DESIGN GUIDE

CLOUDFLARE

Cloudflare One, our SASE platform

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INDEX

Note: More use cases will be added

About this Guide

This design guide is intended for technically-minded practitioners and provides illustrative examples of how organizations can simplify and strengthen their networking and security architecture with Cloudflare One, our SASE platform. Cloudflare One unifies network connectivity services with Zero Trust security services — all delivered on the Cloudflare global network.

The first section of this design guide focuses on holistic transformation and modernization by illustrating all the possible connectivity and security elements aligned to inbound networking, outbound networking, and applications before vs. after Cloudflare. It compares the legacy centralized security perimeter approach relying on multi-vendor solutions to the Cloudflare global network approach that leverages one composable platform architecture.

The next sections walk through common technical use cases — first, how that problem is typically solved with a legacy approach, and then, how Cloudflare One solves the same problem with greater efficiency and improved experience.

Two use cases were prioritized based on their popularity among customers, but they by no means represent the full scope of Cloudflare One's capabilities.

- Secure access for private and public web applications
- DNS filtering for on-prem and remote employees

We will continue to expand this guide with additional use cases, including secure access to private networks, advanced threat/data protection, and more.

Transformation:
A Before vs. After Cloudflare Comparison

Secure, fast, reliable, & private connectivity for any user

Any user

Organizations must enable secure, fast, reliable, and private connectivity for two groups of users.

Managed users are employees accessing a resource with a corporate or personal device from home, the office, or anywhere in between.

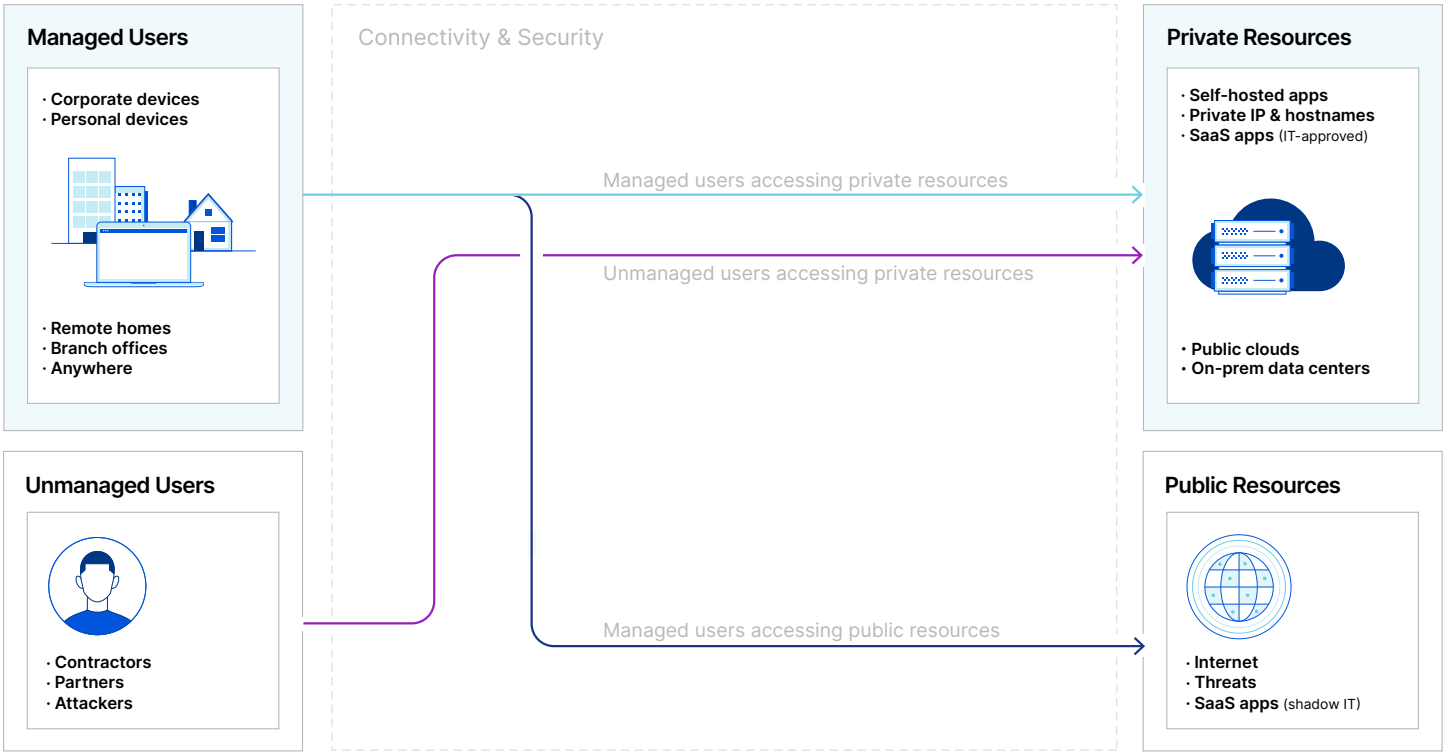
Unmanaged users include contractors or partners authorized to access a resource but also attackers who are not.

Any resource

Organizations must enable access management with threat and data protection for two groups of resources.

Private resources include self-hosted apps and private IPs or hostnames within public clouds and on-prem data centers, plus IT-approved SaaS apps.

Public resources on the Internet include unsanctioned SaaS apps and threats.



Comparing connectivity & security before vs. after Cloudflare

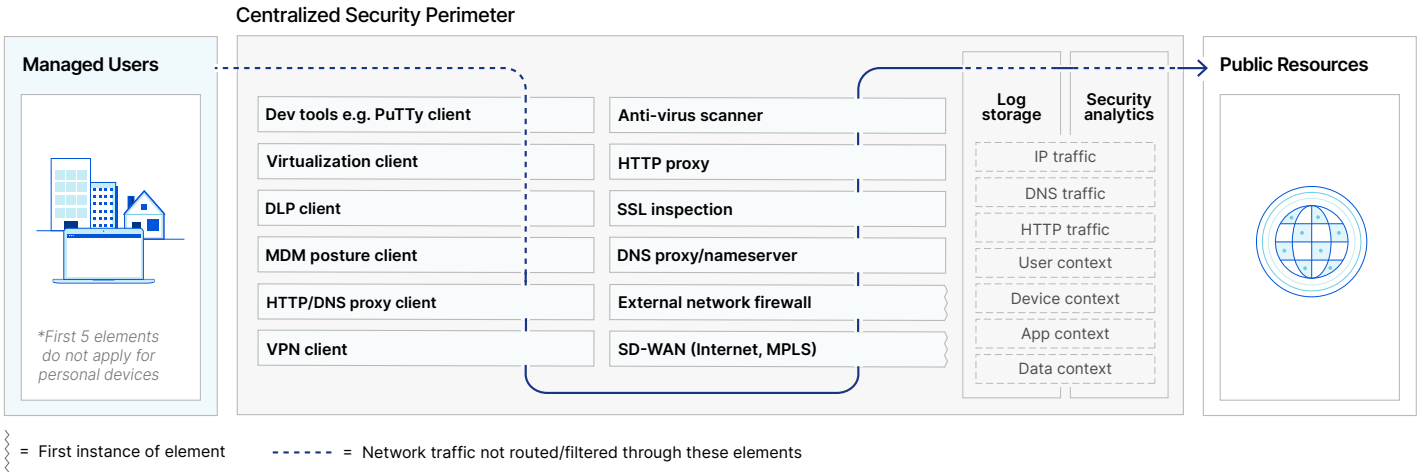
On the next six pages, a series of before vs. after diagrams incrementally layer details about all the possible connectivity and security elements your organization require for managed users accessing public resources and managed or unmanaged users accessing private resources.

The first “before” diagram illustrates the endpoint compute and network appliances deployed in a centralized security perimeter.

The second “after” diagram illustrates the comparable cloud services delivered via Cloudflare’s global network.

1a. Simplifying connectivity & security for public resources

Before Cloudflare



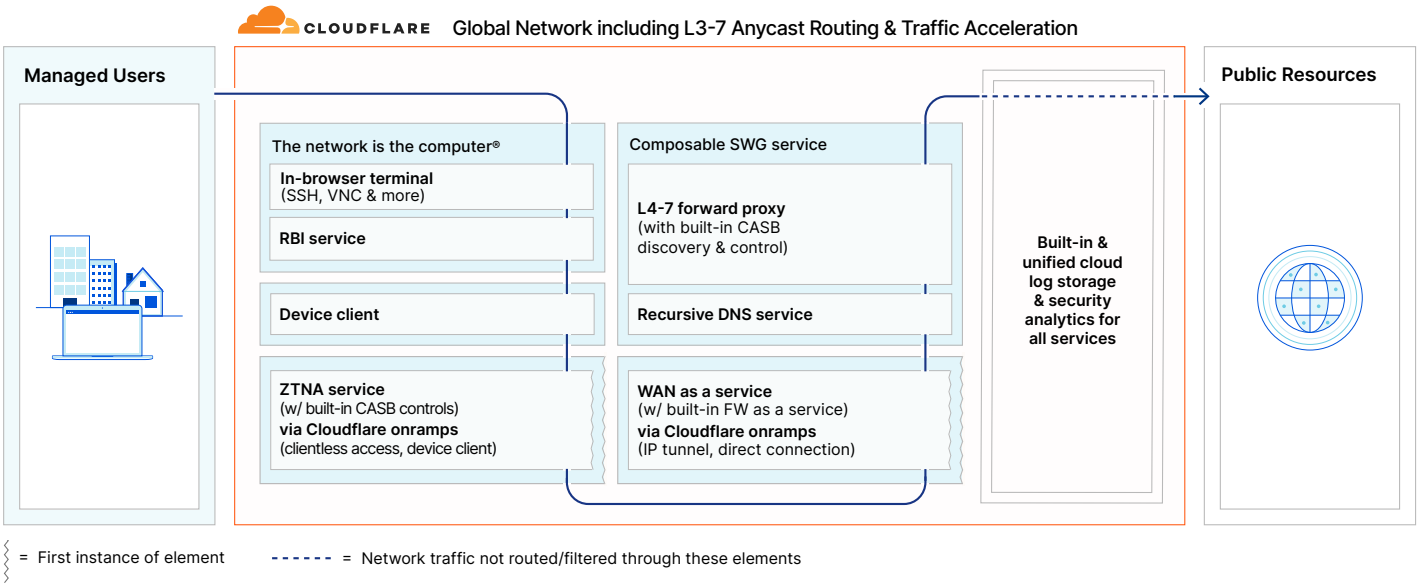
Managed users (to public and private resources)

IT teams had to manage many clients for connectivity and security — or worse, they couldn't for personal devices. Dev tools and VPN for private access private. HTTP/DNS proxy for public access. Virtualization, DLP, and MDM for better protection.

Public resources

Security teams relied on the VPN client or SD-WAN to route traffic from remote or office users through the network firewall, DNS proxy, SSL inspection, HTTP proxy, and anti-virus scanner appliances to protect public resource access.

After Cloudflare



Managed users (to public and private resources)

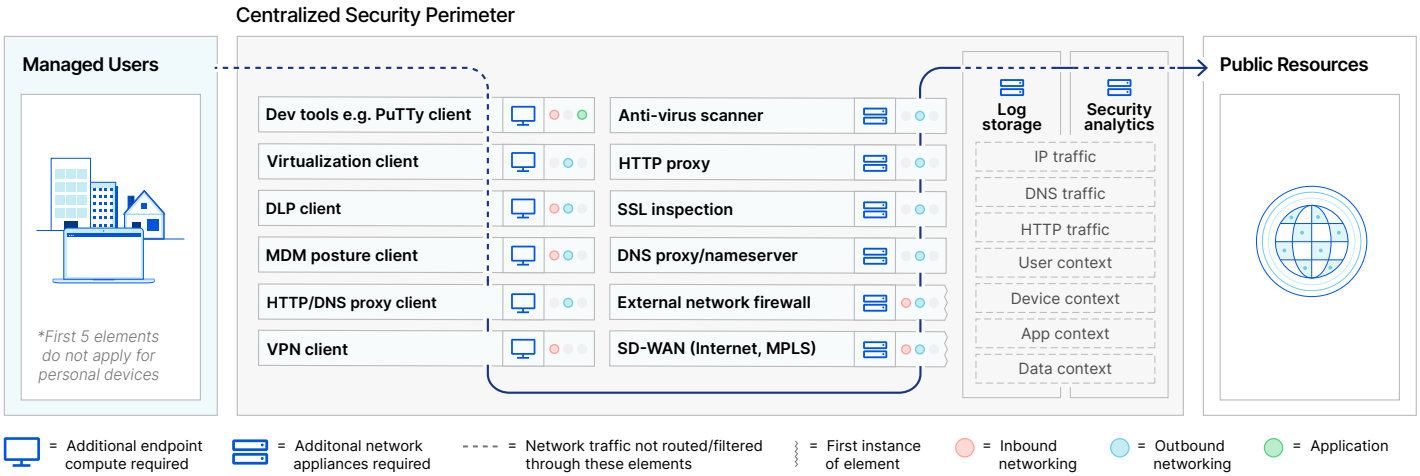
The network removes many functions from the computer or one client consolidates many functions.

Public resources

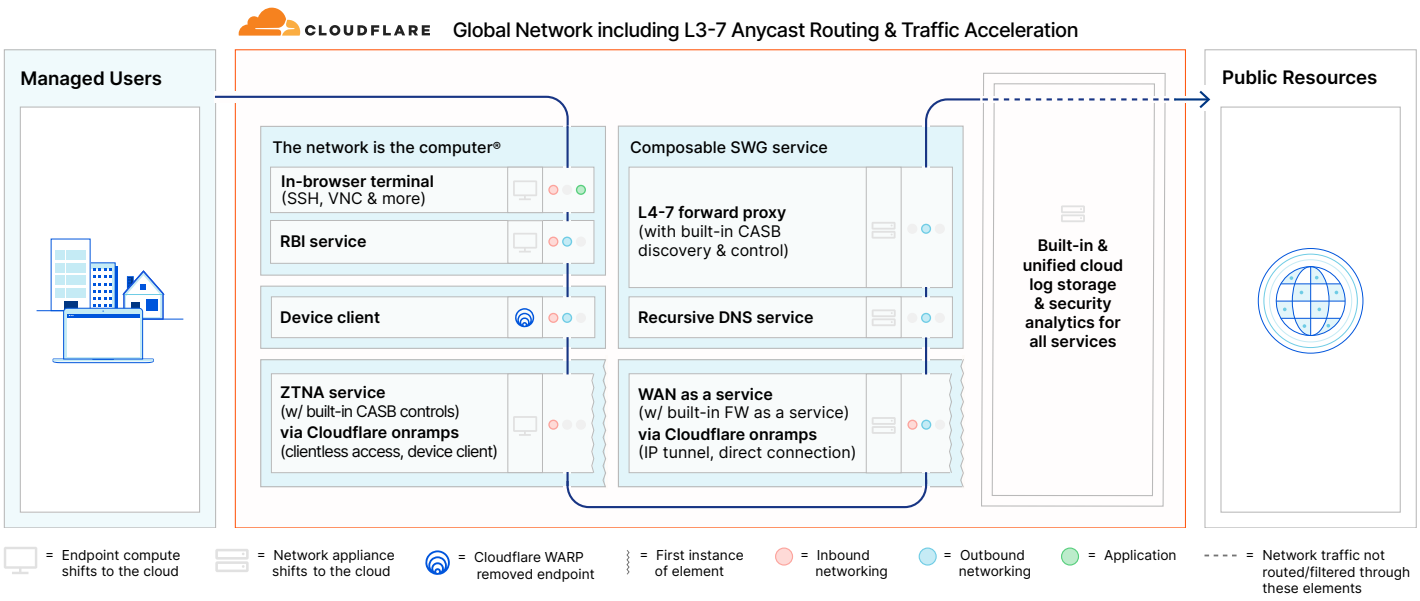
Our composable SWG service inspects traffic in a single pass before or after adopting our WAN as a service and/or ZTNA service with built-in security.

1b. Simplifying connectivity & security for public resources

Before Cloudflare



After Cloudflare



Cloud-native services

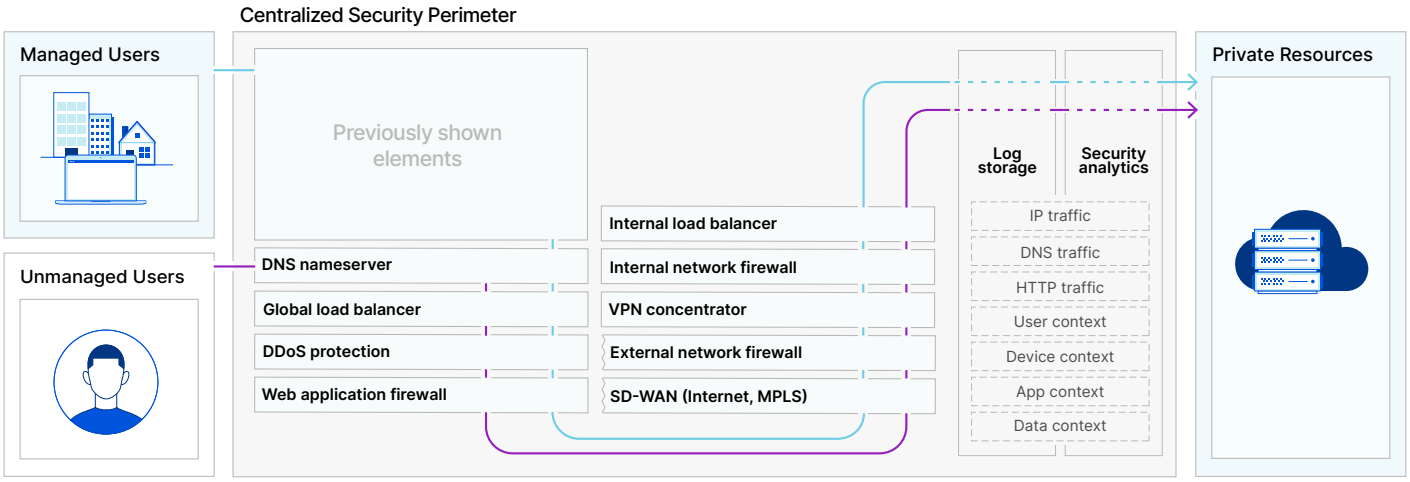
Endpoint compute and network appliance requirements are reduced.

Composable architecture

The inbound and outbound networking stacks are unified with the application stack for end-to-end security and performance.

2a. Simplifying connectivity & security for private resources

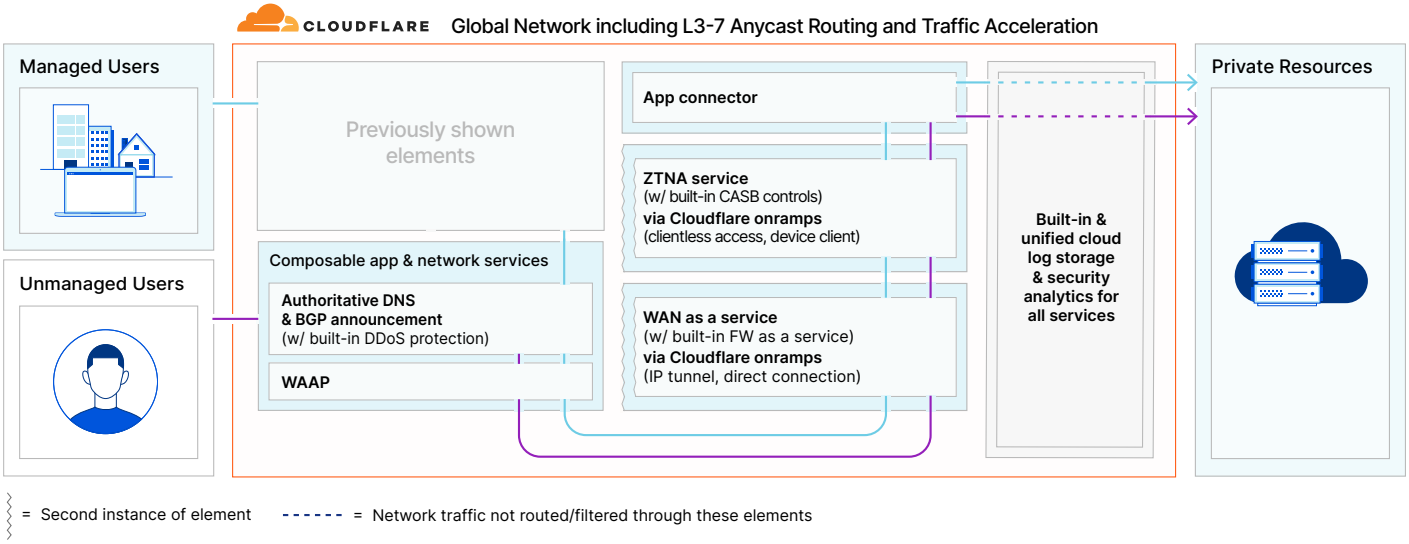
Before Cloudflare



Unmanaged users
Network teams had to manage publicly announcing availability of private resources to contractors and partners, and guard against DDoS or exploitation by attackers.

Private resources (from managed & unmanaged users)
Security teams relied on the VPN client or SD-WAN to route traffic from users through network firewalls, VPN concentrators, and load balancers to secure private resource access.

After Cloudflare

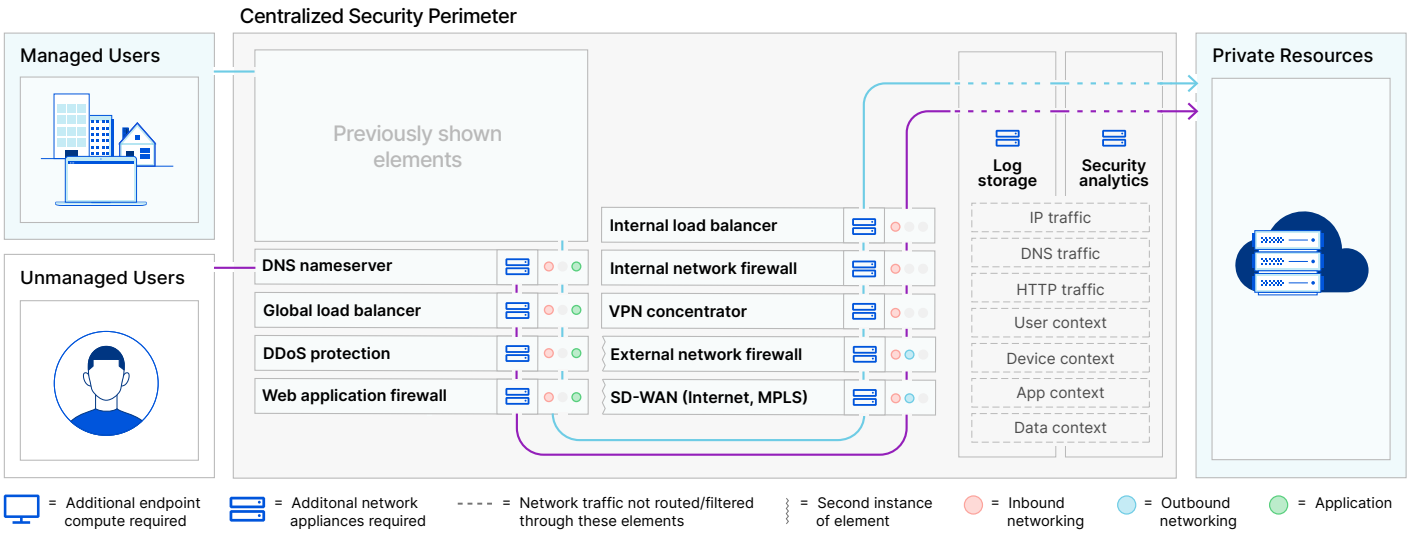


Unmanaged users
Our composable application and network services eliminate this burden either before or after adopting our ZTNA service or WAN as a service with built-in security.

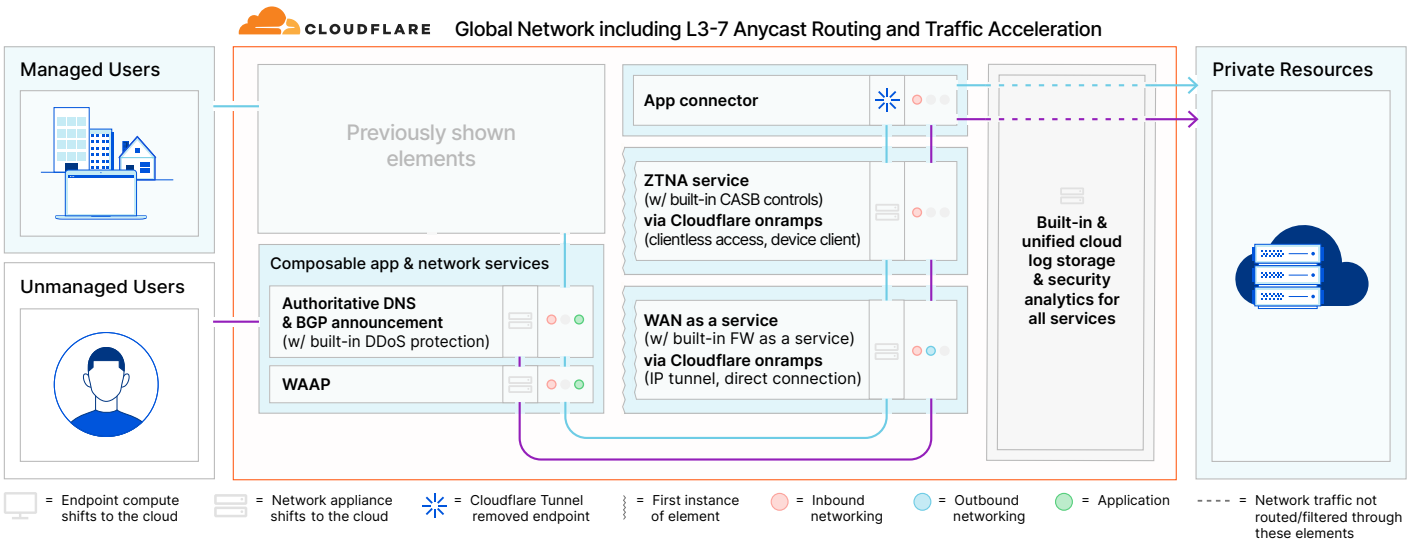
Private resources (from managed & unmanaged users)
Our ZTNA service and/or WAN as a service with built-in security simplifies access using our app connector.

2b. Simplifying connectivity & security for private resources

Before Cloudflare



After Cloudflare



Cloud-native services

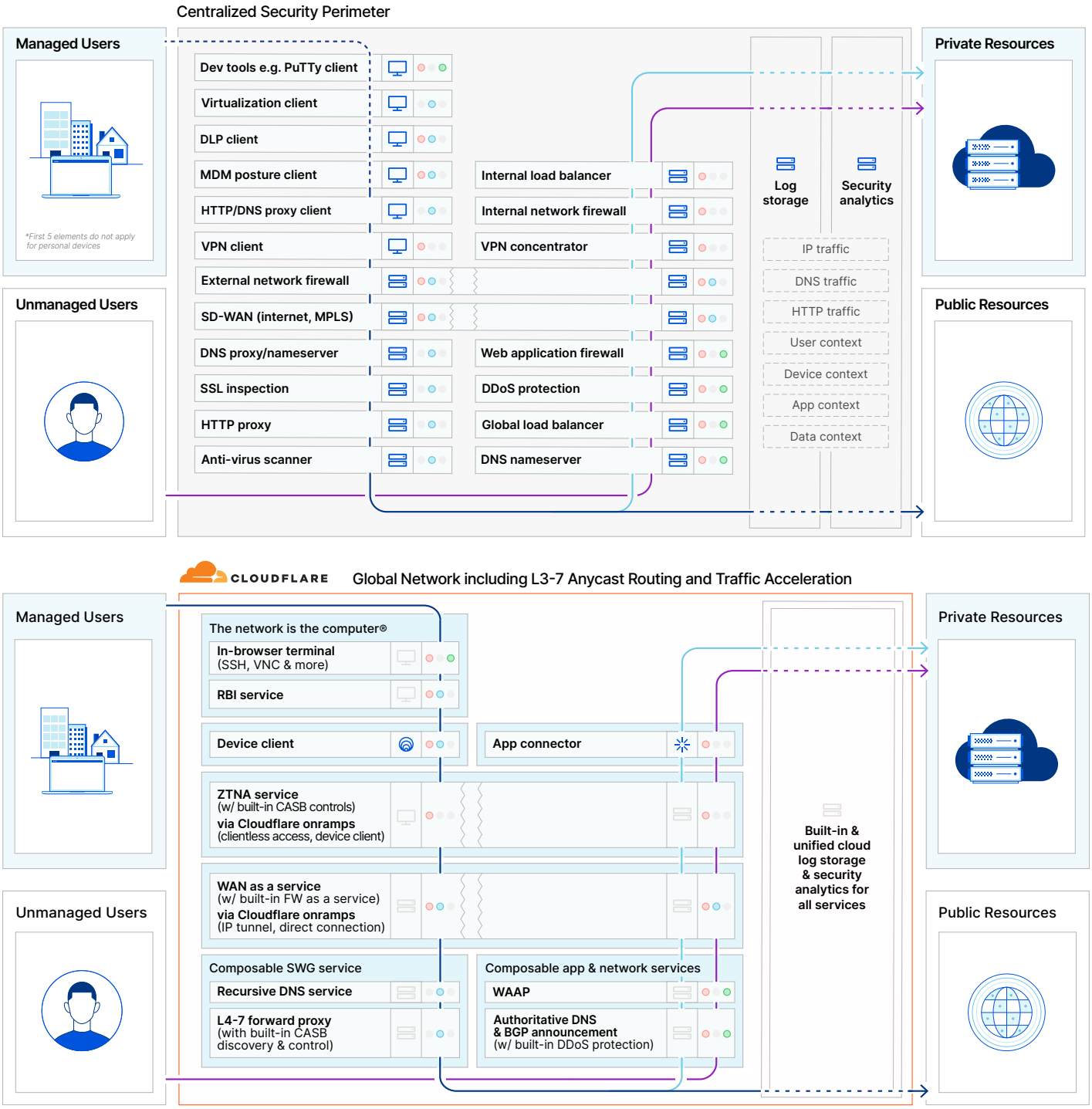
Endpoint compute and network appliance requirements are reduced.

Composable architecture

The inbound and outbound networking stacks are unified with the application stack for end-to-end security and performance.

Simplifying connectivity & security for any resource

This view combines diagrams 1 and 2 together.

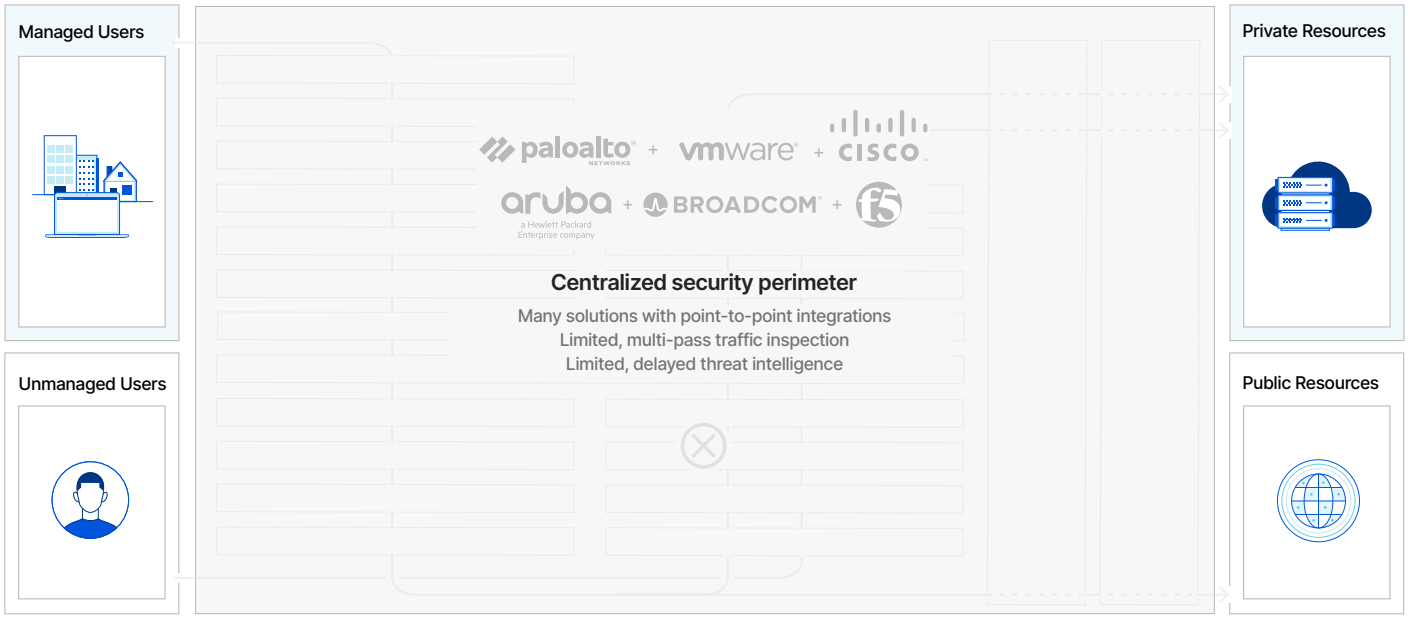


After

Connectivity and security elements are re-used when any user accesses any resource, which improves efficiency and experience. Also, our ZTNA service and WAN as a service spans elements that were traditionally managed in silos across IT, network, and security teams.

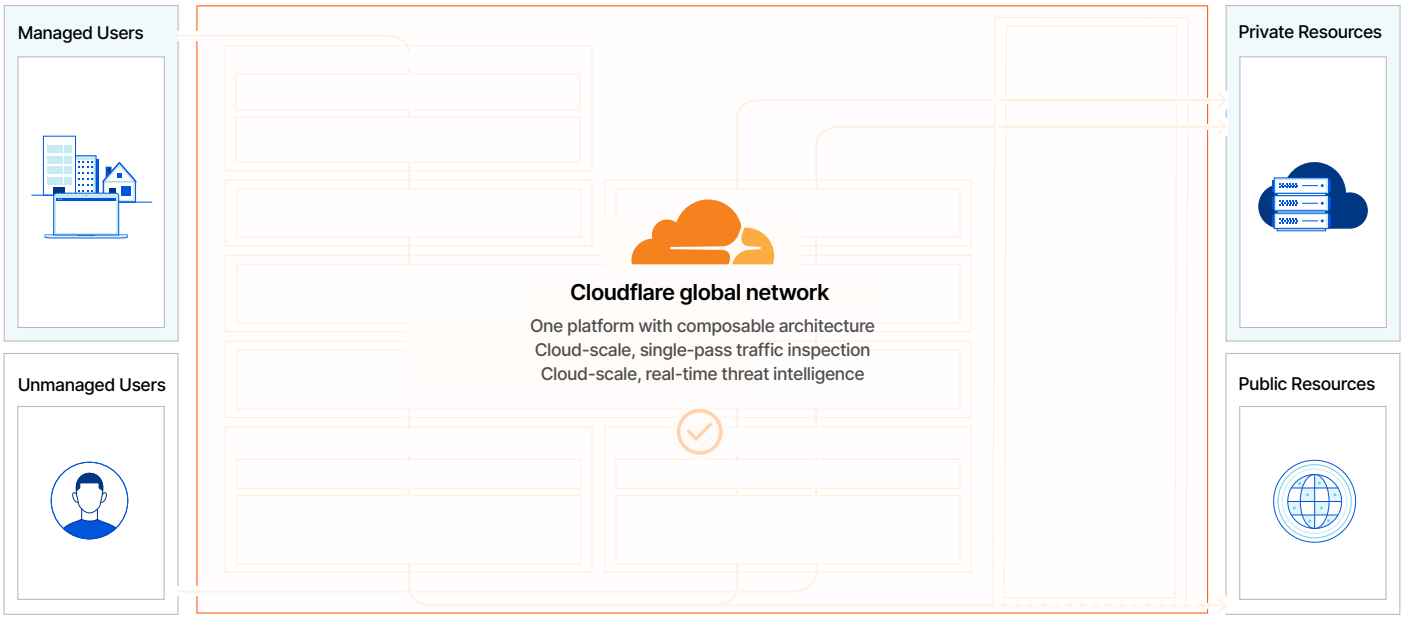
One platform for the simplest connectivity & security

Centralized security perimeter vs. Cloudflare global network



Before

IT, network and security teams relied on many vendors' solutions, each with a different architecture, such that point-to-point integrations led to connectivity and security gaps with limited performance.



After

All teams leverage one platform with the same composable architecture to eliminate gaps and performance tradeoffs. Our entire platform runs everywhere and is built to fit your world, not the other way around. You can deploy any number of services, in any sequence, and it'll still work uniformly together.

Use Case 1:
Secure Access for Web Applications

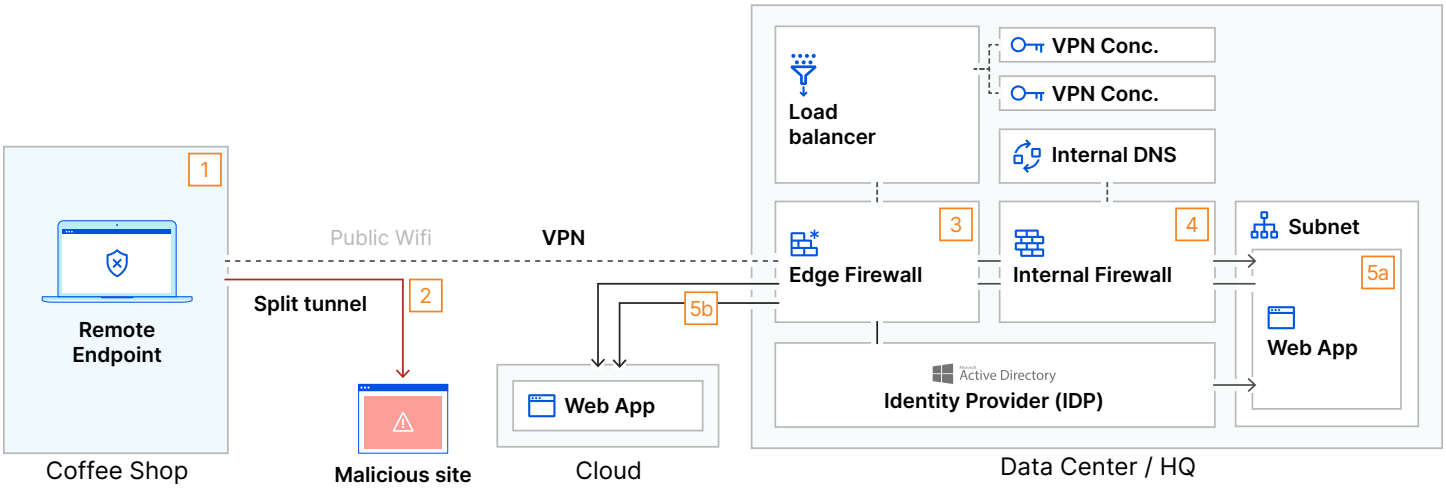
Legacy design - first glance

This graphic represents a traditional method of providing remote access to web applications. Here, a remote employee accesses corporate resources, specifically both a private (self-hosted) and public (cloud-based) web application.

We have included a few of the most common security measures any reasonable organization would have in place, including an edge firewall, an internal firewall for segmentation, and a VPN.

From left to right, this scenario illustrates the life of a session as a user logs in from a public location—a scenario that subsequent design graphics will build upon.

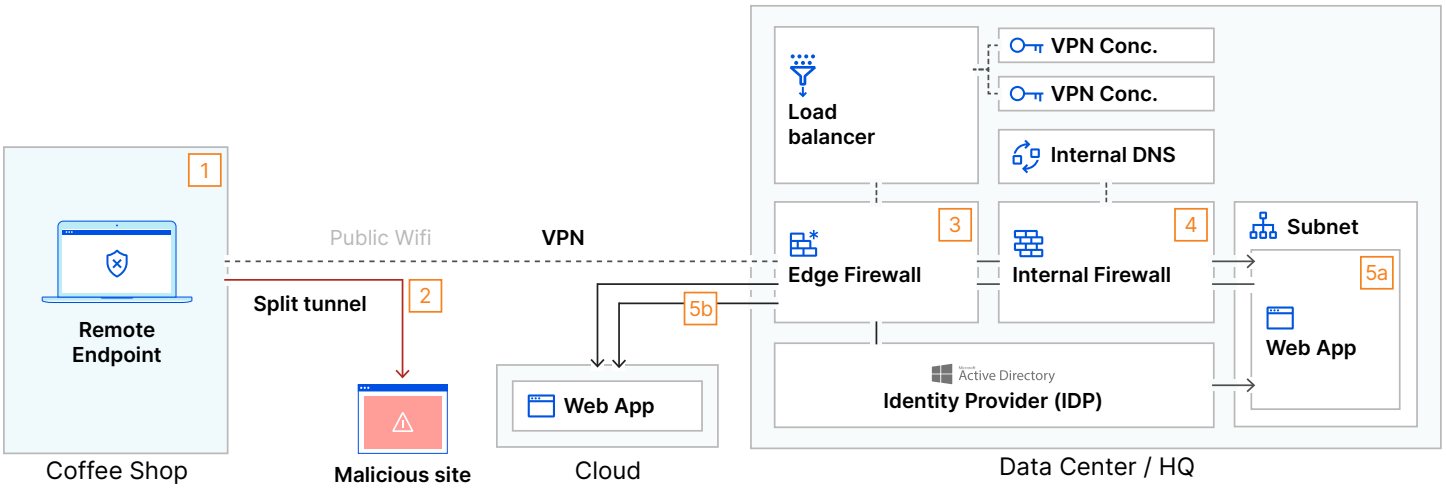
Note: This graphic only depicts the devices, appliances, and traffic flows involved in this specific network transaction and does not represent a comprehensive snapshot of all technologies that would be present in a legacy network architecture.



	Network/Security Action
1	A remote device connects to corporate resources via public Wifi
2	The remote device reaches corporate edge via VPN client, but split tunnels other traffic
3	VPN terminates at Edge Firewall or VPN Concentrator behind firewall
4	Firewall policy grants remote user access to subnet with private web application
5	User accesses web app via private IP/URL **[5a]** or Public URL **[5b]** after authenticating to IDP

Legacy design - security flaws

This graphic adds another column to the table below highlighting security flaws issues that are associated with each specific step in this scenario and that leave an organization vulnerable.

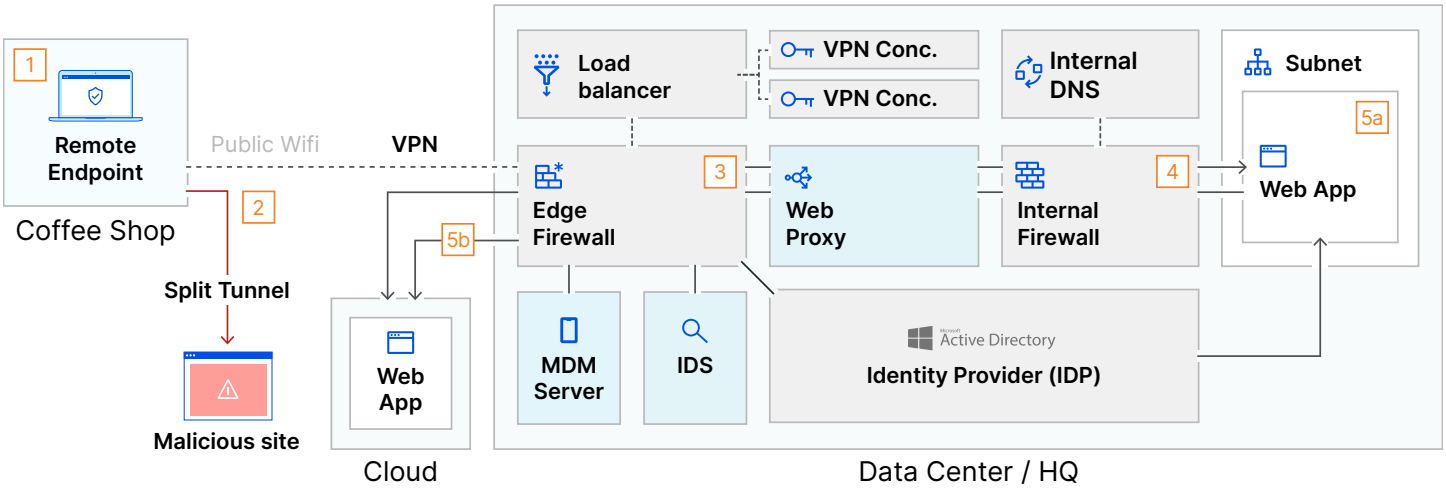


	Network/Security Action	Relevant Legacy Solution	Legacy Design Flaw
1	A remote device connects to corporate resources via public Wifi	Corporate VPN Client	An unsecured device on public wi-fi is a target for bad actors
2	The remote endpoint reaches corporate edge via VPN client, but split tunnels other traffic	Corporate VPN Client	VPN-specific security will not protect split-tunneled traffic
3	VPN terminates at Edge Firewall or VPN Concentrator behind firewall	Load balancer Edge Firewall VPN Concentrator	Inbound FW/VPN Rules may expose ports/ protocols to the internet, expanding potential attack surface
4	Firewall policy grants remote user access to subnet with private web application	Internal Firewall	The user has access to resources outside their job function
5	User accesses web app via private IP/URL **[5a]** or Public URL **[5b]** after authenticating to IDP	Active Directory Internal DNS (Private)	If the endpoint is compromised, company app/ network is at risk

Legacy design - required security add-ons

To address the design flaws highlighted in the previous page, the organization now needs to modify their existing network architecture.This graphic adds another column to the table below, detailing typical solutions to protect users and resources.

Layering each security add-on adds complexity and ongoing management costs across likely multiple vendors to the legacy environment.



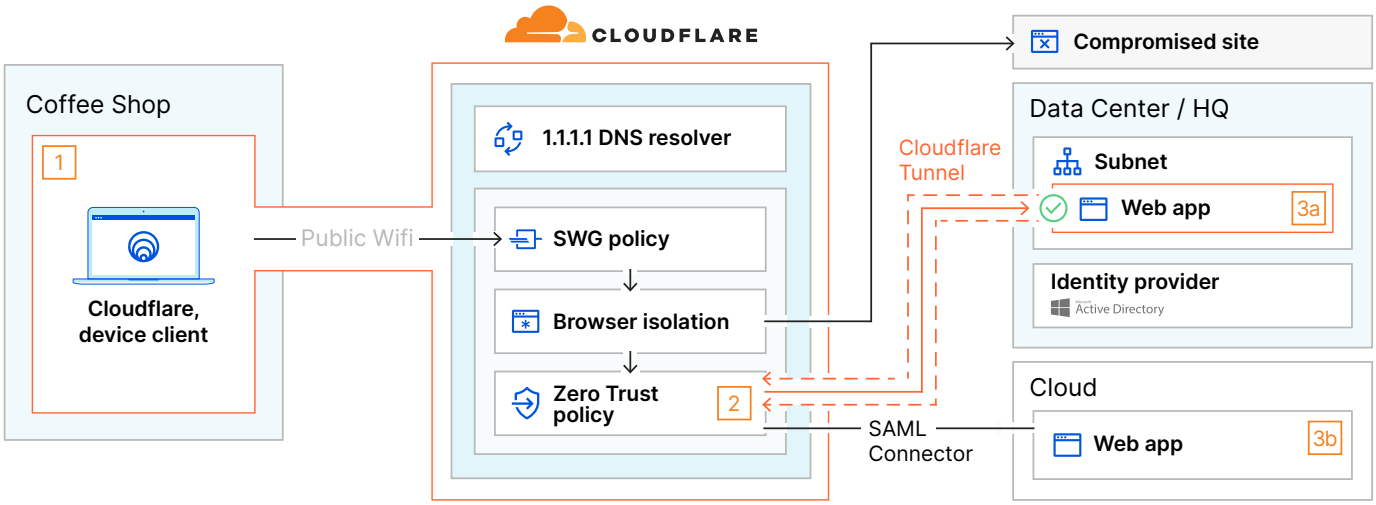
	Network/Security Action	Relevant Legacy Solution	Legacy Design Flaw	Required Security Add-on
1	A remote device connects to corporate resources via public Wifi	Corporate VPN Client	An unsecured device on public wi-fi is a target for bad actors	Endpoint Protection Platform (EPP)
2	The remote device reaches corporate edge via VPN client, but split tunnels other traffic	Corporate VPN Client	VPN-specific security will not protect split-tunneled traffic	Disable Split Tunnel
3	VPN terminates at Edge Firewall or VPN Concentrator behind firewall	Load balancer Edge Firewall VPN Concentrator	Inbound FW/VPN Rules may expose ports/protocols to the internet, expanding potential attack surface	Intrusion Detection System (IDS)
4	Firewall policy grants remote user access to subnet with private web application	Internal Firewall	The user has access to resources outside their job function	Web Proxy
5	User accesses web app via private IP/URL **[5a]** or Public URL **[5b]** after authenticating to IDP	Active Directory Internal DNS (Private)	If the endpoint is compromised, company app/network is at risk	Mobile Device Mgmt (MDM) Server

Cloudflare One design

This below graphic highlights how an organization can adopt a simpler, more efficient approach to secure application access by implementing Cloudflare One.

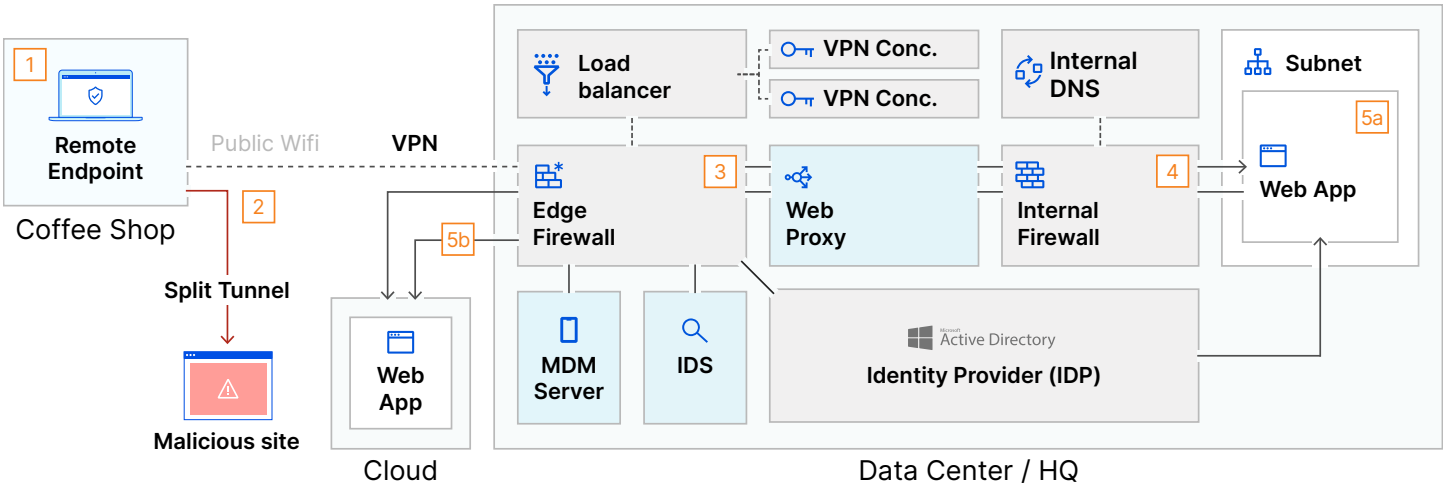
Here, much of the legacy network architecture shown beforehand is offloaded to Cloudflare, and many of the existing design flaws are corrected without the need for additional solutions.

With Cloudflare One, the traffic between the remote user and the organization's resources runs along Cloudflare's global network with single-pass inspection. All services shown below run in all of Cloudflare's data centers, located in 250+ cities in over 100 countries.

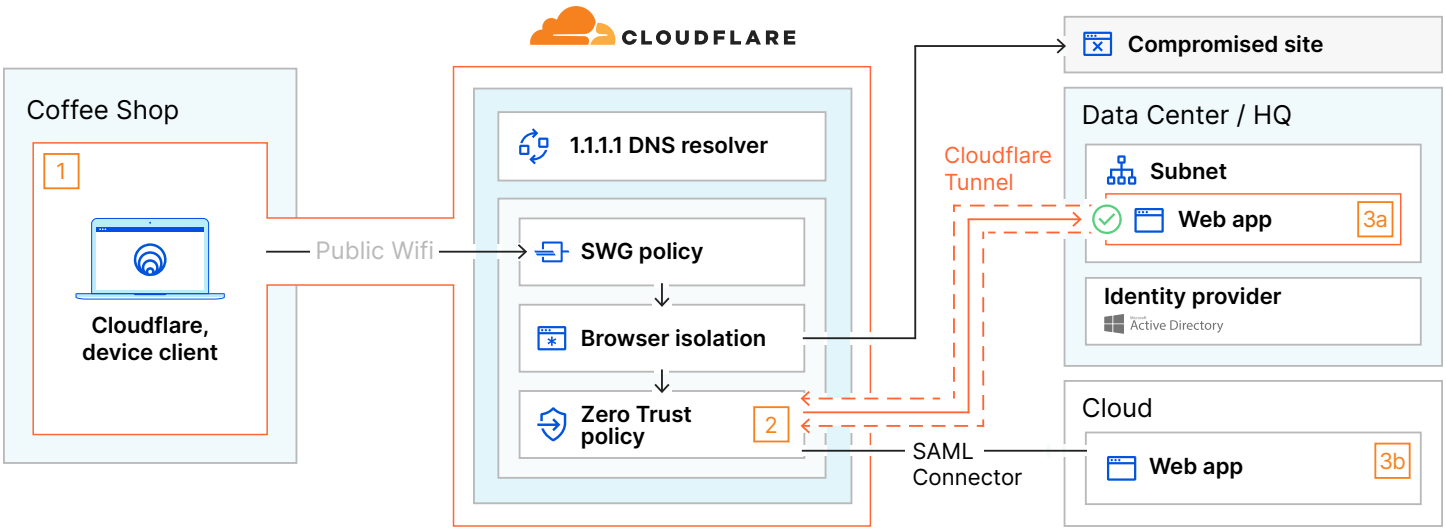


	Network/Security Action	Relevant Cloudflare One Element	Design Flaw Correction
1	A remote device connects to corporate resources and the internet via Cloudflare	Cloudflare Device Client Secure Web Gateway policy Browser Isolation	Local Secure Web Gateway client lets Cloudflare One filter DNS/HTTP/Network traffic to user's device via gateway policy Browser Isolation absorbs/isolates impact of successful malware attacks from websites
2	User undergoes IDP and device posture checks in Cloudflare	Zero Trust policy	Zero Trust policy performs device posture check before permitting access, mitigating risk of compromised devices Zero Trust policy authenticates user to the resource instead of the underlying network, preventing lateral movement
3	Access [Private | Public] web app directly via [Cloudflare Tunnel | SAML Connector]	Cloudflare Tunnel 1.1.1.1 DNS resolver	Cloudflare Tunnel securely brokers a connection to the web application and eliminates the use of explicit FW rules

Legacy design - required security add-ons



Cloudflare One design



Legacy design - required security add-ons

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5	User accesses web app via private IP/URL **[5a]** or Public URL **[5b]** after authenticating to IDP	Active Directory Internal DNS (Private)	If the endpoint is compromised, company app/network is at risk	Mobile Device Mgmt (MDM) Server

Cloudflare One design

	Network/Security Action	Relevant Cloudflare One Element	Design Flaw Correction
1	A remote device connects to corporate resources and the internet via Cloudflare	**Cloudflare Device Client** **Secure Web Gateway policy** **Browser Isolation**	Local Secure Web Gateway client lets Cloudflare One filter DNS/HTTP/Network traffic to user's device via gateway policy Browser Isolation absorbs/isolates impact of successful malware attacks from websites
2	User undergoes IDP and device posture checks in Cloudflare	**Zero Trust policy**	Zero Trust policy performs device posture check before permitting access, mitigating risk of compromised devices Zero Trust policy authenticates user to the resource instead of the underlying network, preventing lateral movement
3	Access [Private | Public] web app directly via [Cloudflare Tunnel | SAML Connector]	**Cloudflare Tunnel** **1.1.1.1 DNS resolver**	Cloudflare Tunnel securely brokers a connection to the web application and eliminates the use of explicit FW rules

Use Case 2: DNS Filtering

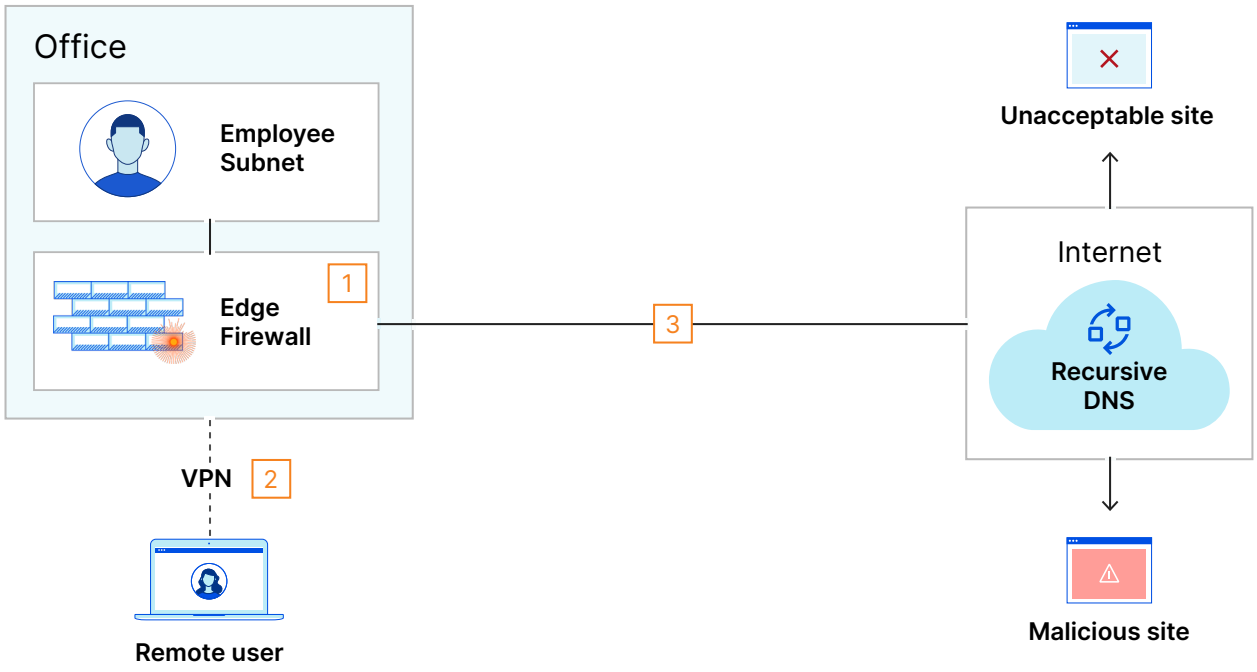
Legacy design - first glance

This graphic represents how organizations implement DNS filtering for onsite and remote employees in a legacy environment.

Typically, DNS filtering for organizations is accomplished via built-in features of on-prem solutions like a firewall. Remote users send requests through this firewall by first backhauling traffic through a full-tunnel VPN.

To resolve websites, the organization sends its DNS queries to a recursive DNS (like Google's 8.8.8.8).

Note: Just as with other sections in this guide, this legacy environment does not represent every technology inside an office, but only the ones involved in this specific use case.



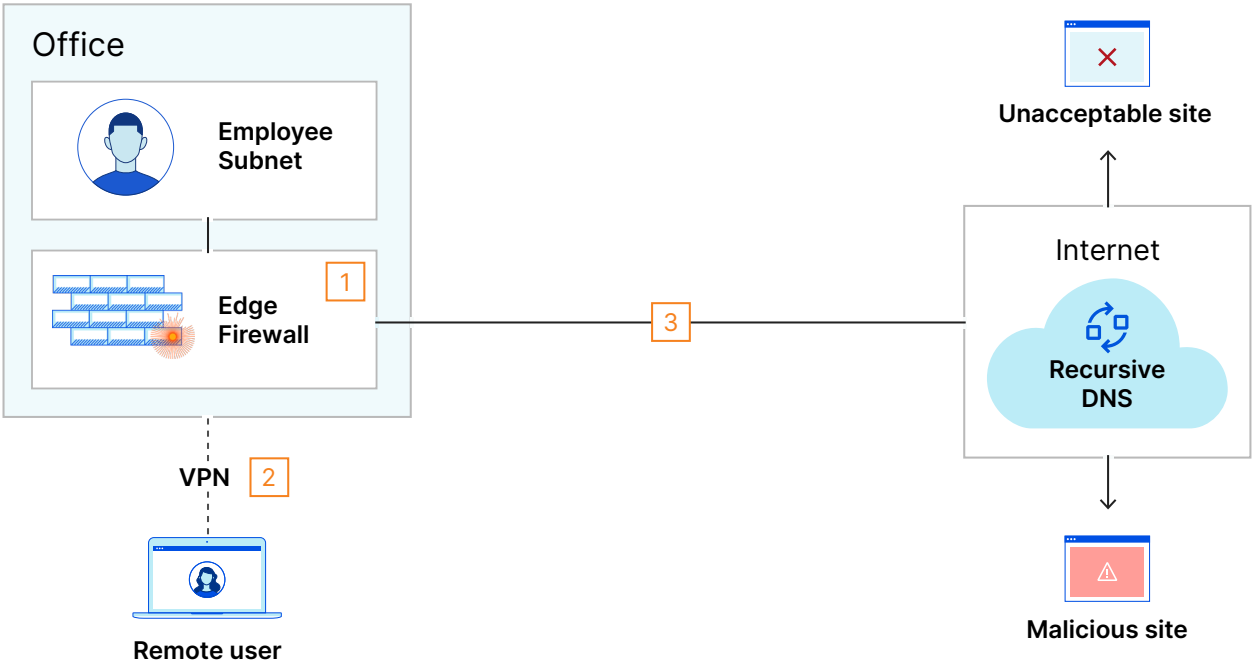
	DNS-Related Event
1	An onsite user has their DNS requests content filtered for security by the built-in feature on the Edge Firewall
2	A remote user has their DNS requests filtered after connecting to the organization's full tunnel VPN
3	Outbound DNS requests are transmitted in the clear.

Legacy design - operational flaws

This next graphic adds a column to the table below articulating the challenges associated with this traditional design.

The most pressing challenge is that relying on local hardware to perform DNS filtering at-scale will eventually bottleneck performance for all users, especially when that hardware is responsible for other critical services as well (such as terminating the remote-user VPN).

In addition, sending DNS queries without encryption (which occurs by default) creates a new attack vector with unknown risk.



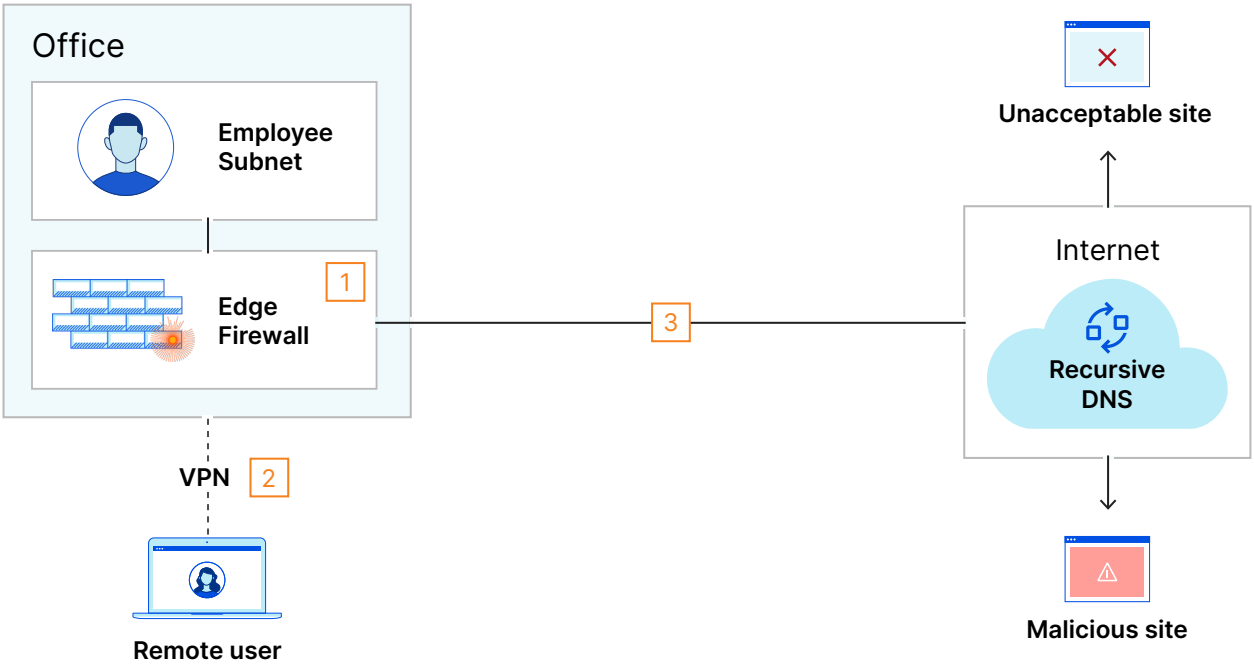
	DNS-Related Event	Relevant Elements	Design Flaw
1	An onsite user has their DNS requests content filtered for security by the built-in feature on the Edge Firewall	Edge Firewall	Relying on the Edge FW for too many essential operations can degrade performance across the organization
2	A remote user has their DNS requests filtered after connecting to the organization's full tunnel VPN	VPN Concentrator Edge Firewall	A full-tunnel VPN creates a 'double tax' of internet packets, which can create a performance bottleneck for the entire organization tunneled traffic
3	Outbound DNS requests are transmitted in the clear.	UDP53	DNS over UDP port 53 is unencrypted and therefore not private. Anyone who sees that can recon user web behavior

Legacy design - required network modifications

To address the design flaws highlighted in the previous page, the organization now needs to modify their existing network architecture. This graphic adds another column to the table below, highlighting common solutions with their own drawbacks.

Here, buying new hardware to handle more users or increase bandwidth consumption will lead to higher capital and operational expenses over time.

Organizations that attempt to scale this approach themselves often encounter considerable growing pains, and in fact, many organizations avoid DNS filtering entirely because of these operational concerns.



	DNS-Related Event	Relevant Elements	Design Flaw	Non-Cloudfare Solution
1	An onsite user has their DNS requests content filtered for security by the built-in feature on the Edge Firewall	Edge Firewall	Relying on the Edge FW for too many essential operations can degrade performance across the organization	Discrete DNS Filter
2	A remote user has their DNS requests filtered after connecting to the organization's full tunnel VPN	VPN Concentrator Edge Firewall	A full-tunnel VPN creates a 'double tax' of internet packets, which can create a performance bottleneck for the entire organization tunneled traffic	Increase ISP bandwidth Hardware upgrade Enable Split Tunnel*
3	Outbound DNS requests are transmitted in the clear.	UDP53	DNS over UDP port 53 is unencrypted and therefore not private. Anyone who sees that can recon user web behavior	DNS over TLS/HTTPS

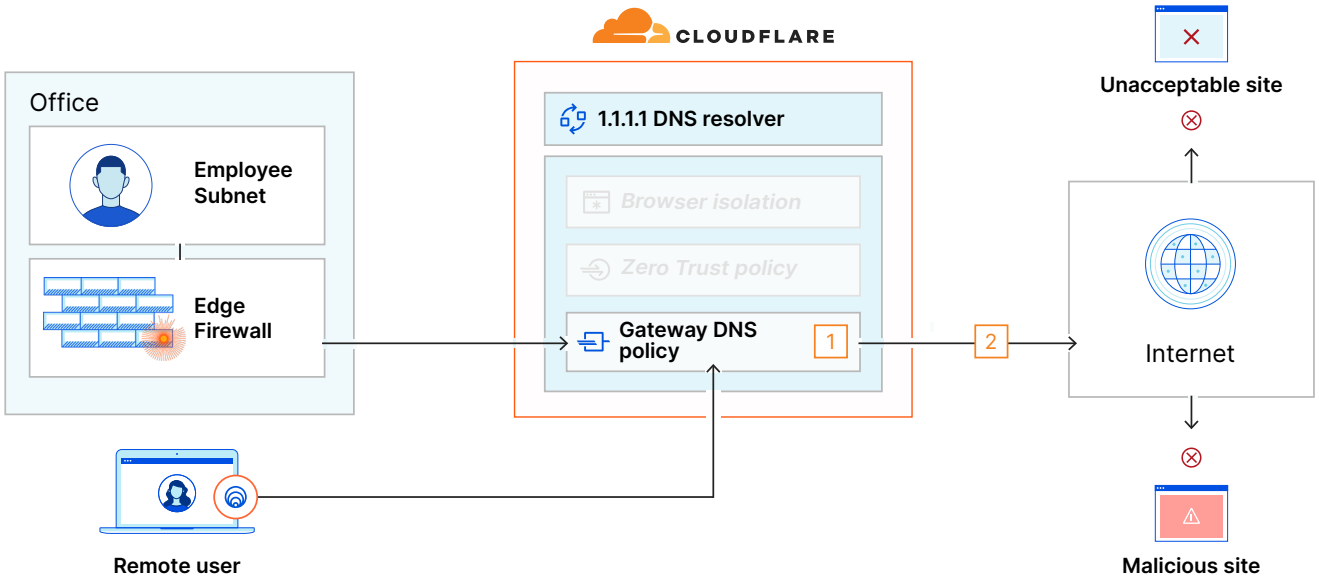
Cloudflare One design

Organizations that adopt Cloudflare One point their traffic to Cloudflare's global network and can perform DNS filtering for the entire workforce without worrying about the operational limits of their local hardware.

Cloudflare's DNS filtered is easy to deploy for both on-prem and remote users:

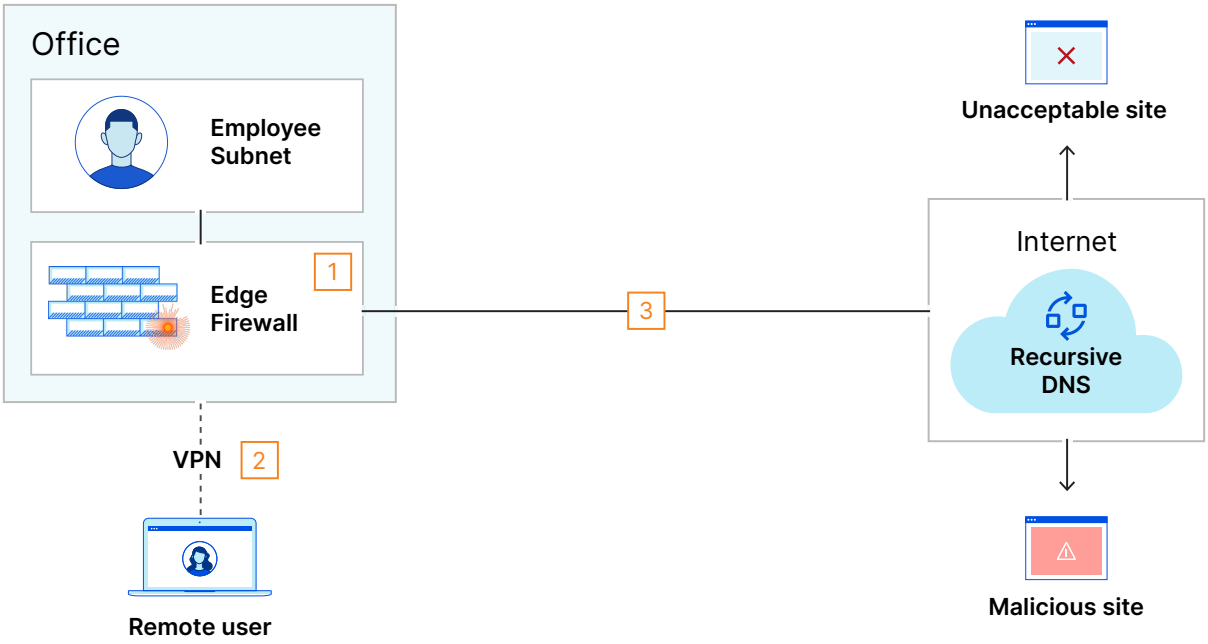
- Traffic from office users is sent to Cloudflare based on the outbound IP from the edge firewall
- Traffic from remote users is sent to Cloudflare from our device client

In addition, Cloudflare's 1.1.1.1 DNS resolver supports DNS over TLS/HTTPs, which resolves the security issue detailed in the legacy environment.

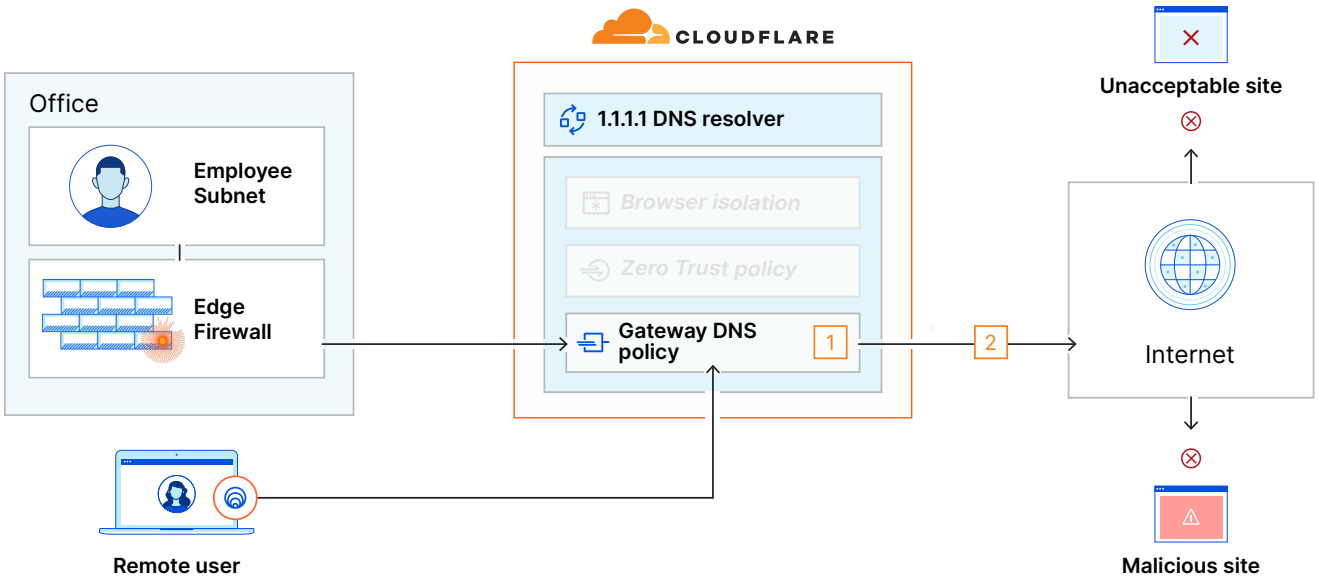


	DNS-Related Event	Relevant Cloudflare One Element	Design Flaw Correction
1	Both onsite and remote users have their DNS requests content filtered by Cloudflare	Secure Web Gateway	Gateway DNS policies offloads DNS filtering from local hardware (or provides it for the first time)
2	The organization's DNS requests are encrypted before being sent out.	1.1.1.1 DNS resolver	Cloudflare's 1.1.1.1 DNS resolver supports DNS over TLS/HTTPs, encrypting DNS requests and hindering hostile reconnaissance

Legacy design



Cloudflare One design



Legacy design

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1	An onsite user has their DNS requests content filtered for security by the built-in feature on the Edge Firewall	Edge Firewall	Relying on the Edge FW for too many essential operations can degrade performance across the organization	Discrete DNS Filter
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3	Outbound DNS requests are transmitted in the clear.	UDP53	DNS over UDP port 53 is unencrypted and therefore not private. Anyone who sees that can recon user web behavior	DNS over TLS/HTTPS

Cloudflare One design

	DNS-Related Event	Relevant Cloudflare One Element	Design Flaw Correction
1	Both onsite and remote users have their DNS requests content filtered by Cloudflare	**Secure Web Gateway**	**Gateway** DNS policies offloads DNS filtering from local hardware (or provides it for the first time)
2	The organization's DNS requests are encrypted before being sent out.	**1.1.1.1 DNS resolver**	Cloudflare's **1.1.1.1 DNS resolver** supports DNS over TLS/HTTPs, encrypting DNS requests and hindering hostile reconnaissance