not all. The applications that are unable to run on the student laptops are typically Windows applications that require a faster processor and / or memory than what the student device supports or in the case of Chromebooks, any windows application would not be supported. For those applications that cannot run directly on the one-to-one devices, districts purchase and maintain multiple windows-based labs.



For years, many school districts have been looking for an alternative to the situation. Virtual desktops or VDI was thought to be the answer, but the cost was too prohibitive and too complex to setup and maintain. Still, it would be preferred that the students use their one-to-one device in all class and lab situations.

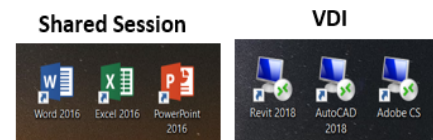
We believe now that a cost effect and easier to support VDI solution can be provided that will both significantly reduced hardware and software cost to the district as well as reduce the support effort for the technology staff. We also believe that the performance will meet the demands with the use of technology such as solid-state drives, faster CPUs and faster GPUs for graphics. **The goal is to replace a minimum of 3 standard labs with a single virtual server host.**

It is believed that the school based labs can be virtualized with a combination of off-the-shelf refurbished servers from vendors such as Trinity 3

(<http://www.trinity3.com>) or new servers from

companies such SuperMicro

(<http://www.supermicro.com>) along with



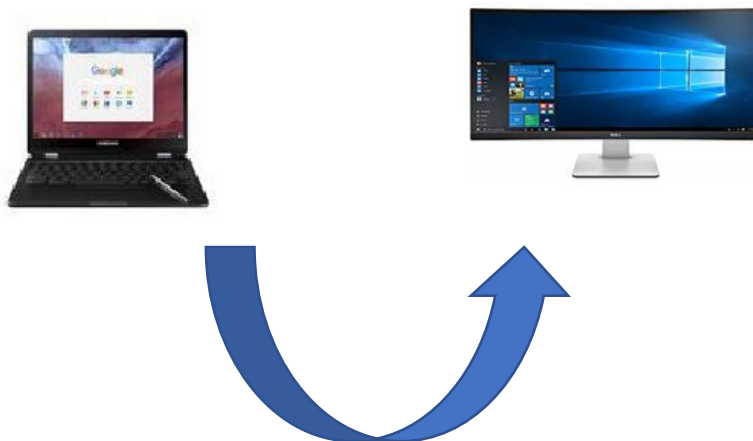
Microsoft's Hyper-V virtualization software. The combination supports both true VDI for CTE/CATE technology classes and shared session (terminal services) for classes that do not require an individual Windows 10 desktop but can run in a shared session (terminal server) environment. This provides a very flexible solution at a **cost-effective** price. It would allow the districts that are one-to-one with Chromebooks to utilize their Chromebooks as the end-point device to run windows-based applications. The districts that are one-to-one with windows devices would also benefit from a virtual lab solution since the student laptops typically are not capable of running software such as AutoCAD or Adobe's Creative Cloud software that requires faster processor speed and more memory.

Solution Cost Considerations

When building the virtual lab solution there are recommended hardware and software components that the district would need to purchase.

- Physical server to function as the host for the virtual lab
- Windows 2016 data center server software
- RDS client access licenses (CAL)
- Setup services for the solution

Note: Microsoft provides a free client in the Google Play Store than can be distributed to the district Chromebooks as well as for Macs and Android devices. Also, for classes such as AutoCAD, the student may still need to use a separate monitor, keyboard and mouse attached to their one-to-one device.



Cost Comparison

To justify the use of a virtual solution to replace or enhance existing traditional school district labs a cost comparison is provided. The comparison is based on discussions with multiple school districts. The chart below assumes that lab cost ranges from as low as \$600 to approximately \$800 per desktop or more.

MS Office Lab Count	Device Cost	Totals
1 lab x 30 computers	\$600	\$18,000
3 labs x 30 computers	\$600	\$54,000
8 labs x 30 computers	\$600	\$144,000

AutoCAD-Adobe Lab Count	Device Cost	Totals
1 lab x 30 computers	\$800	\$24,000
3 labs x 30 computers	\$800	\$72,000
8 labs x 30 computers	\$800	\$192,000

**** Note: Goal to replace a minimum of 3 labs with 1 virtual server host**

This comparison does not include the intangible cost:

- Cost of physically replacing lab computers (labor)
- Cost of disposing of the older computers
- Cost of time maintaining lab computers

Server Count Calculation

When considering the cost of virtualizing your student labs, there are a few items to consider when calculating the cost. You may be surprised how few servers you actually need to replace your existing physical student lab computers. In general, a server can support 60 - 100 VDI sessions (AutoDesk/Adobe/Microsoft) and a session server supporting 100 simultaneous connections.

1. How many labs are in the district that you wish to replace?
2. What classes are taught in the labs?
3. How many labs are running simultaneously?
4. How many computers are in each?
5. On average, how many students are in each?

**** Example Server Count Calculation on next page ****

Server Count Calculation – Example

1. Number of labs in the district = 20
2. Classes taught in labs
 - a. AutoDesk labs = 6
 - b. Adobe labs = 8
 - c. Office Suite labs = 6
3. Labs running simultaneously
 - a. AutoDesk = 3 simultaneously
 - b. Adobe = 4 simultaneously
 - c. Office = 4 simultaneously
4. Computers in each lab = 30
5. Average number of students in each lab
 - a. AutoDesk = 12
 - b. Adobe = 15
 - c. Office = 25

VDI Server Count = 4

AutoDesk VMs – $12 \times 3 = 36$ VDI sessions

Adobe VMs – $15 \times 4 = 60$ VDI sessions

Office – $25 \times 4 = 100$ VDI sessions

Server Count - 3 servers + 1 server for fault tolerance = 4

Virtualization Server Cost

The cost of the virtual server hardware has finally become viable and affordable with the use of off-the-shelf refurbished or new servers and the low cost of solid-state drives and memory. The cost of the server can vary, but current configuration shown below is approximately \$16,000 - \$20,000. Again, this does not include any software, including the following:

- Microsoft Server 2016 licenses – host and virtual
- Microsoft Windows 10 licenses – for full VDI support
- Microsoft RDS client access licenses (CALs)
- Setup Labor Services

Server Configuration Recommendation

A recommended server configuration below can be purchased from vendors such as Trinity3 (<http://www.trinity3.com>) for refurbished (1 generation back) or a new server from SuperMicro (<http://www.supermicro.com>).



In general, it is believed that a ratio of one virtual lab server for every three physical labs of computers would be assumed. If the district has eight labs, then assume three virtual host servers properly configured would be necessary along with a supply of replacement parts.



With this ratio in mind, the actual cost of the server verses the physical three labs would also be at potentially the same ratio of 3 to 1. ***A significant cost savings.***

Dell R730 (Refurbished) Configuration (May change over time)

Component	Qty	Recommendation
CPU	2	2 x 12 Core - Intel Xeon E5-2680v3 / 2.5 GHz
Memory	768	768GB
Disk	16	1TB Solid State Drives (SSD)
Controller	1	Perc H730P
NIC	2	4 port NIC - 1GB or 10GB
Video (GPU)	2	Nvidia Quadro P4000 (8G of ram)

SuperMicro 2029U-TRT (New) Configuration (May change over time)

Component	Qty	Recommendation
CPU	2	2 x 24 Core – 3GHz
Memory	1500	1.5TB – yes TB
Disk	16	1TB Solid State Drives (SSD) – Total 16TB (supports 24)
Controller	1 or 2	SCSI
NIC	2 - 4	4 – 1G NICs or 2 - 10GB NICs
Video (GPU)	2	Nvidia Quadro P4000 (8G of ram) – Needed for AutoDesk classes and possibly Adobe

The above recommended configuration should run 60 - 100 VDI simultaneous sessions and / or 100 simultaneous shared sessions (terminal servers).

GPU – What is it and why do I need it?

Definition - What does *Graphics Processing Unit (GPU)* mean?

A Graphics Processing Unit (GPU) is a single-chip processor primarily used to manage and boost the performance of video and graphics. GPU features include:

- 2-D or 3-D graphics
- Digital output to flat panel display monitors
- Texture mapping
- Application support for high-intensity graphics software such as AutoCAD
- Rendering polygons
- Support for YUV color space
- Hardware overlays
- MPEG decoding

These features are designed to lessen the work of the CPU and produce faster video and graphics.

A GPU is not only used in a PC on a video card or motherboard; it is also used in mobile phones, display adapters, workstations and game consoles.

Source: <https://www.techopedia.com/definition/24862/graphics-processing-unit-gpu>

Conclusion

Schools have moved or are quickly moving to provide a one-to-one laptop / device environment with their students. The preference would be that the student can perform all task using their own device and not have to put it away just to use a lab computer for applications that cannot directly run from the student devices. Virtual desktops have been the hopes and dreams to fix this issue for over 10 years now, but the cost and complexity was always a deterrent. Thankfully, it appears that we can finally do this with a properly configured low cost refurbished server or new server, with solid state drives and ample memory along with Microsoft's Hyper-V RDS (Remote Desktop Services). This configuration provides both true VDI and Share Session services which provides the flexibility to allow schools to provide access to windows-based applications from any device and from anywhere including home. We believe we can finally remove the physical lab computers, which will save school districts money and effort and allow them to provide those save services, but in a more productive way.