

VMware Home Labs: A Definitive Guide 2021 Update



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[vExpert 2008-2021](#) | [vSAN vExpert](#)



Home Lab in 2 Parts

Part 1: 101
Home Labs: A Definitive Guide 2021
May 12th

- Presentation of common Home Lab information
 - Dale taking Q&A

Part 2 – 201
Home Lab Roundtable
May 25th

- Home Lab Experts taking level 201 Q&A Live
 - Submit your questions ahead of time

Register on vmug.com events section

Purpose of the Home Labs: A Definitive Guide

Over the years common themes and questions came up around Home Labs...

- *Where do I start?*
- *Why should I build a Home Lab?*
- *What are some of your experiences with Home Labs?*
- *Do you have any examples of Home Labs?*
- *What should I consider when building a Home Lab?*



If you think about it, Home Labs are like porridge...



The Goldilocks Principal



Agenda

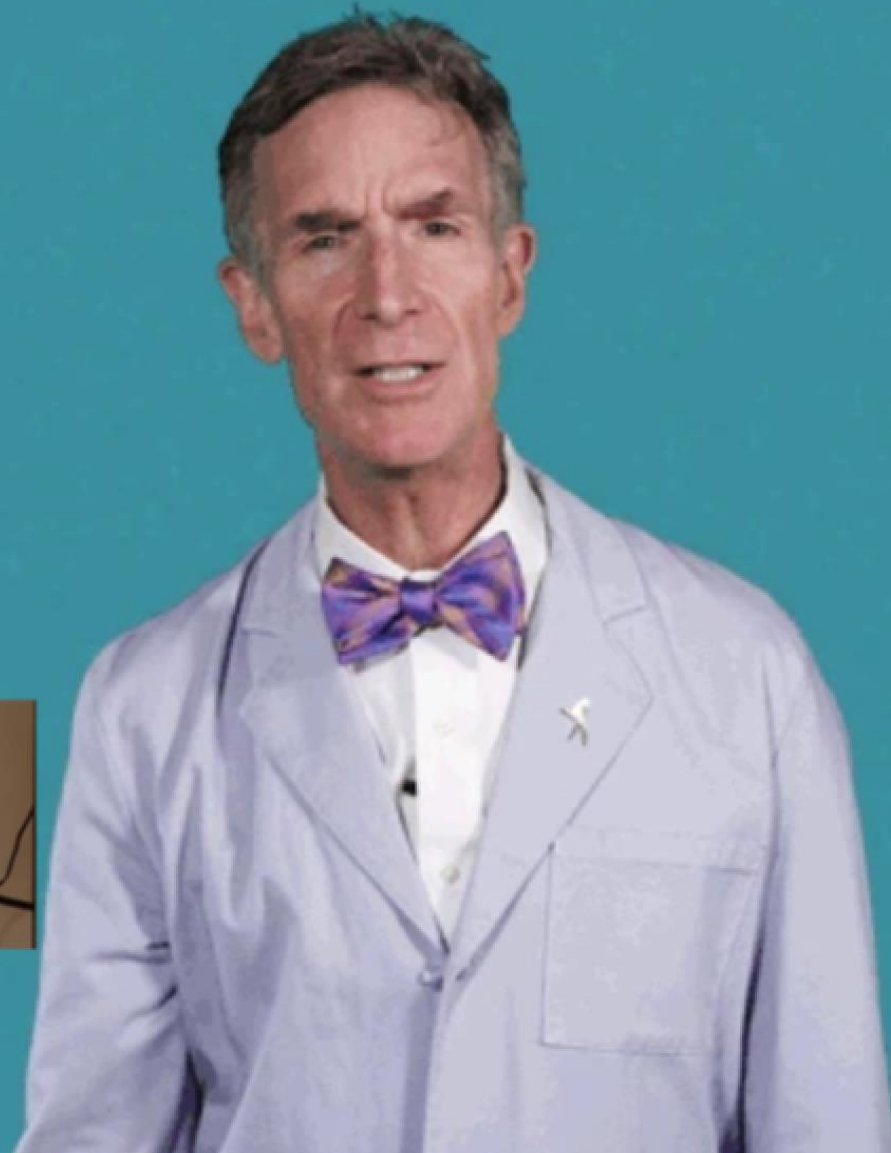
- **Consider the following about Home Labs**
 - What is a home lab?
 - Why build a home lab?
- **Planning your Home Lab**
 - Where do I start?
 - Software Requirements Table
 - Considerations Table
 - Planning Example
- **Building up your Home Lab**
 - Four key areas for Home Labs
- **Recommendations**
- **My Current Home Lab**
- **Helpful Links**



Consider
the
following



HOMELABS



What is Home Lab?

- There are many different types for Home Labs, but for this presentation: a home lab is any type of non-production VMware environment meant for personal or development use.
- Depending on your expected outcomes and budget it may contain different, outdated, and dislike hardware (or it may not) OR it could contain connections to cloud resources.
- VMware Home Labs usually run the following software:
 - VMware Workstation (Nested Environment)
 - VMware vSphere Environment (vCenter Server, ESXi, vSAN, etc.)

Why build Home lab?

Have Fun!



Gain Knowledge



Hardware

Software

Certification
Prep

Career
Advancement

Confirm a fix

Do something
different

Emerging
Tech

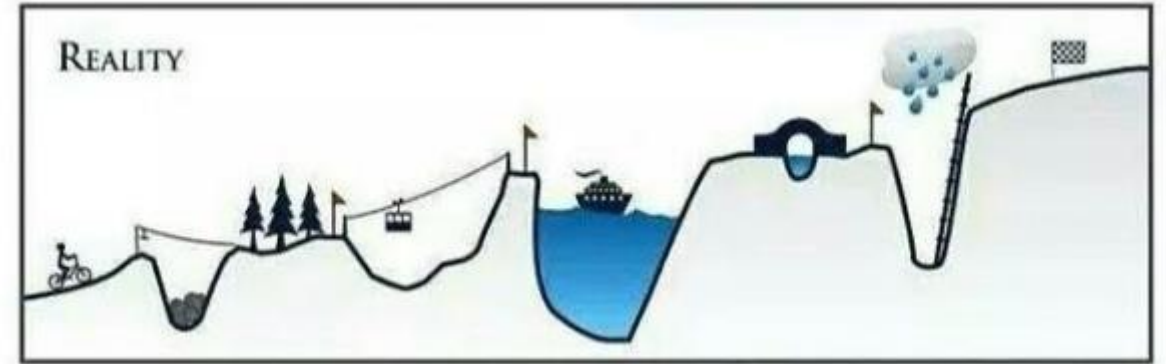
Test a Theory

Planning your Home Lab



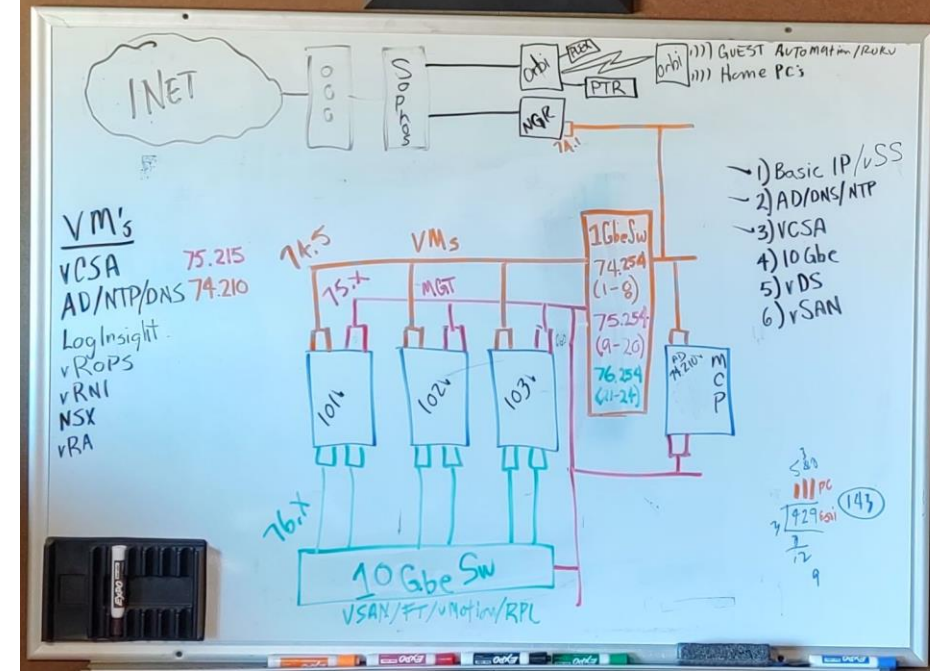
Where do I start?

- Have a plan and run your Home Lab same as a production environment
 - Hardware, Networking, Power, Cooling, Installations, Documentation
- Start out small and build it up, but have a plan



Where do I start? (Resist buying first)

- **Think about the requirements and outcomes?**
 - What do you want to do with your home lab?
 - Will it involve your personal home network?
 - Do you like the hardware or software side of Home labs, maybe both?
 - Ask questions, talk with others, gather information
- **Form your ideas**
 - Whiteboard or document your ideas / requirements
- **Research the software requirements (See Table)**
 - What are the software requirements | Do you need training or hands on experience?
- **Review the Home Lab Considerations Table (See Table)**
- **Research what hardware you may need**
- **Lastly, (in my opinion) if you can explain your home lab simply, you are ready...**



Research the common software requirements (05/2021 Update)

Software Product	CPU	RAM	Disk	LINK
VMware vCenter Server 7.x Standard (VCSA)	vCPU 2 TNY / 4 SM 8 MED / 16 LGR / 24 XL	12GB TNY / 19GB SML 28GB MED / 37GB LRG / 56GB XL	See Chart 415GB to 3.6TB	Recommended Link
ESXi 7.x Hardware Requirements (#1 Area of Home Lab Failure)	2 pCORES MIN (Check CPU Requirements)	4 GB MIN 8GB to run VM's	Varies 8GB-32GB	Recommended Link
VMware vSAN™ 7.0	ESXi Host standard 4 pCORES Recommended 10% CPU overhead for vSAN	32GB MIN RAM Link	All FLASH: 2 x SSD or PCIe Flash Hybrid: 1 SSD or PCIe Flash x 1 HDD	Recommended Link
VMware NSX-T 3.1	NSX Manager 2-12 vCPU NSX VM Edge 2-16 vCPU	NSX Manager 8GB-48GB NSX Edge 4-64GB	NSX Manager 300GB (<10ms) NSX Edge 200GB	NSX-T Link
VMware vRealize Network Insight 6.2	10-20 vCPU Faster GHz reduce requirements	32-64GB RAM	1TB-2TB	Recommended Link
VMware Site Recovery Manager 8.4	2-4 vCPU	8GB-12GB	60GB MIN	Recommended Link
VMware vRealize Log Insight™ 8.4	2-16 vCPU	4GB-32GB	Use the vRealize Log Insight Sizing calculator	Recommended Link
VMware vRealize Operations™ 8.4	2-24 vCPU Remote Collector 2-4 vCPU	8GB-128GB RD: 4GB-16GB	Use the vRealize Operations Manager Sizing tool	Recommended Link
VMware vRealize Automation 8.4	12-24 vCPU	42GB-96GB	278GB-332GB	Recommended Link
VMware vRealize Orchestrator 8.1	4 vCPU	12GB	200GB	Recommended Link
VMware vCloud Suite® Standard	NA	NA	NA	Recommended Link
VMware Horizon® Advanced Edition 7	NA	NA	NA	Recommended Link

Review the Home Lab Considerations (2021 Update)

Design Considerations	Description
Initial Cost	How much does the Home lab solution cost to build out?
Noise	When the home lab is running how much noise will it produce and are the noise levels appropriate for your use case?
Heat / Power Consumption	Does the home lab produce too much heat for the intended location?
Monthly Operational Cost	Based on cost for electricity in your area, how much is it going to cost to run?
Footprint and Mobility	How much space does the solution take up and how mobile is the solution?
Flexibility	Based on the type of product you choose, how flexible is the solution when hardware or other changes are needed to expand?
Bleeding Edge VMware products	How does the solution align to emerging products without major overhaul?
VMware HCL Listed	How does the on-prem solution align to the Hardware compatibility guides?
Refresh Cost (Reusability)	Financially, what would it take to refresh, replace, or update the hardware solution Consider how adaptable is the solution to changing hardware and software demands?
Speed to Use	How quick can the hardware solution be deployed and is useful?

Example of Planning out a Home lab

- Most recently I updated my home lab from Generation 5 to Generation 7.
- I document all my home lab Generations on my blog and how I migrate them.
- For Generation 7, I posted about my findings and outcomes
- Here are the steps I review when updating or rebuilding my Home Lab.
- **First:** What are my initial use cases and goals
- **Second:** Evaluate Software, Hardware, and VM requirements
- **Third:** Review / Document the Home Lab Design Considerations Table
- **Fourth:** Choose the hardware
- **Fifth:** Finalize my orders and start the assembly process
- **Finally,** learn from my mistakes 😊
- Pro-Tip: use Google Sheets



Building up your Home Lab



Four key areas for Home Labs



ESXi
Hosts



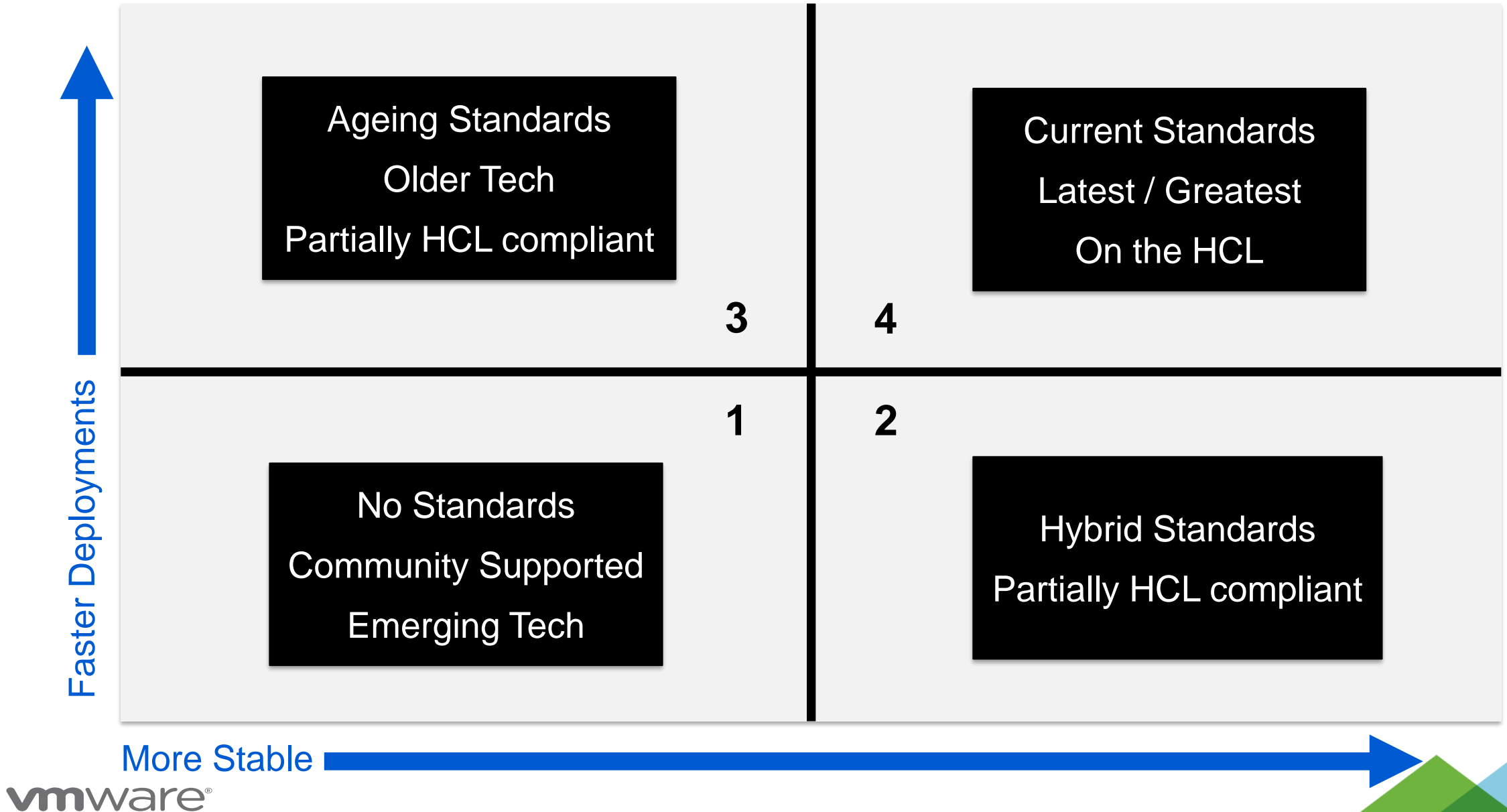
Networking



Storage

License

Home Lab: Standards Quadrant





ESXi Hosts

Common types of ESXi - Building blocks



Laptop



Workstation and DIY PCs



NUC and Micro-Servers



Enterprise Server Class

Classification of Building blocks for comparison



1. Nested Workstation

- Run VMware Workstation or VMware Fusion on Windows, MAC, or Linux
- PC, Laptop, or Workstation class computer
- One CPU, lots of RAM, multiple disk drive slots, and NICs.

2. Mobile / Compact Cluster

- Run ESXi
- 2-3 NUCs, MAC MINI, or Micro-servers in a cluster
- One CPU, RAM Limited, 1-2 Disk slots, NVMe slots, Thunderbolt, external power supply

3. Business Workstation / White box Cluster

- Run ESXi
- 2-3 or more PC or Workstation class computers in a cluster
- 1-2 CPUs, lots of RAM, multiple disk drive slots, lots of room for expansion

4. Server Class Cluster

- Run ESXi
- Consists of 3 or more server class computers in a cluster
- 1-4 CPUs, lots of RAM, multiple disk drive slots, lots of room for expansion

How do these Building blocks compare?

Design Considerations	Nested Workstation	Mobile Compact Cluster	Business Workstation Cluster	White box Cluster	Server Class Cluster
Initial Cost	\$1,200	\$3,000	\$3,000	\$3,000	\$1500-3000
Noise	Low	Low	Can be Low	Can be Low	Loud
Heat / Power Consumption	Low (~125 Watts)	Med (~200 Watts)	Med-High (300-600 Watts)	Med-High (300-600 Watts)	High (~800-1K Watts)
Monthly Operational Cost	Low \$11/mo.	Med \$17/mo.	Med \$28/mo.	Med \$28/mo.	High \$70/mo.
Footprint and Mobility	Depends (Laptop, NUC, PC)	Very Small Very Mobile	Large Footprint Not Very Mobile	Large Footprint Not Very Mobile	Large Footprint Not Very Mobile
Flexibility	Somewhat	3 x NUC Small Limited Flexibility	3 x Workstations Flexible	3 x Desktops Very Flexible	3 x 1U or 2U Somewhat Flexible
Bleeding Edge VMware products	Yes (Limited by Nesting)	Yes (Limited by Flexibility)	Yes (Very Flexible)	Yes (Very Flexible)	Yes (Very Flexible)
VMware HCL Listed	No	No / Limited	No / Limited	No / Limited	Possible
Refresh Cost (Reusability)	Low	Buy New / Some Adds	Buy New / Some Adds	Change out components	Buy New / Some Adds
Speed to Use	Quick	NUCs - Quick Micro Servers – Quick	Quick	Not as Quick	Quick

ESXi Host Trends for 2021

Generally, all prices rose in 2021 as much as 50%

- **CPU's**

- Higher software demands are driving more cores, look for more cores
- E5 Xeon v2, might be coming off the HCL
- AMD CPUs always a great value

- **System Boards**

- Look for System boards with single or dual Socket with DDR4
- New or Used System Boards \$120-\$200
- Lookout for Narrow 2011 & Special Power Requirements
- Recommend SuperMicro and on the HCL

- **RAM**

- Shoot for 128GB systems or better
- Used DDR4 ECC prices have risen, up ~30% in 2021

- **HBAs**

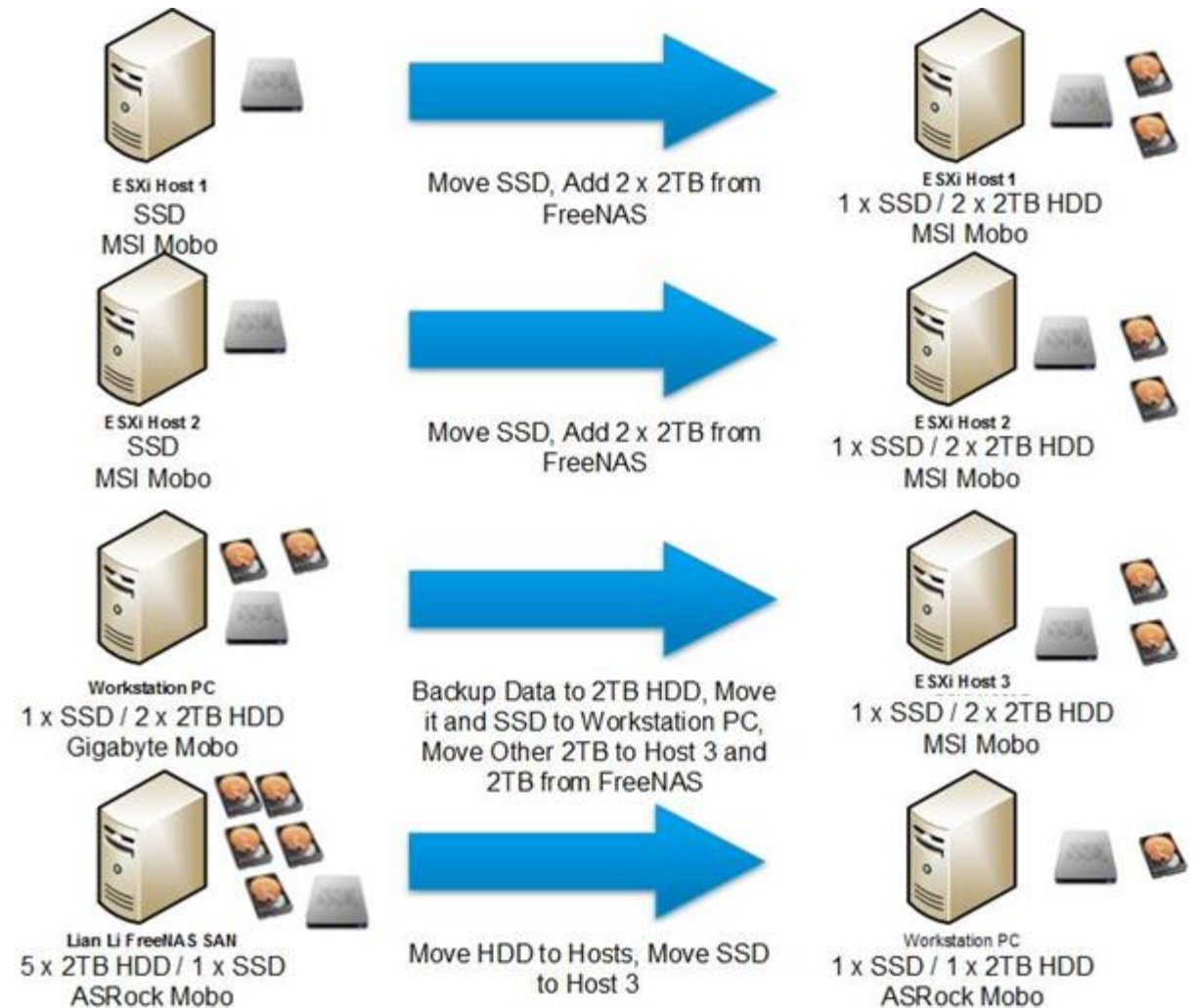
- Have been hearing about Enterprise Servers not accepting all HBA's
- Stick to the HCL and vendor recommendations

- **Laptops**

- Modern performance-based Laptops are starting to be a good approach for Nested Home labs. Ensure lots of Cores, RAM, SSD, and/or NVMe disks. Avoid Spinning Disks = poor performance

Maximize your investments

- One home lab strategy is to start with what you have and build up from there.
- As you evolve your home lab think about choosing items that you can repurpose
- Example:
 - I had deployed 3 ESXi Hosts with a FreeNAS server
 - When vSAN came out I chose components that were flexible enough to evolve
 - [More info here](#)





Networking

What are the common types of networking?



L3 Switch, VLAN, Managed, PoE, NetFlow
1 Gbe and/or 10 Gbe SFP+ / DAC Cables



Ethernet Cross over cable



InfiniBand Switch 10Gbs – 100Gbs



InfiniBand
Cable

vmware® Subnet Manager

Networking Trends for 2021

- Low Latency Networks (RDMA) are starting to trend for vSAN (Do your research)
- 10Gbe per port price is somewhat stable, look for switches that have 10Gbe SFP+ and use DAC cables
- If you are looking for “cheap” but new 10Gbe switch, consider MikroTik
 - Fair Warning – their CLI can be hard to learn, its not intuitive or Cisco like in anyway.

CRS309-1G-8S+IN

Desktop switch with one Gigabit Ethernet port and eight SFP+ 10Gbps ports



CRS305-1G-4S+IN

Five-port desktop switch with one Gigabit Ethernet port and four SFP+ 10Gbps ports





Storage

What are the common types of shared storage?

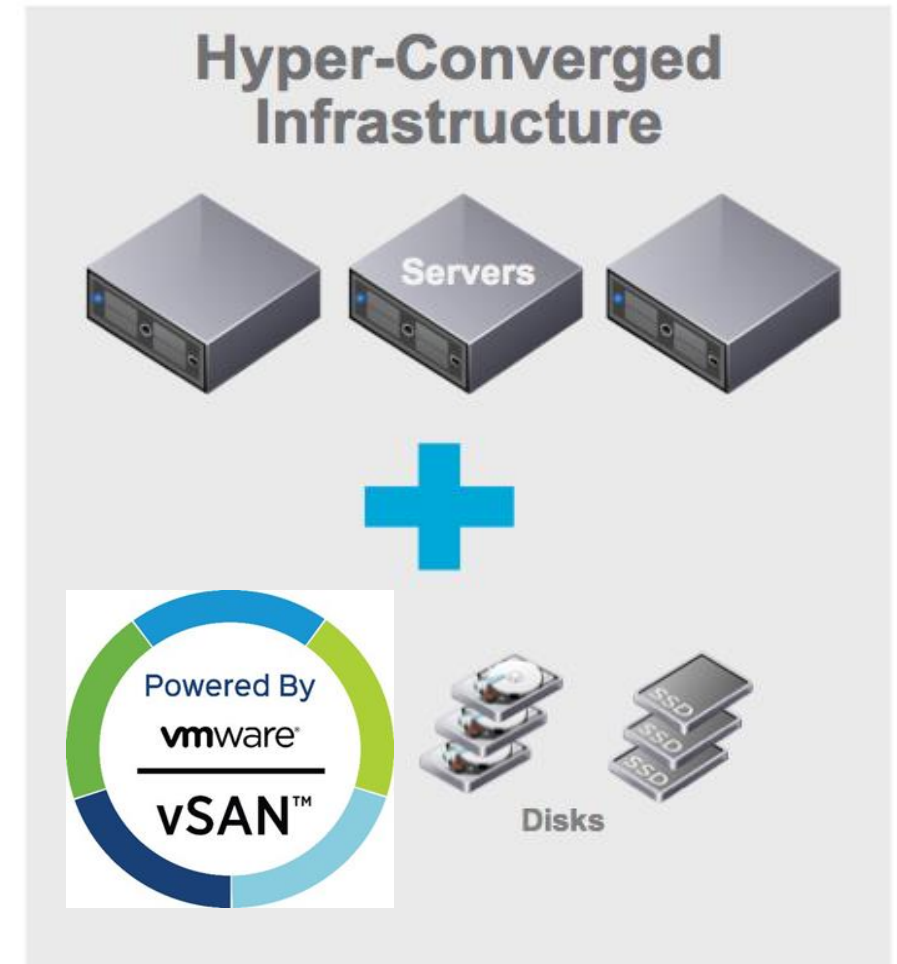
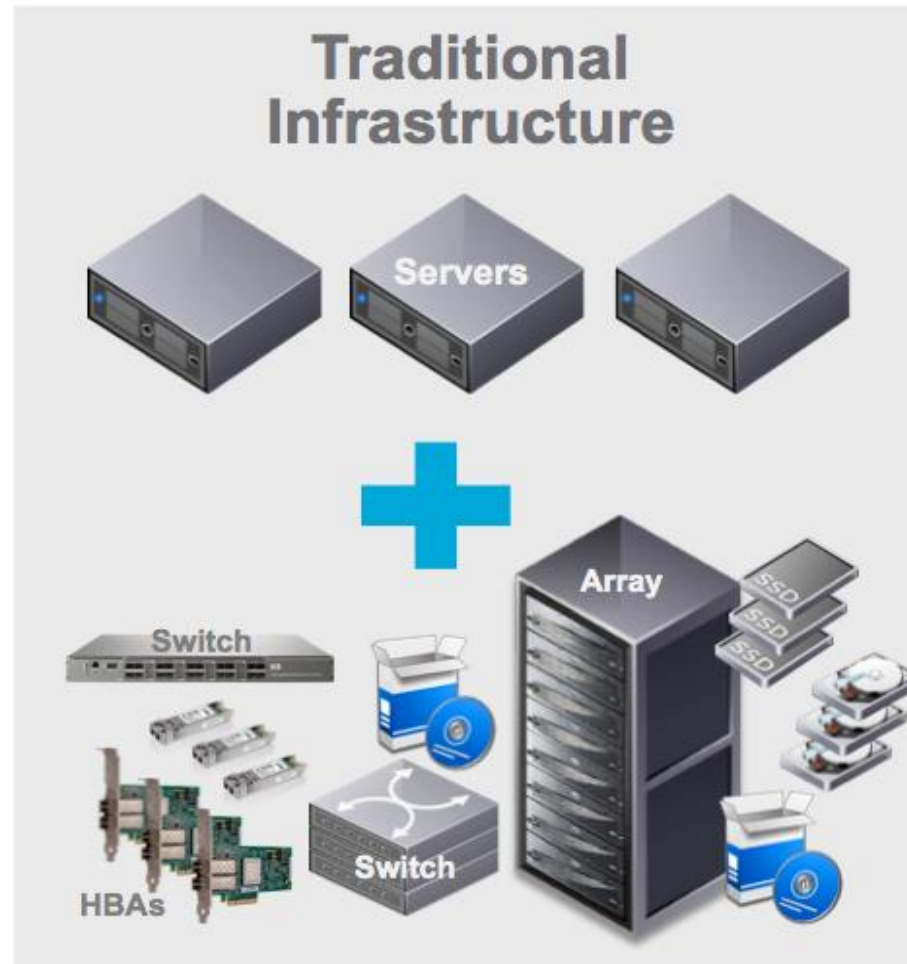


Storage Arrays
Personal or SMB



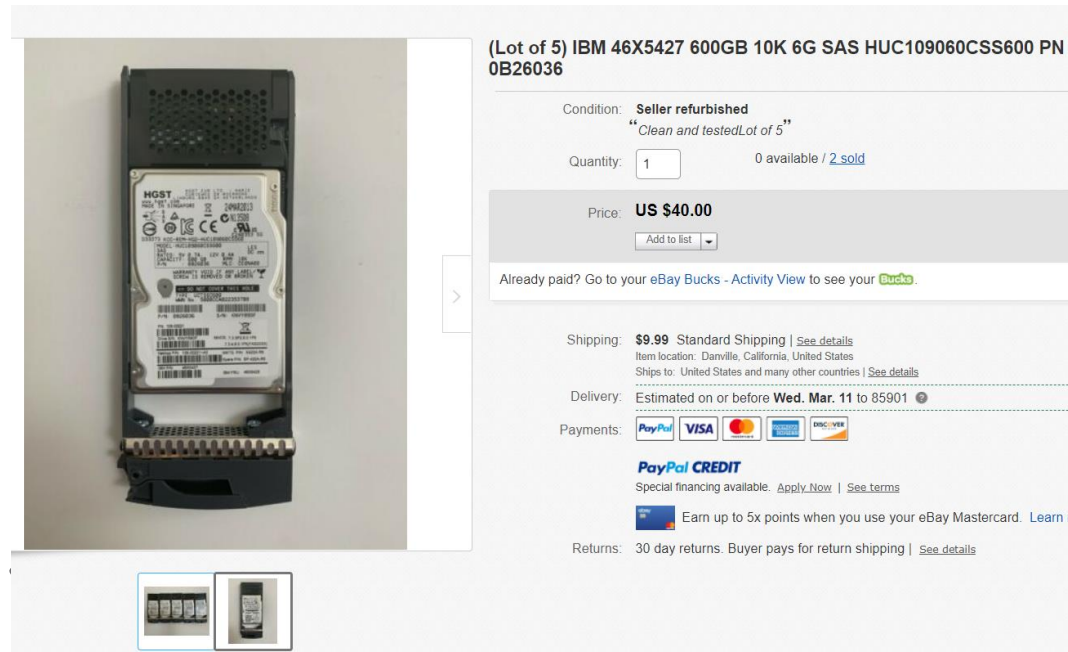
HCI
VMware vSAN

Consider the following around Storage....



Trends in Storage for 2021

- Used Enterprise SAS HDD price is stable | Flash and NVMe are starting to increase
- The used market is flooded with cheap Enterprise SAS drives from Storage Arrays
- Look out for:
 - Drives can come with 520b Sector size vs. a 512b Sector size
 - These disks can be labeled as IBM, Hitachi, Seagate, etc. Best to check with the seller if the drive you are interested in was used in a NetApp Array.
 - Some have been successful using these disks, but my recommendation is to avoid as most SAS Controllers will have issues





Consider this for Licensing...



VM's

Visual Studio
Linux



Hosts

Servers
Motherboards
IPMI / Remote Access



Networking

Switches might
need licensed to
enable features
(InfiniBand this is a must)



Storage

Storage Arrays and even
HCI might need license to
enable features

What about VMware Licensing?

- Your company may have keys. Check your licensing agreements
- Work with your VMware Account team / TAM, they may have options
- If you are a VMware Partner, consider NFR Keys (request additional)



Consider VMUG Advantage (Eval-Experience) \$200/yr

Data Center & Cloud Infrastructure

- VMware vCenter Server Standard (includes vRealize Suite 2019 Enterprise and vSphere Enterprise Plus)
- VMware vSphere® vCloud Suite Standard
- **VMware vSphere® 7 *NEW**
- VMware Cloud Foundation
- **VMware vSphere with VMware Tanzu Basic *NEW**
- **VMware Cloud Director *NEW**

Networking & Security

- VMware NSX Data Center Evaluation
- VMware vRealize Network Insight

Storage and Availability

- **VMware vSAN™ 7 *NEW**
- VMware Site Recovery Manager

Cloud Management

- VMware vRealize Orchestrator
- VMware vCloud Suite® Standard

Desktop & Application Virtualization

- VMware Horizon® Advanced Edition
- VMware vRealize Operations for Horizon®

Personal Desktop

- VMware Fusion Pro
- VMware Workstation Pro

Become a VMware vExpert

- License keys are one of the program perks
- Need help reach out to a follow vExpert



Name	
2021 Fusion 12 PRO	2021 vCenter Server 7 Standard
2021 HCX ENT	2021 vCloud Director 10
2021 Horizon 8 Advanced	2021 VMware Cloud Director Availability version 4
2021 Horizon App 8 Advanced	2021 VMware Horizon 8 Enterprise
2021 Integrated Open Stack	2021 VMware vCenter Server 6 Standard for Horizon
2021 NSX Advanced Load Balancer	2021 VMware Virtual SAN 5.5
2021 NSX Data Center	2021 vRealize Insight 6 for SD WAN
2021 SDDC Manager	2021 vRealize Network Insight 6 ENT
2021 SRM 8 ENT	2021 vRealize Operations 6 Manager for Horizon
2021 Tanzu	2021 vRealize Suite 2019 ENT
2021 Telco Cloud Automation	2021 vRealize True Visibility Suit ENT
2021 ThinApp 5 Packager	2021 VSAN 7 ENT
2021 vCenter Server 6 Standard	2021 vSphere 6 ENT
2021 vSphere 7 ENT Plus	2021 vSphere 6 ENT
2021 Workstation 16 PRO	2021 vSphere 6 Enterprise Plus

Where to start?

Home Lab Recommendations

Quick note: Recommendations below are just that... recommendations
Your system, your design, and your plan may vary

Start with VMware Workstation

- Recommendation:
 - Draw up a plan of what you want to accomplish
 - Install Workstation on to your laptop or PC and get familiar with setting up a nested environment. Most VMware products can be installed
 - This is not time wasted as the VM's can be moved to ESXi hosts
 - Think about “building blocks”. What next for your home lab?
- Workstation Hardware:
 - PC, MAC, Laptop, NUC, workstation class PC (Check the VMware Workstation requirements)
 - Lots of RAM (64GB or better)
 - 1Gbe pNIC or two
 - 6 Core or better CPU
 - FAST disk access – SSD, M.2, NVMe
 - Multiple smaller HDDs (Distribute your VMs)
- PROS: Cost effective way to start your Home Lab, carry over into your next generation Home lab
- CONS: No support for VLAN or external routing, at some point performance might be a factor

Building an ESXi Home Lab

- Recommendation:
 - Enhance or draw up a plan, have good idea of what you want to do with your Home Lab and how it might grow. Think how am I going to expand my home lab?
 - Go with VMUG Advantage / Visual Studio for your Licenses.
 - Use what you have but use as many common “building blocks” (Mobos, pNICs, Disk, RAM, CPU)
 - Don’t forget about Networking, DNS, TCP/IP, DHCP
 - Use your VMware Workstation PC to house some services
- Hardware:
 - 2-3 x ESXi Hosts, Layer3 Switch + 10Gbe SPF+ ports, vSAN or OpenFiler/FreeNAS
 - ESXi Hosts
 - Case: ATX/EATX case, lots of drive bays, easy to working on, fits cheap commodity parts
 - Mobos: Look for 128GB or better, support for ECC/Non-ECC RAM, CPU Support, 8x or better PCIe ports , Use the 16x PCIe < ensure you can, Headless (look for AST2400), NVMe/M.2 support
 - SSD: SAS Based better, Standard SSD okay
 - HDD: Have at least one host with a large HDD, comes in handy for moving VM’s around
 - Boot to SSD or HDD
 - Power supply: Look for efficient as possible
- PROS: Longevity, Cost Control, max flexibility, Low Noise / Heat
- CONS: Overall Size can be a bit bulky for some designs

My Home Lab for 2021

- Dual Xeon E5-2640v2
- 256GB RAM DDR3
- vSAN Hybrid (12Tb)
- 10gbe Network (MikroTik)
- 4 x Cisco Switches
- vSphere 7.0u2 (SM X9DRD)
- Workstation 15 (i7-8700)
- NSX, vRLI, vRNI

What's next?

- K8S / Solar / Wind Power

Section 2: CURRNT HOME LAB Build Information

Overview:

My Gen 7 Home Lab is based on vSphere 7 (VCSA, ESXi, and vSAN) and it contains 3 x ESXi Hosts, 1 x Windows 10 Workstation, 4 x Cisco Switches, 1 x MikroTik 10gbe Switch, 2 x APC UPS. Read further below for an itemized list.



	Hypervisor:	VMware ESXi, 7.0.0, 15843807	CPU	Free: 22.18 GHz
	Model:	X9DRD-7LN4F(-JBOD)/X9DRD-EF	Used: 9.82 GHz	Capacity: 32 GHz
	Processor Type:	Intel(R) Xeon(R) CPU E5-2640 v2 @ 2.00GHz	Memory	Free: 171.02 GB
	Logical Processors:	32	Used: 84.82 GB	Capacity: 255.84 GB
	NICs:	6	Storage	Free: 9.8 TB
	Virtual Machines:	14	Used: 2.93 TB	Capacity: 12.74 TB
	State:	Connected		

Storage Devices

Check out vmexplorer.com Blog, YouTube, and Twitter



HOME LAB: Guide / Info

This Page contains two sections:

1) HOME LABS: A DEFINITIVE GUIDE and 2) CURRNT HOME LAB Build Information (further below)

Section 1: HOME LABS: A DEFINITIVE GUIDE

For the 2020 HOME LABS: A DEFINITIVE GUIDE I was invited to present my updates to various groups. Below are links to my slides and videos. During these sessions I go into detail around Home lab design considerations, which is something we usually don't think of when building a home lab. I do hope you find this information very useful. Please feel free to ask any questions or post comments.. Thanks — Enjoy!

AUG-2020 VMUG Advantage Session

- [CLICK HERE to download my slides from this session\(PDF\)](#)
- [CLICK HERE for the VMUG Recorded session](#)

MAY-2020 Cedar Park VMUG Session

- [CLICK HERE to download my slides from this session\(PDF\)](#)

MAR-2020 TAM Lab Recorded Session

Matt Mancini
@vmexplorer

VMware Staff TAM | Proud Lefty | Run a NO-Nonsense straight to the point blog/vblog | vExpert 13x, vSAN vExpert 6x | CTOA | VCP-DCV/NV

📍 Arizona, USA 🌐 vmexplorer.com 📅 Joined September 2010

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Its that time of year for VMUG Home Lab presentations. Part 1 this week, and Part 2 on May 25th. Register at vmug.com events section! #vexpert #vmug #homelab #vmware

Home Lab in 2 Parts

Part 1: 101 Home Labs: A Definitive Guide 2021 May 12th	Part 2 – 201 Home Lab Roundtable May 25th
<ul style="list-style-type: none">• Presentation of common Home Lab information• Dale taking Q&A	<ul style="list-style-type: none">• Home Lab Experts taking live 201 Q&A Live• Submit your questions ahead of time

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HOME VIDEOS PLAYLISTS CHANNELS DISCUSSION ABOUT

VMware Home Lab Gen V Build Part 3 Motherboard Overview
Matt Mancini · 1.2K views · 1 year ago

** Quick Update – I have updated my Home Lab since this posting. For more information: <https://vmexplorer.com/2020/11/03/updating-vmware-homelab-gen-5-to-gen-7/> ** In this video I'll cover...

VMware Home Lab Gen V Build Part 1 Components Overview
Matt Mancini · 2.1K views · 1 year ago

** Quick Update – I have updated my Home Lab since this posting. For more information: <https://vmexplorer.com/2020/11/03/updating-vmware-homelab-gen-5-to-gen-7/> ** In this video I'll cover...

VMware Home Lab GEN V Build Videos
Matt Mancini

Home Lab GEN V: The Quest for More Cores! – First Look · 5:56
VMware Home Lab Gen V Build Part 1 Components Overview · 4:35

[VIEW FULL PLAYLIST](#)

Helpful Links

- [Recommended FREE Community Guide - VMware Operations Management, 3rd Edition](#)
- [HOL vs Home Lab](#)
- <https://vexpert.vmware.com/>
- <https://visualstudio.microsoft.com/>
- <https://www.vmug.com/home>
- <https://mikrotik.com/>
- <https://williamlam.com/home-lab>
- <https://www.freenas.org/>
- <https://www.vmware.com/my-vmware-partners.html>
- InfiniBand Links [\(1\)](#) and [\(2\)](#)
- <https://configmax.vmware.com/home>
- <https://www.vmware.com/resources/compatibility/search.php>
- Hardware Price [Trends](#)

Helpful links

- vSAN
 - [Designing and Sizing vSAN Hosts](#)
 - [Best practices when using vSAN and non-vSAN disks with the same storage controller](#)
 - [Understanding vSAN memory consumption](#)
 - [Designing vSAN Disk groups – All Flash Cache Ratio Update](#)
- NSX-T
 - [NSX-T Data Center Installation Guide](#)
- vRealize Products
 - [vRealize Suite Editions and Products](#)

Porridge is only as good as you make it.



Thank you!