Core Network services for the campus

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Essential services for the campus network like DHCP/DNS/NTP

DNS caching resolvers

Translate domain names into IP addresses for your users

Having your **own resolvers is better** than **far away** public DNS resolvers like 8.8.8.8 or 1.1.1.1 which will cause latency for your users

Servers for **resolver/recursive/caching DNS** and **authoritative DNS** should be separated

ACLs on your resolvers are important, having **open DNS resolvers** is an additional attack surface for your network

Many options to choose from: unbound, knot-resolver, powerdns-resolver

NTP

Accurate time keeping for all network-connected equipment

Very important for logs, authentication, certificates…

Can be in the same machine as DNS resolver/DHCP server

Can be synced from a local GPS clock if you have one OR from public pool on the internet pool.ntp.org

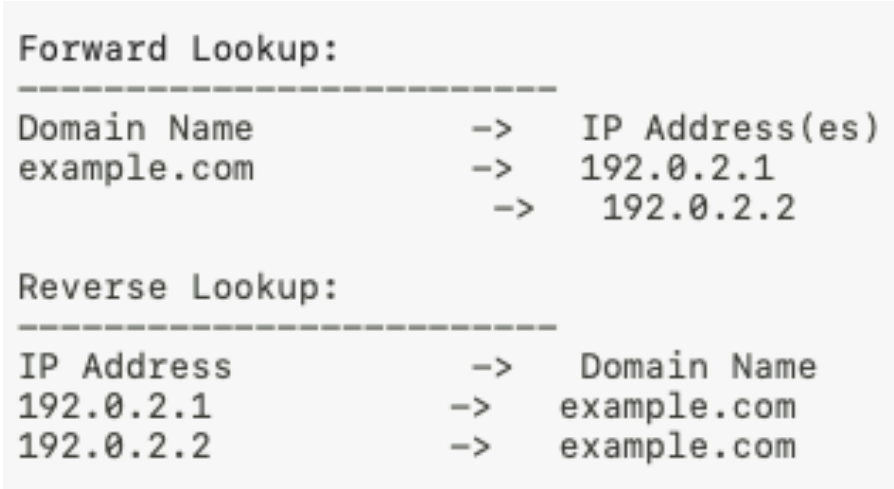
Recommended software:

ntpsec: a more secure version of standard ntpd, available as package on all major linux distros

chronyd: ntp client from Red Hat

Authoritative DNS servers

- You need authoritative DNS only if you are managing * **your own** * domain names or reverse zones
- A domain name a unique name that identifies a resource on the internet. An authoritative DNS server translates this domain name into one or many IP addresses. This is called forward lookup.
- A reverse zone contains records for performing reverse lookups. While forward lookup maps domain names to IP addresses, reverse lookup maps IP addresses to domain names.



Backbone/IXP services

Services you usually find at ISP backbones or IXPs but can also be deployed in very large campus networks

Opensource Mirrors

- Repository of popular opensource software hosted locally within the campus network, reducing dependence on external servers
- Improve download speeds
- Reduce Internet bandwidth usage
- Reliability & resilience: guarantee uninterrupted access even in the event of failure/unreachability of the main source

Opensource Mirrors

- RSYNC for updating repositories
- HTTP/HTTPS to offer software for download
- Examples of software on the mirror:
    - Operating systems: Debian, Ubuntu, Rocky/Alma Linux
    - Repositories: CRAN, CPAN, CTAN, GCC, fedora-epel, GNU
    - Routers/firewalls: OpenWRT, OPNsense, IPfire
    - Software: MariaDB, VLC, Grass GIS, Gimp, LibreOffice, SAGE

mirror.marwan.ma

Index of /

../	
alma/	17-Feb-2025 23:1
alpine/	18-Feb-2025 00:5
centos/	15-Feb-2024 09:4
cpan/	17-Feb-2025 04:3
cran/	17-Feb-2025 10:1
ctan/	17-Feb-2025 12:0
debian/	18-Feb-2025 00:4
debian-archive/	15-Mar-2024 21:1
debian-cd/	11-Jan-2025 18:4
elrepo/	17-Feb-2025 16:4
fedora/	08-Sep-2023 16:5
gcc/	05-Feb-2015 17:1
gimp/	01-Apr-2020 19:3
gnu/	21-Jan-2025 19:3
gnualpha/	08-Dec-2024 21:2
grass/	17-Feb-2025 12:3
hbcd/	17-Feb-2025 23:0
ipfire/	31-Jul-2019 14:1
kali/	13-Oct-2023 15:3
kali-images/	05-Jul-2024 14:5
lyx/	11-Feb-2016 17:1
mariadb/	13-Feb-2025 05:5
openstreetmap/	17-Feb-2025 04:1
openwrt/	04-Feb-2025 01:3
opnsense/	22-Mar-2024 09:0
putty/	03-Sep-2023 06:0

bond0

2025-02-18 08:15

today		yesterday		all time	
rx	299.51 GiB	rx	484.48 GiB	rx	220.48 TiB
tx	444.05 GiB	tx	2.50 TiB	tx	968.79 TiB
=	743.56 GiB	=	2.97 TiB	=	1.16 PiB
	215.06 Mbit/s		302.80 Mbit/s	since	2023-10-01

2025-02		2025-01	
rx	12.43 TiB	rx	14.20 TiB
tx	33.69 TiB	tx	54.52 TiB
=	46.12 TiB	=	68.71 TiB
	270.74 Mbit/s		225.66 Mbit/s

rx tx

vnStat / Teemu Toivola

bond0 / daily

2025-02-18 08:15

day	rx	tx	total	avg. rate
2025-01-20	423.62 GiB	1.89 TiB	2.30 TiB	234.46 Mbit/s
2025-01-21	420.91 GiB	1.91 TiB	2.32 TiB	236.11 Mbit/s
2025-01-22	340.62 GiB	2.01 TiB	2.34 TiB	238.61 Mbit/s
2025-01-23	685.51 GiB	1.65 TiB	2.32 TiB	235.77 Mbit/s
2025-01-24	691.90 GiB	1.56 TiB	2.23 TiB	227.17 Mbit/s
2025-01-25	482.55 GiB	1.32 TiB	1.79 TiB	181.98 Mbit/s
2025-01-26	478.43 GiB	1.32 TiB	1.78 TiB	181.57 Mbit/s
2025-01-27	447.96 GiB	1.74 TiB	2.18 TiB	221.46 Mbit/s
2025-01-28	483.73 GiB	2.17 TiB	2.64 TiB	268.82 Mbit/s
2025-01-29	558.18 GiB	1.66 TiB	2.20 TiB	224.11 Mbit/s
2025-01-30	567.36 GiB	1.66 TiB	2.21 TiB	224.98 Mbit/s
2025-01-31	572.59 GiB	1.49 TiB	2.05 TiB	209.08 Mbit/s
2025-02-01	401.63 GiB	1.68 TiB	2.08 TiB	211.27 Mbit/s
2025-02-02	404.69 GiB	1.28 TiB	1.67 TiB	170.42 Mbit/s
2025-02-03	380.20 GiB	1.73 TiB	2.10 TiB	213.85 Mbit/s
2025-02-04	491.80 GiB	1.82 TiB	2.30 TiB	234.06 Mbit/s
2025-02-05	561.01 GiB	2.19 TiB	2.74 TiB	278.86 Mbit/s
2025-02-06	1.23 TiB	2.31 TiB	3.54 TiB	360.24 Mbit/s
2025-02-07	1.14 TiB	1.82 TiB	2.96 TiB	301.01 Mbit/s
2025-02-08	739.92 GiB	2.19 TiB	2.91 TiB	296.72 Mbit/s
2025-02-09	1.22 TiB	1.48 TiB	2.69 TiB	274.33 Mbit/s
2025-02-10	736.84 GiB	1.90 TiB	2.62 TiB	267.05 Mbit/s
2025-02-11	348.59 GiB	2.09 TiB	2.43 TiB	247.53 Mbit/s
2025-02-12	475.81 GiB	2.16 TiB	2.62 TiB	266.93 Mbit/s
2025-02-13	887.38 GiB	2.20 TiB	3.07 TiB	312.49 Mbit/s
2025-02-14	990.23 GiB	1.94 TiB	2.91 TiB	296.35 Mbit/s
2025-02-15	1.03 TiB	1.99 TiB	3.01 TiB	306.92 Mbit/s
2025-02-16	799.08 GiB	1.98 TiB	2.76 TiB	280.90 Mbit/s
2025-02-17	484.48 GiB	2.50 TiB	2.97 TiB	302.80 Mbit/s
2025-02-18	299.51 GiB	444.05 GiB	743.56 GiB	215.06 Mbit/s
estimated	871.29 GiB	1.26 TiB	2.11 TiB	

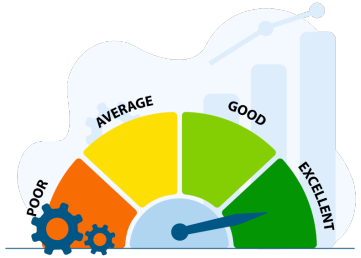
vnStat / Teemu Toivola

Content Distribution Networks / Caches

- A **Content Distribution Network** or **CDN** is distributed network of servers designed to deliver content, such as web pages, images, videos, and other digital assets, to users based on their geographic location
- **Caches** are a set of servers (and ToR switches) part of a CDN that store temporary copies of data (web/photo/video/file). They are intentionally close to the user to improve access speed and performance

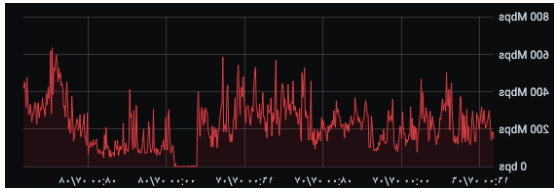
Caches

- **Performance optimization**: improve campus network performance by reducing latency and improving load times for the most requested content



- **User satisfaction**: by delivering content from a local cache, we reduce load times and improve the overall user experience

- **Bandwidth savings**: Reduce the amount of external bandwidth consumed by delivering cached content directly from the campus network.



Most popular caches

1. Google Global Cache (GGC) : Serve YouTube, Google map tiles, Play Store, and other static assets from “inside” the local network to cut transit costs, reduce latency and improve video start times
2. Facebook Network Appliances (FNA) : In-ISP caches that store static assets for Facebook, Instagram, and WhatsApp to offload backbone traffic and speed up load times
3. Other caches (targeting rather large ISPs/IXPs): Apple CDN, Netflix Open Connect Appliances, Azure CDN nodes
4. Classic CDNs (targeting rather large ISPs/IXPs): Akamai, Cloudflare, Fastly. They serve web objects (HTML, JS, video segments, downloads) **for thousand of costumers/websites**.

DNS root-servers

- First points of contact for DNS resolution
- 13 servers designated by the letters ‘a’ through ‘m’
- They sit at the root of the DNS hierarchy, directing queries to the appropriate TLD servers, and from there the process continues until it reaches the authoritative name server for the specific domain
- Benefits of hosting a root-server: reduces DNS resolution latency resulting in a better web-browsing experience for users, and making the internet more **decentralized** and more **resilient**