Picking Hardware

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Things to think about when picking hardware to

Why actual hardware?

- Virtual machine's on your laptop aren't persistent and can eat too many resources
- Cloud computing has limited interactivity with your home environment for building a domain.
- Cloud computing keeps costing money when you are not using it.

What sort of things do we want to consider

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Cost of Acquisition

- The financial cost - how much money it costs
- The value - Both the are you getting a good deal for what you are getting, and are you forced to buy more than will need or use.
- Shipping - Shipping hardware can get really expensive quickly. Sometimes you need to be able to get to a place to pick something up.
- Time - especially for used hardware to get it you might have to drop things to get stuff when it’s available, or spend a lot of time hunting for what

Infrastructure requirements

- Space - How much space will it take up, and what sort of furniture does it need.
- Power - How much it's going to take and if you even have the appropriate circuits for that.
- Cooling - Can you keep the equipment and yourself cool enough.
- Network - Can you get this connected to your local network.

Supportability

- Warranty - Is there someone you can call when it breaks through no fault of your own.
- Replacement parts - Are they available and affordable
- Repairability - Do you need special tools to take it apart and/or is it all glued and soldered together.

Cost of operation

- Financial Obligation - Do you have ongoing bills from this.
- Power - Power bills can be a concern.
- Heat - Can make power bills bad but also can be uncomfortable.
- Noise - Some hardware is really loud, and some data centers require hearing protection.

Homelab lifecycle

- Estimated life span - How long before this hardware is not useful
- Expandability - If you buy small can you add to it later
- Virtualization - Can it act as a hypervisor to house guests
- Repurposable - When it doesn't fit it's main role can you do something else with it.

Classes of hardware

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New Enterprise AI/GPU Servers: description

These are rack mount servers that can accommodate 8+ high-end GPUs for advanced computation, like crypto, AI, rendering CG movies. The generally take up 4-5 rack U in deep racks, have and sometimes require multiple power-supplies. Many top-tier vendors have some offering here, but it is a space dominated by mid-tier vendors like supermicro. Generally these are bought new. Generally will only have wired networking

New Enterprise AI/GPU Servers: factors

- Cost of Acquisition - High. These are expensive. 10s of thousands of dollars.
- Infrastructure requirements - High. you need deep racks, industrial cooling a wired network, and high power requirements above most home outlets.
- Supportability - Bad. Warranties are had, but if(when) a GPU goes bad, it can be like pulling teeth to get a replacement.
- Cost of operations - High. Even if you didn't finance the purchase, the power, cooling and noise will be a lot.
- Life cycle - Mixed. If you're not careful you'll burn this machine out shortly after the warranty ends. But generally they do have good numbers of drive bays and banks for memory, and you can swap out GPUs for a few generations probably.

New Enterprise AI/GPU Servers: conclusions

Don’t target this. Get this class of hardware if this is what you need. If you really need this class of hardware this presentation shouldn’t be what is telling you that.

New Enterprise Servers: description

These are 1 or 2 rack unit servers. They may have support for some expansion, but not all do. Generally they don't come with built-in WiFi. Since they're built for racks they aren't optimised for sound. Raid-controllers, ECC-memory, and redundant power supplies are common features, but not universal. There are 2 and 4 post rack mount variants, but the 2 post rack variants will generally be less.

New Enterprise Servers: factors

- Cost of Acquisition - High, generally these machines are priced to be discounted. If you don't have a relationship to get a discount you're going to pay a lot.
- Infrastructure requirements. - Varies. Variants built for comm closets can be low needs but generally. It's going to be a rack and maybe some serious power draw
- Supportability - Warranties here are great. Generally built to be fixed.
- Cost of operations - Mixed. Did you finance it? If you're not too power hungry these can be fine.
- Life cycle - Great. These *CAN* run for a decade or more. You might make choices like SAS-2 or TPM that will end it earlier than that. Some parts will be hard to replace. And generally they can/do have storage attached so that memory and CPUs are the limiting factor. These machines often end up as hypervisors.

New Enterprise Servers: conclusions

Probably don’t. They can be expensive and the people who get the most from them are the people that can take advantage of having many of the same thing. If you do, get something that is expandable, but don’t expand it out all at once wait to see what you need.

Used Enterprise Servers: description

These are just enterprise servers, but later in their lifecycle.

Used Enterprise Servers: factors

- Cost of Acquisition - Mixed. Often great on the $ front but you may have to ship which gets expensive fast, or drop everything, or spend lots of time looking until you find something.
- Infrastructure requirements. Mixed as above. These may use less power but are also often less efficient than modern equivalents.
- Supportability - Bad. Out of warranty. Repairable, but the parts are custom and if you have to ship for repair, it's often not worth it. But you should be able to get an idea of if these are bad before acquiring
- Cost of operations - varies, but generally the same as new.
- Life cycle - a lot of the life has been used from these. But they are still often going to be expandable and capable of virtualization

Used Enterprise Servers: conclusions

This is what a lot of homelabs end up running on, but rarely where they start. The space/infrastructure need generally has people wait until they are further in. Also for many people their first enterprise server is a 3rd hand one that they only had the infrastructure costs for. These workhorses are great and if you're in a community with lots of other homelabbers with similar machines you might be able to help each other with parts.

First Party Desktops: description

These are desktops from vendors like Dell. They come in unique cases, that are often in the mini-tower or monitor-stand(previously pizza-box) form factor. The might not support all the craziest GPUs depending on where the GPU power port is. This form factor has offerings at all price points, but it really can be a case of you get what you pay for.

First Party Desktops: factors

- Cost of Acquisition: Mid, but you can get a good good deal, and shopping is generally available when you are.
- Infrastructure requirements: Minimal, there will run off wall power. And don't need racks.
- Supportability: Warranties can be good to terrible. At this size they are often repairable, but the parts are custom, and if your model didn't have a long initial offering you might hit a "fixable" problem but have to start from scratch. Bios updates after the warranties are over also are unreliable, which can be a security problem.
- Cost of operations: Good. These generally run well, with no major gotchas.
- Life cycle: Bad. Often these machines are crippled with limited expendability. In budget models failure rates after warranty will be high. Parts might not be of too much value to start building the next one either.

First Party Desktops: conclusions

These participate in the home lab space a lot in the primary machine, to part of homelab pipeline, as well as the side hustle to homelab pipeline, especially if the side hustle doesn't materialize. But if you don't have infrastructure and know what you want and get the expandability you crave this can be it.

Parts Built Desktops: description

This is machine built from parts bought individually, either by yourself or someone else. These tend to be either inelegant clunky things or art pieces depending on who made them.

Parts Built Desktops: factors

- Cost of Acquisition: Varies. Can be one of the least expensive to the most expensive, and doesn't all have to be acquired at once.
- Infrastructure requirements: Tools, patience, and living close to a micro-center, are about all the infrastructure needed.
- Supportability: Mixed. Very repairable. Replacement parts are a breeze, until technology changes. Getting warranty on the parts is a nightmare. The retailer passing the buck to the manufacturer to the other parts of the machine in an endless loop.
- Cost of operations: Varies. Some people go flashy and expensive, others just try to get the job done. Will be out of commission more.
- Life cycle: These machines tend to be like the ship of theseus. Parts get outgrown and replaced, when enough parts are swapped out secondary machines get frankensteined together. Any limitation can be navigated for a price.

Parts Built Desktops: conclusions

Building computers from parts can be a hobby on it's own. Getting the right parts on the first time doesn't always happen and sometimes parts get ruined. This is a good choice for people that like shopping for things to purchase. These often end up in homelabs after being a primary desktop, or if they were made for someone to get that experience.

Laptop: description

A Laptop. A machine with a built in keyboard pointer and display that folds up and often has a power brick instead of just plugging into the wall. And an internal battery.

Laptop: factors

- Cost of Acquisition - Many price points but you're paying for battery, screen, and compactness with the computing requirements.
- Infrastructure requirements - Often as part of a homelab these are attached to a dock to get more ports. These are the machines that are most likely to have "fad" ports that you won't see after you buy the adapter for this generation.
- Supportability - Bad. Many come with warranties. But these are nightmares to work in and use custom chips. Many are soldered together which makes a lot of issues require nearly full system replacement.
- Cost of operations - Good. Generally these are cost effective machines to run.
- Life cycle - Bad. These don't target a long life span and often have no or limited expandability. While they can be repurposed battery swelling needs to watched out for.

Laptop: conclusions

I wouldn’t buy one for this purpose (again). But as a second life for hardware you already have it can be okay if you don’t need to expand it too much. Also many ot these machines are underpowered and while quit on you if under constant load. But if the price is free and it’s the only free choice, go ahead.

System on a Chip: description

These are small self contained computers. Often using camera / phone storage cards for their storage. These machines often have connections for connecting to other electronics or sensors. Typically sold without a case. Raspberry Pi’s fit in this category.

System on a Chip: factors

- Cost of Acquisition - These are inexpensive.
- Infrastructure requirements - made to require little infrastructure, but you can get fancy with PoE (Power over ethernet)
- Supportability - bad. Often no warranty, and add-ons are replaceable, but for a lot of problems you will be trashing it and starting again. But it's cheap enough to play with fixing.
- Cost of operations - Good. These are generally cheap to operate.
- Life cycle - These can go a long time. And they are super-repurposable. Less expandable. And with generally limited storage I'm not sure people use them for virtualization much.

System on a Chip: conclusions

These are a cheap way to get your foot in the door, and they are very repurposable. These machines rarely stay in the center of a homelab but often make up a lot of the periphery. These are also used for home-built appliances, automation, and sensing.

Micro-PC: description

These a really small form factor machines. Generally without any PCI slots. The mac mini and intel nuc are examples of this.

Micro PC: factors

- Cost of acquisition - Good, generally more expensive than an SoC but less than a first party desktop.
- Infrastructure requirements - few. These are machines made knowing they might go into entertainment systems.
- Cost of Operations - Good. Generally cheap to run.
- Supportability - bad. Often these have limited warranties. They're all custom parts and often not constructed to be repaired.
- Life cycle. These machines might die early or keep chugging forever, but driver/os updates will tend to stop sooner. They aren't expandable, and they can be underpowered. And with limited storage often don't get used for virtualization.

Micro-PC: conclusions

These are a fine choice but often lose out to SoC, being a more expensive cousin. A large number of these machines start or end up as media PCs that drive entertainment systems. Powerful arm chips and good interconnects are starting to change the fate of this class. Time will tell if this class outlives that first-party desktops.

Club Lab target platform choices?

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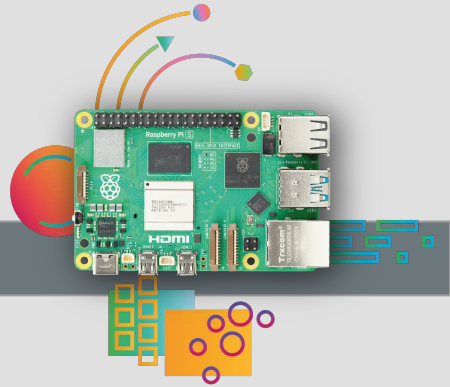
Not every lab we prep can target every possible machine.

- If we did labs with all completely different machines. We would either have to check them all for gotchas or we'd lose a lot of time debugging issues that are only holding up one or two people.
- There are so many edge cases that any instructions would get bogged down in them and miss out on the interesting parts.

Goals for picking a target platform

- We want something that club members might have. Targeting $50k machines might be cool, but not useful.
- We want to be able to field some, so that club members don't have to pay an upfront cost.
- We don't have a large budget for this.

Our choice: Raspberry Pi 4



- Memory / RAM options: 8GB
- CPU/Processor: quad-core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
- Storage: SanDisk 128GB Extreme microSDXC
- Connectivity: WiFi or Ethernet, Bluetooth
  - Gigabit Ethernet with POE+ (w/ separate POE+ HAT)
- Video: HDMI output (4k, micro-HDMI)
- Additional Ports: 2 × USB 3.0 ports, 2 × USB 2.0 ports
- Power: USB-C (5V) / PoE Hat
- Pricing: ~$125 ($75 for Board, $20 for PoE Hat, $10 for case, $20 for SD card)

Why?

- Cost of acquisition is low.
- Cost to wipe / reimage should be low
- Club members that want to stick a toe in the water can get just the SD card.
- People who have a toe in the water can get the same hardware and be all the way in, without having to re-buy storage.
- With PoE hats providing network & power for a room full of them can be easier
- These machines should be able to have a long life useful life for anyone that buys one for the club. I.e. we don't think we're saddling people with things that we think have limited other use.