



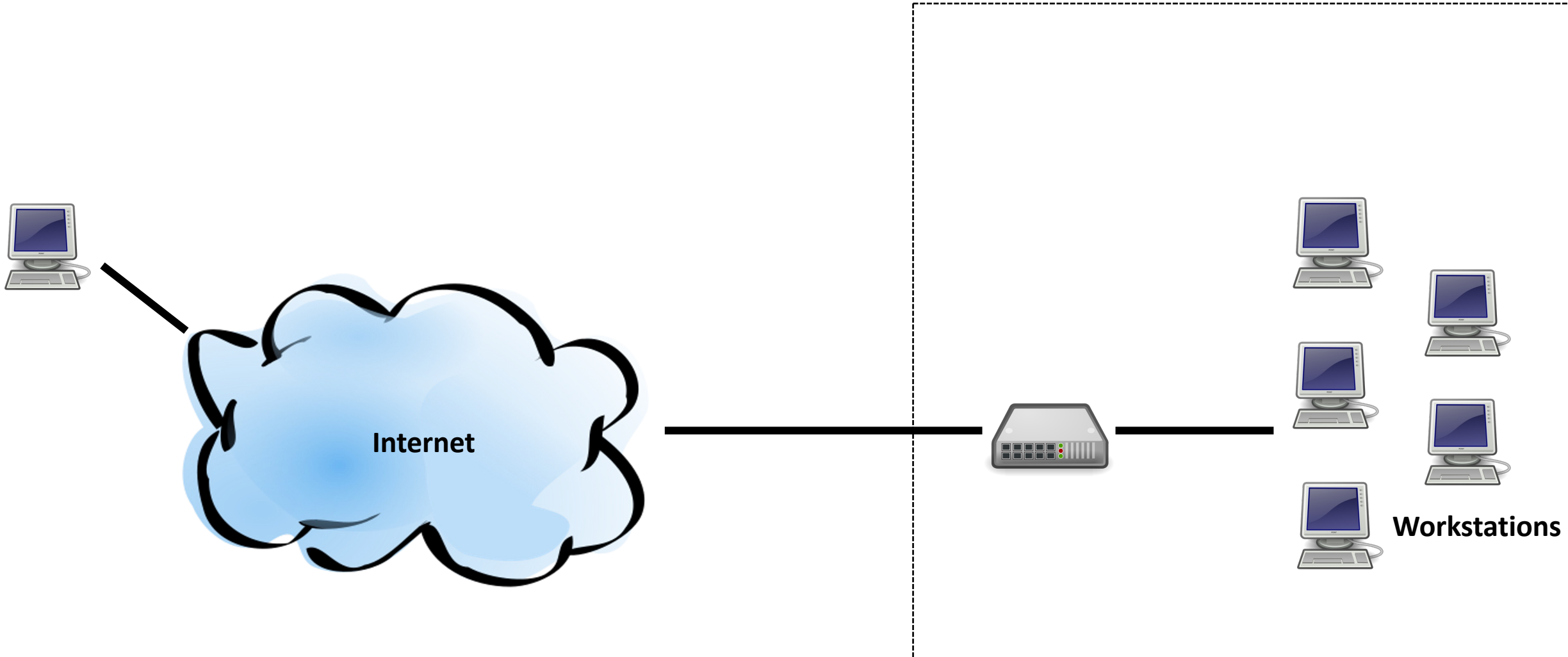
CompSci 401: Cloud Computing

Security in Local Infrastructures

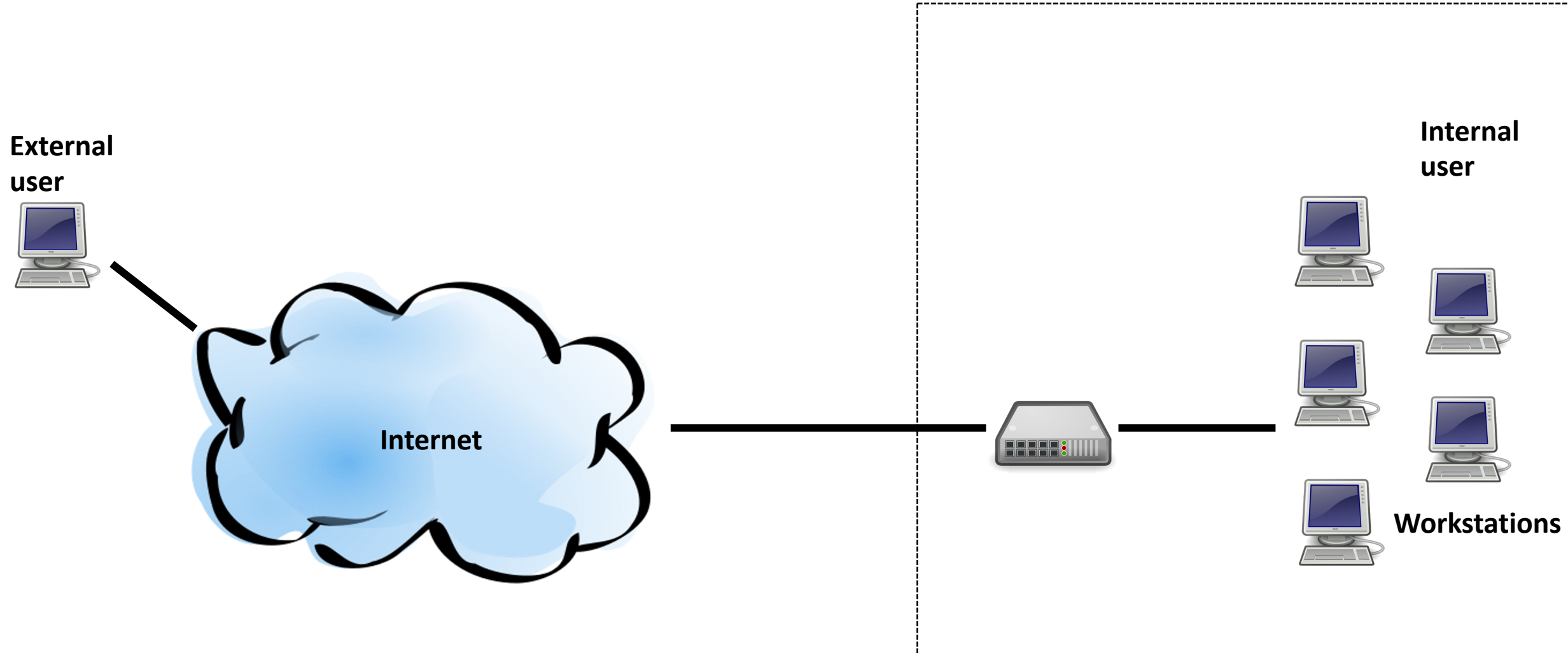
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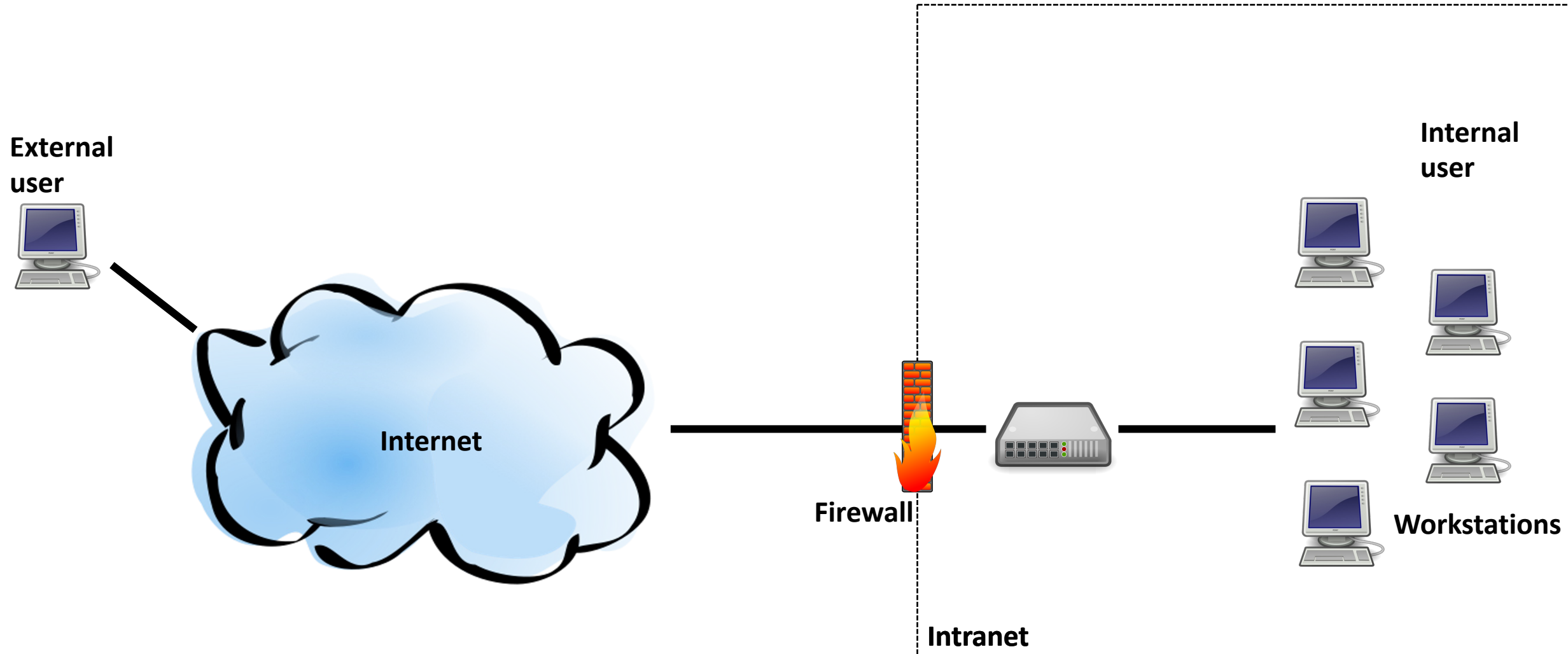
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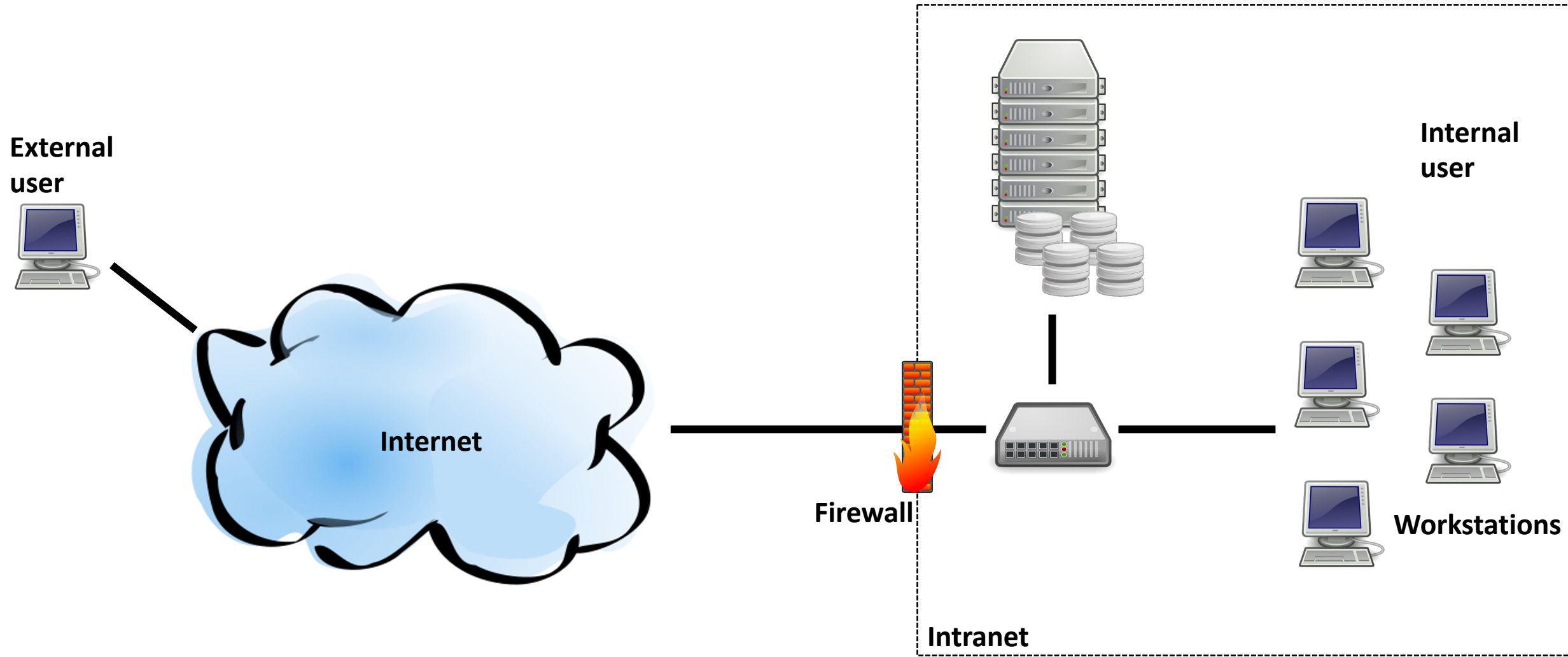
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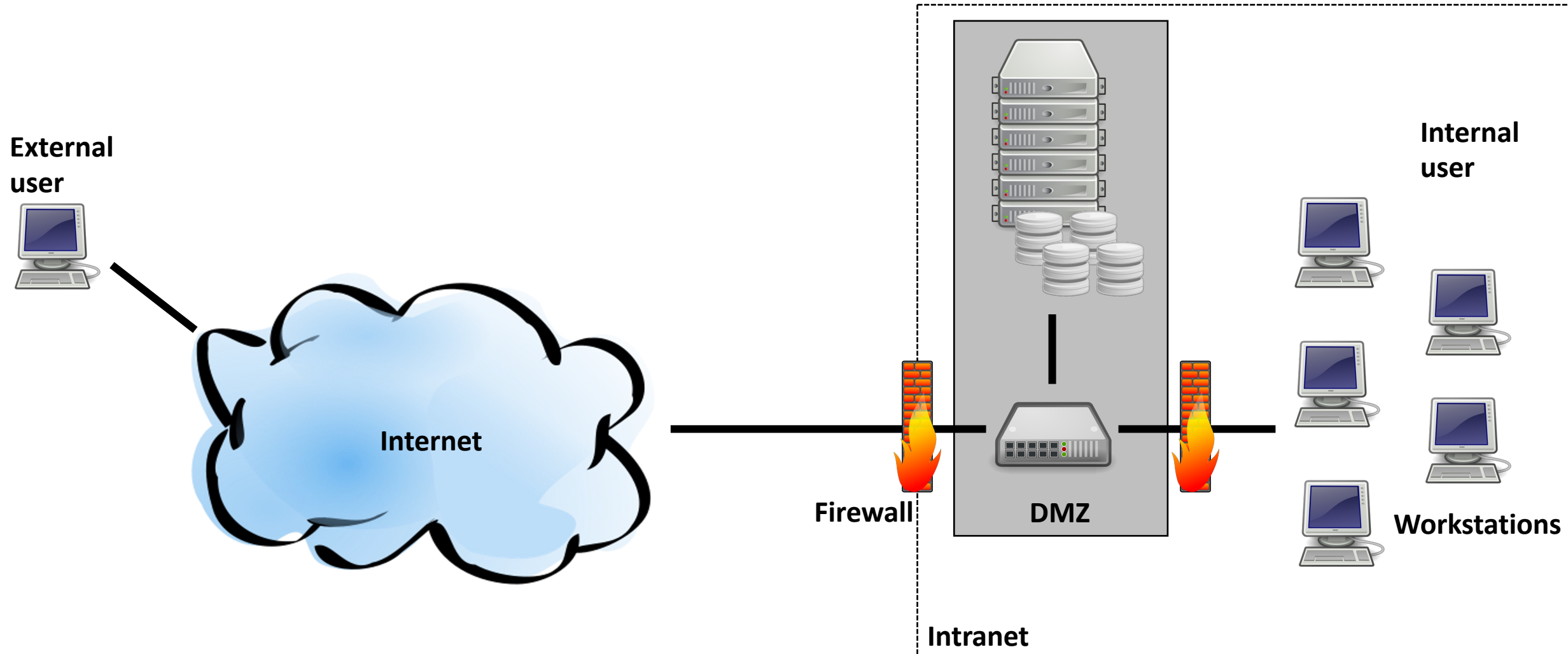
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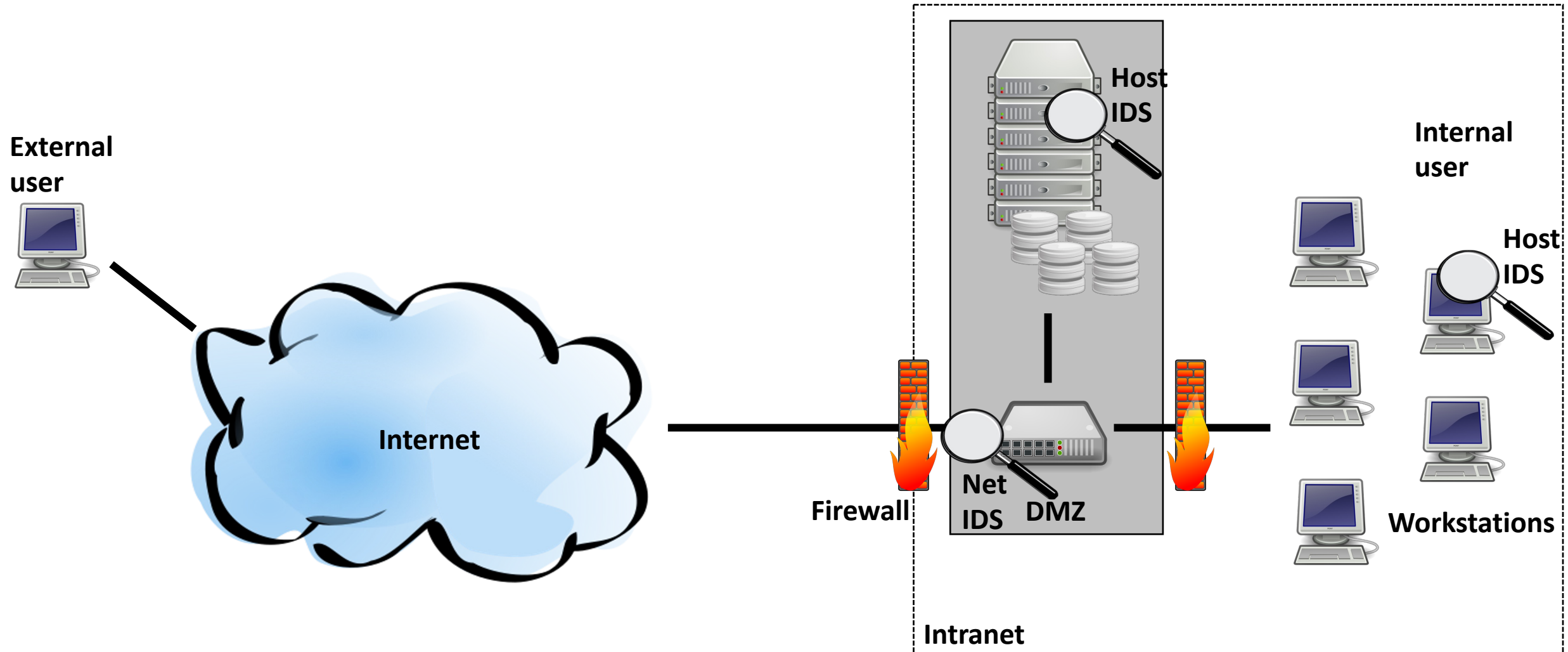
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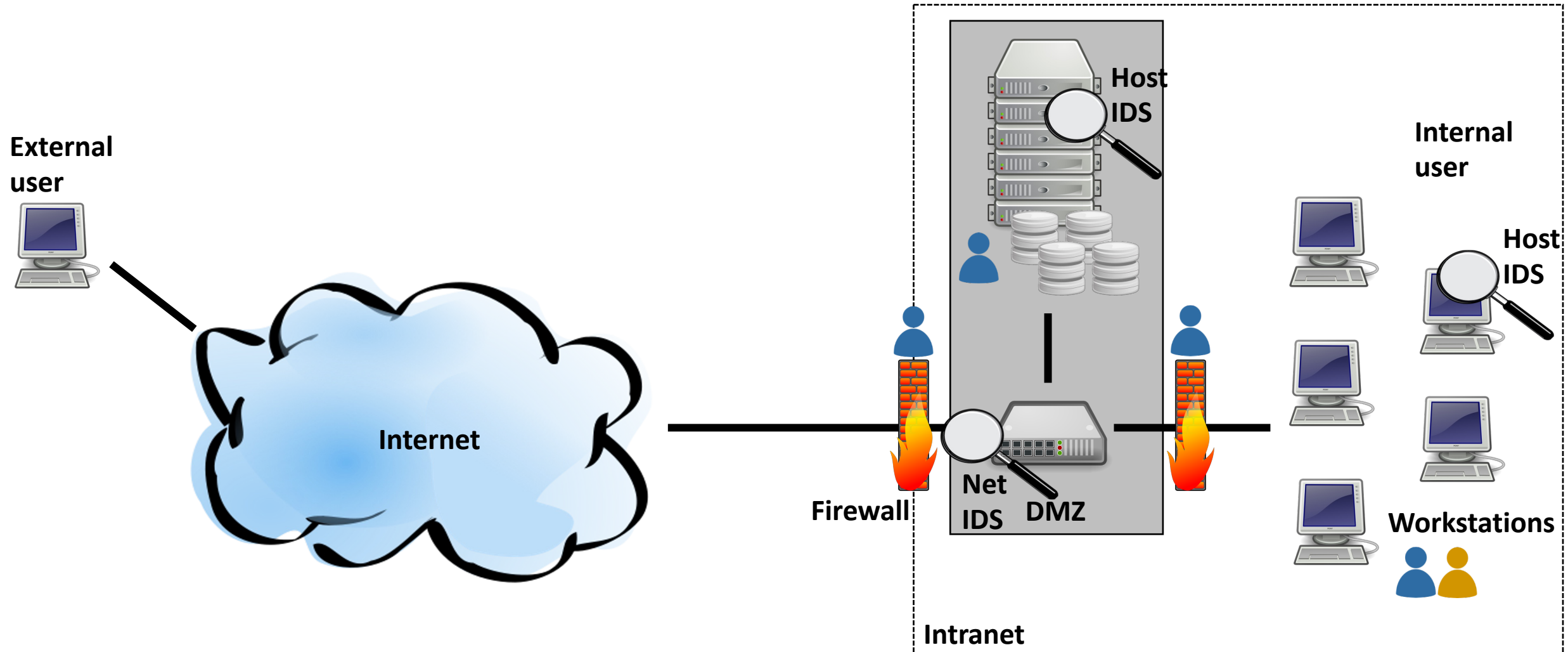
Security in Local Infrastructures



Security in Local Infrastructures



Security in Local Infrastructures



Incompatibilities of the classical approach with cloud computing

- No network perimeter
 - Logical perimeter defined by virtual network
 - Isolation is delegated to cloud operator
 - No control over *shared* physical devices
- Firewall and IDS configurations need to be coordinated with provider
 - Border firewall executes on the cloud provider's resources
 - Provider needs to update policies whenever client changes configuration
- Coarse-grained access control may be insufficient

Security challenges in the cloud

- Lack of control and visibility
 - Tenant has limited ability to investigate issues
 - Hard to differentiate between failure on underlying infrastructure (the provider's fault), on the application (the developer's fault) or an attack (a third-party's fault)
 - Depends on cloud provider to identify the root cause of the problem
- Shared infrastructure
 - Isolation from virtualization, but compute, memory, and network still shared
 - Increased security risk, for example if isolation is not perfect
- Everyone is remote: employees, IT staff, users, clients

Security challenges of cloud-native applications

- Many services with interdependencies
 - Microservices can be secured, but their number increases the attack surface
- Dynamic execution environment
 - Orchestration, autoscaling, rollouts, rollbacks, canaries: multiple systems operating in parallel with the application are confounding factors
- Reliance on software from the cloud provider
 - Cloud software may be subject to security vulnerability in the cloud infrastructure and software stack



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Security in the Cloud

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Collaboration with cloud providers

- Cloud providers have implemented security mechanisms
 - Virtualization technologies to protect their hardware and isolate tenants
 - Several security-related solutions
 - Fine-grained access control
 - Firewalls
 - Load balancers and packet filters
 - Private connections
- Tenants need to learn how to employ these mechanisms
- Collaboration with cloud providers is essential
 - Speed up issue resolution
 - Identify requirements of new solutions to cover existing gaps

Protecting remote access

- Every access is remote in a cloud environment
- Protect and isolate business data
 - Laptops and cell phones are encrypted
 - Hard to extract information from lost or stolen devices

Protecting remote access

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BitLocker recovery

Enter the recovery key for this drive

Use the number keys or function keys F1-F10 (use F10 for 0).

Recovery key ID (to identify your key): ABD09F3E-C04C-4C8F-B2AE-CF0253006F7B

Here's how to find your key:

- Sign in on another device and go to: <http://custom.url.contoso.com>
- Try your Microsoft account at: aka.ms/myrecoverykey
- For more information go to: aka.ms/recoverykeyfaq

SAMSUNG Knox

Protecting remote access

- Every access is remote in a cloud environment
- Protect and isolate business data
 - Laptops and cell phones are encrypted
 - Hard to extract information from lost or stolen devices
- Protect communication
 - End-to-end encryption
- Workflow security
 - Guarantee access and protection policies are enforced
 - Identity management and user authentication
- Enforce encryption and authentication everywhere
 - Virtual Private Network (VPN)



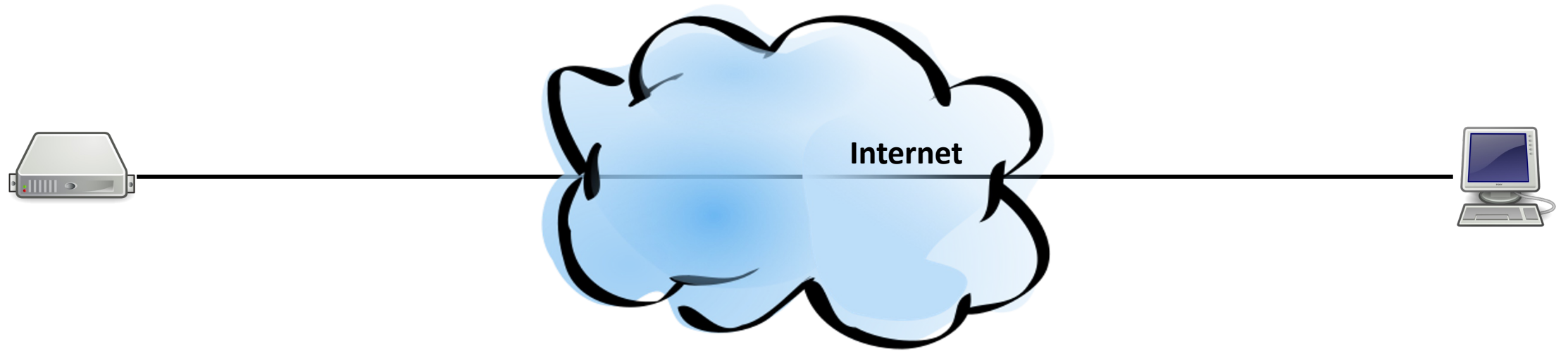
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End-to-end Encryption

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End-to-end encryption



End-to-end encryption



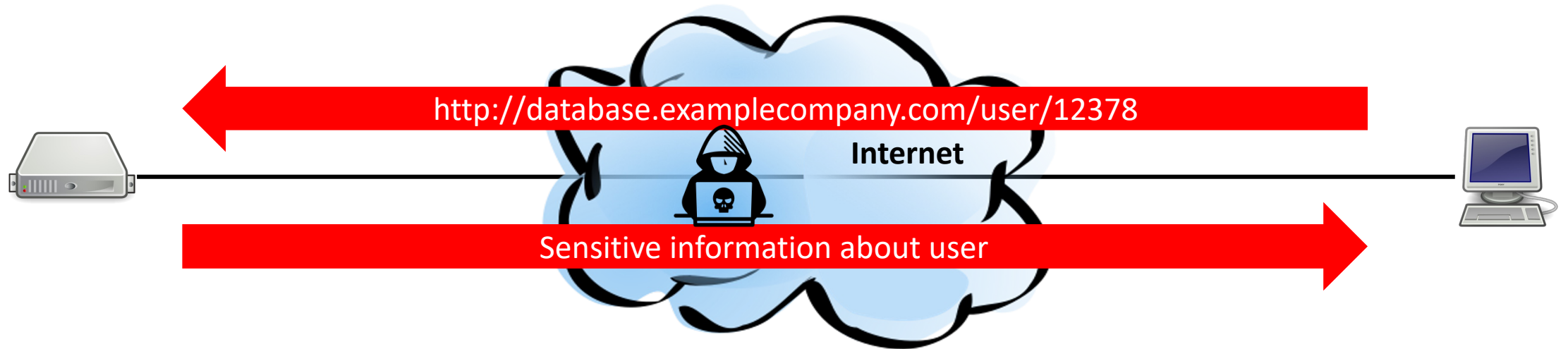
End-to-end encryption



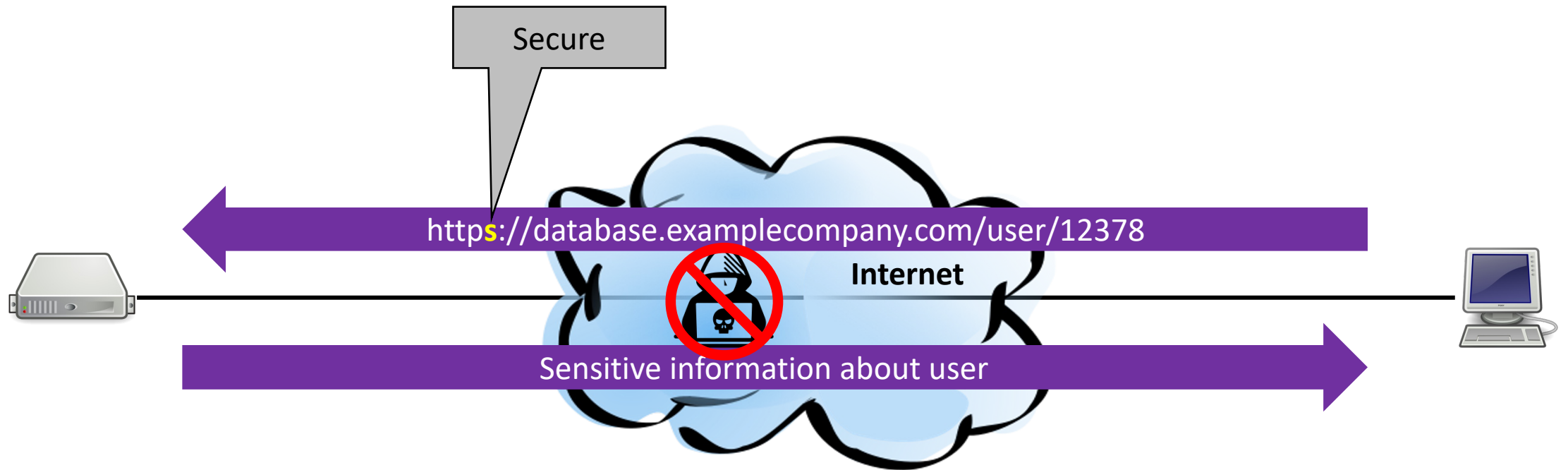
End-to-end encryption



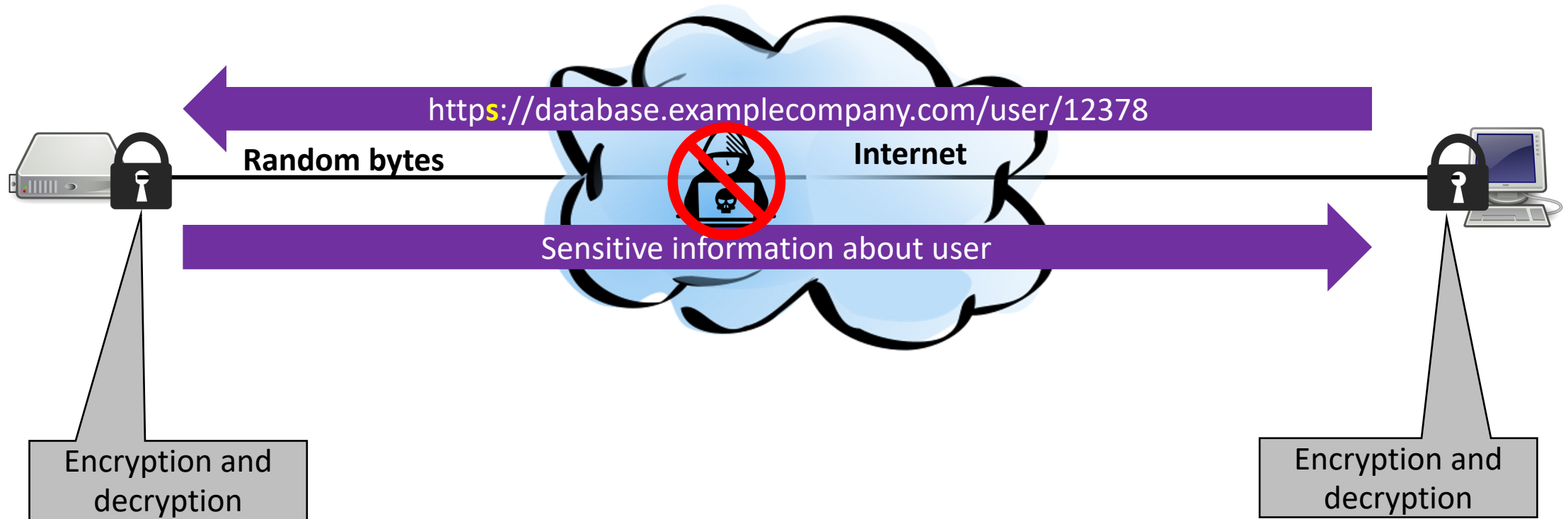
End-to-end encryption



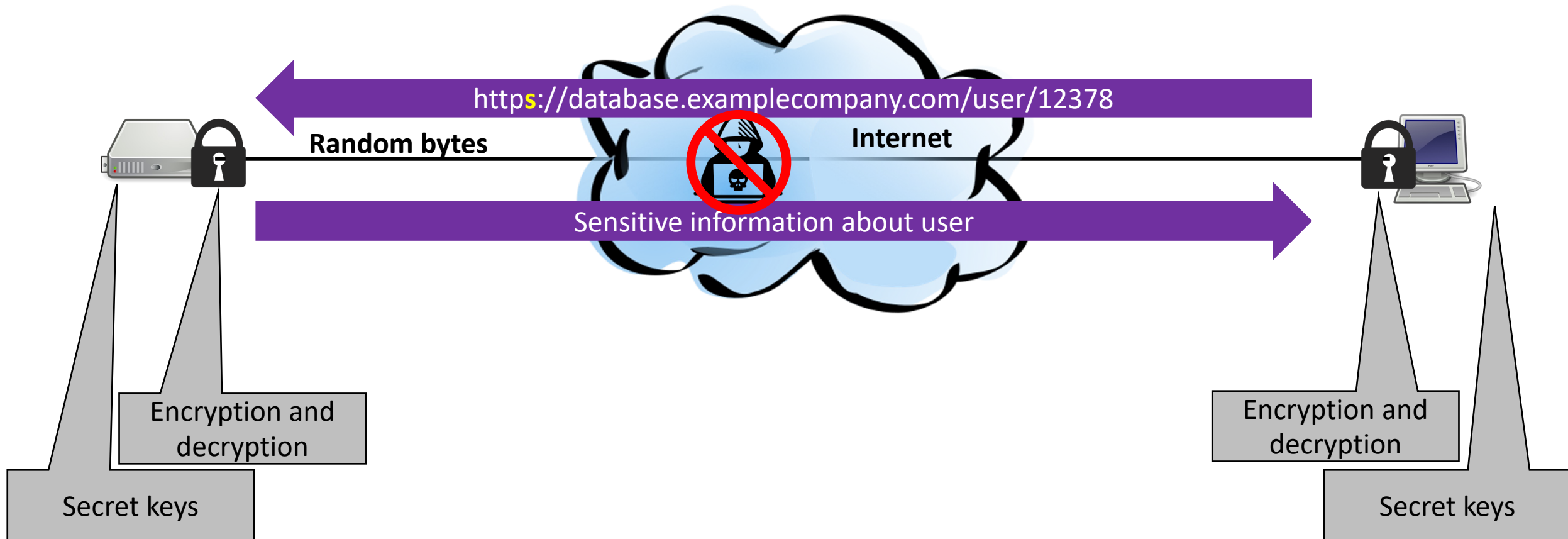
End-to-end encryption



End-to-end encryption



End-to-end encryption





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Identity Management

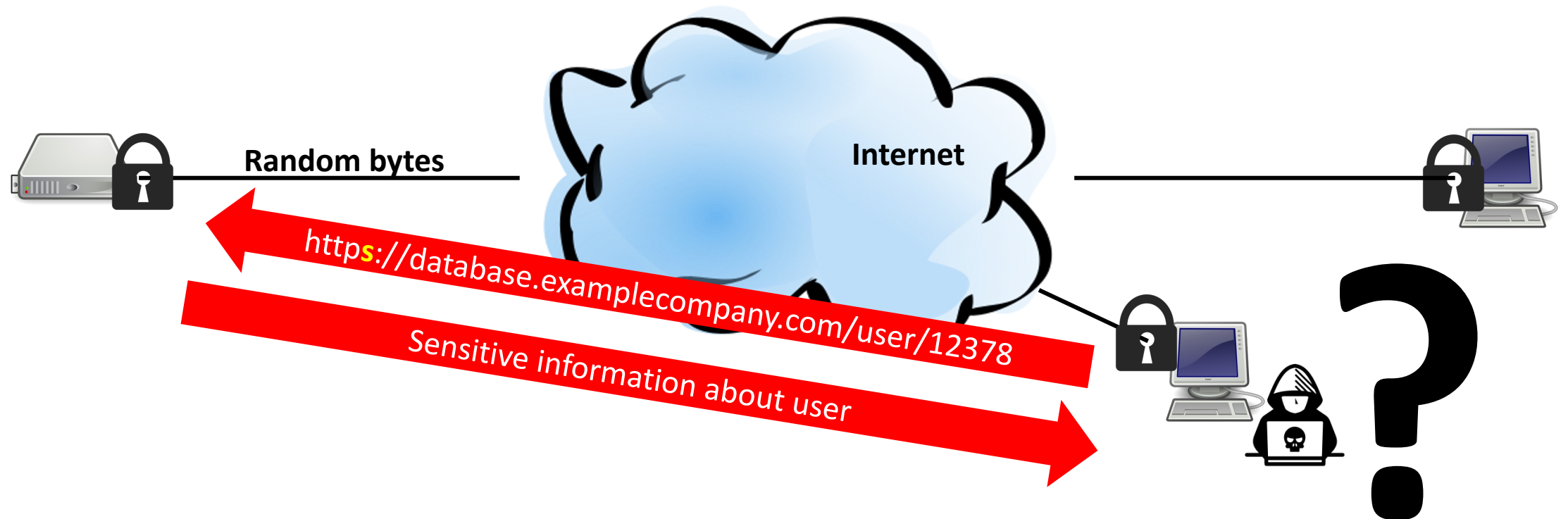
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End-to-end encryption



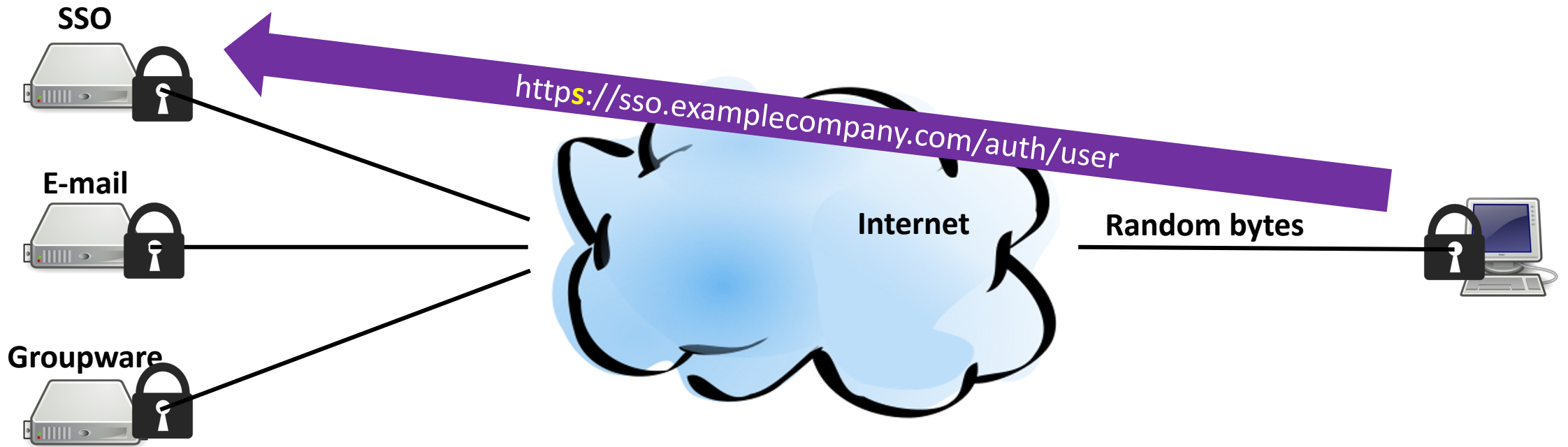
User authentication



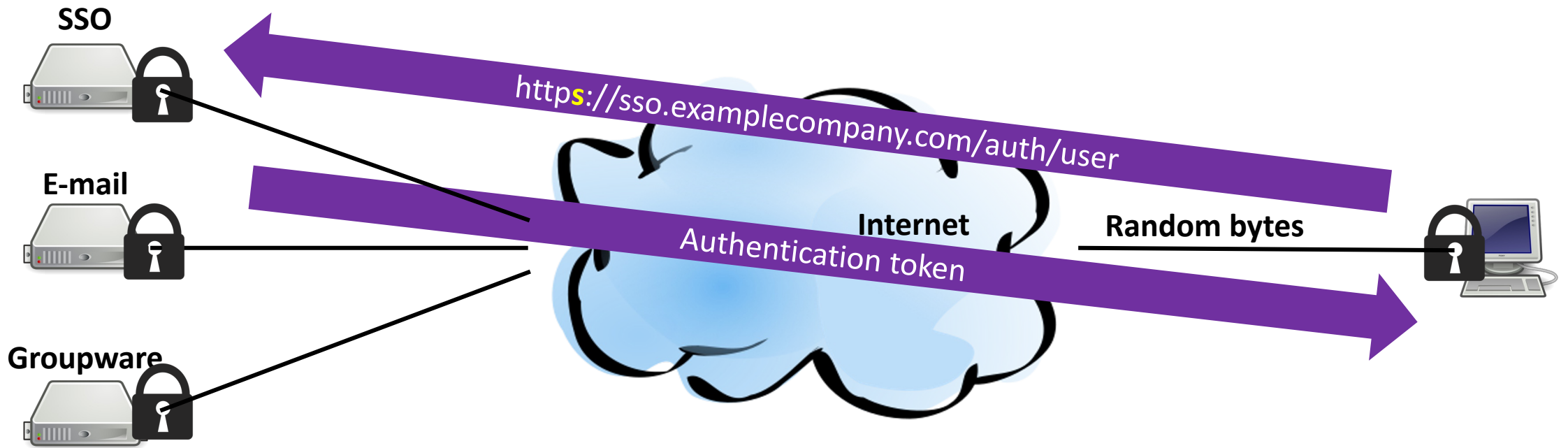
Zero-trust model

- All users are considered malicious/unauthorized until authenticated
- Many virtual machines, many microservices
 - Using an application might involve requests to multiple services
 - Juggling multiple accounts and typing password everywhere gets annoying
- Identity management (IdM)
 - Give each user *one* account and assign privileges/capabilities
 - Have a single point for authentication (Single Sign On, SSO)

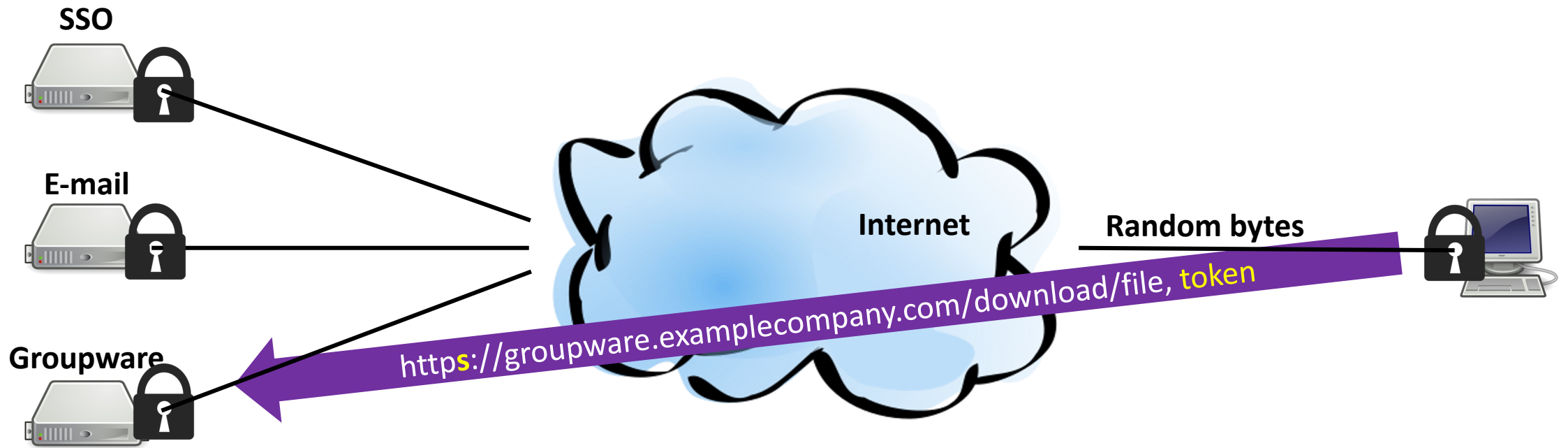
Single Sign On



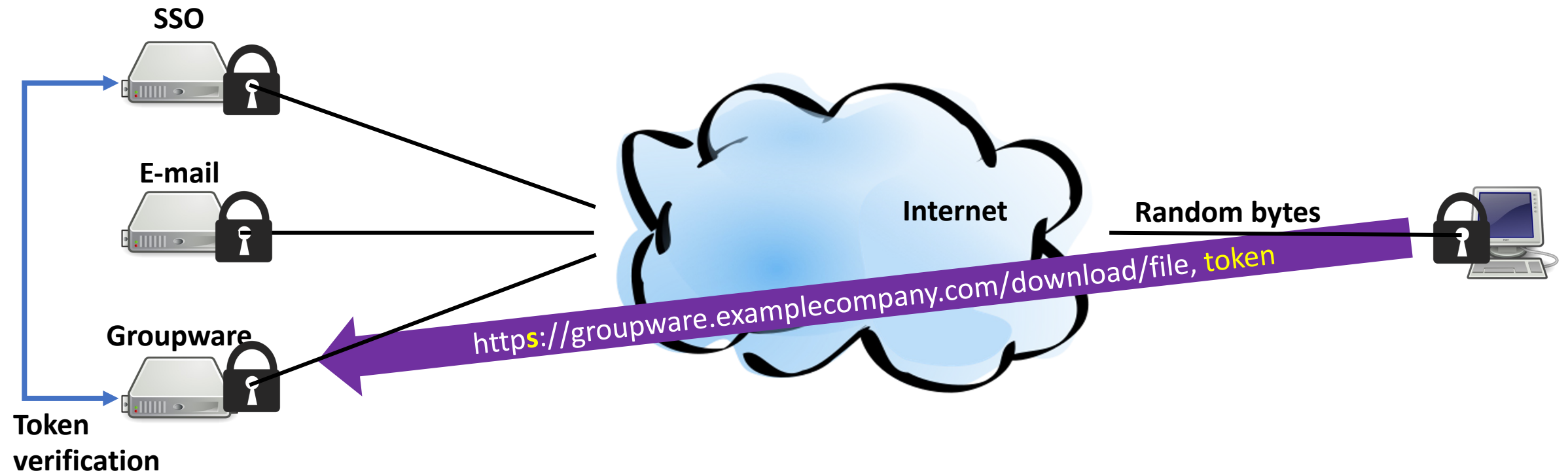
Single Sign On



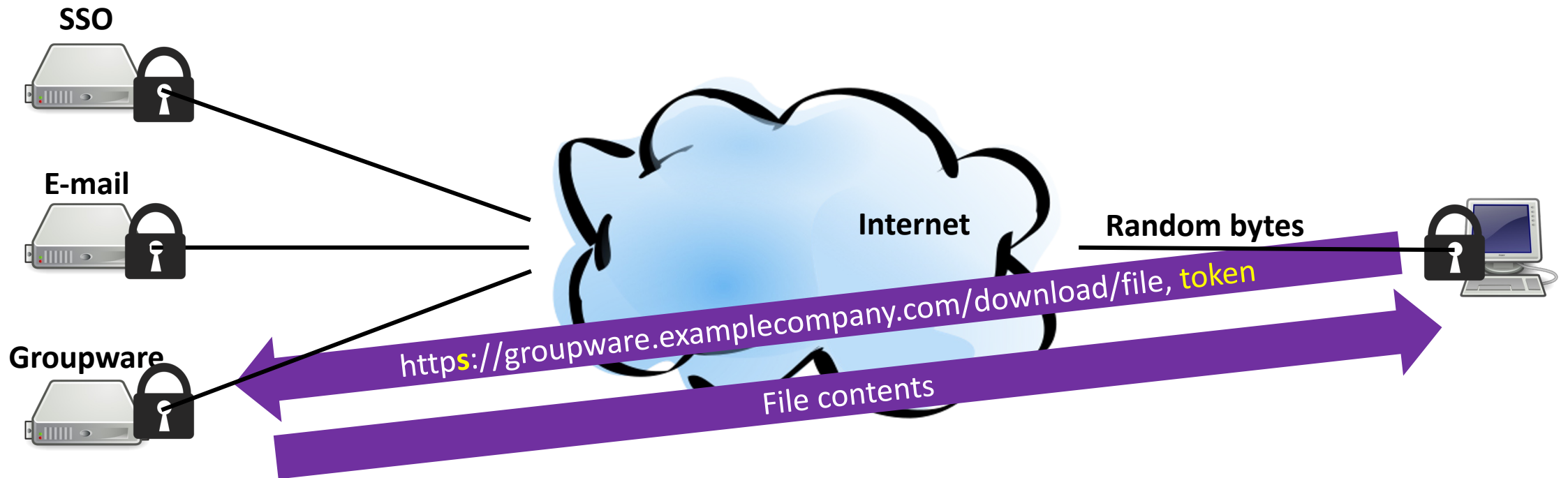
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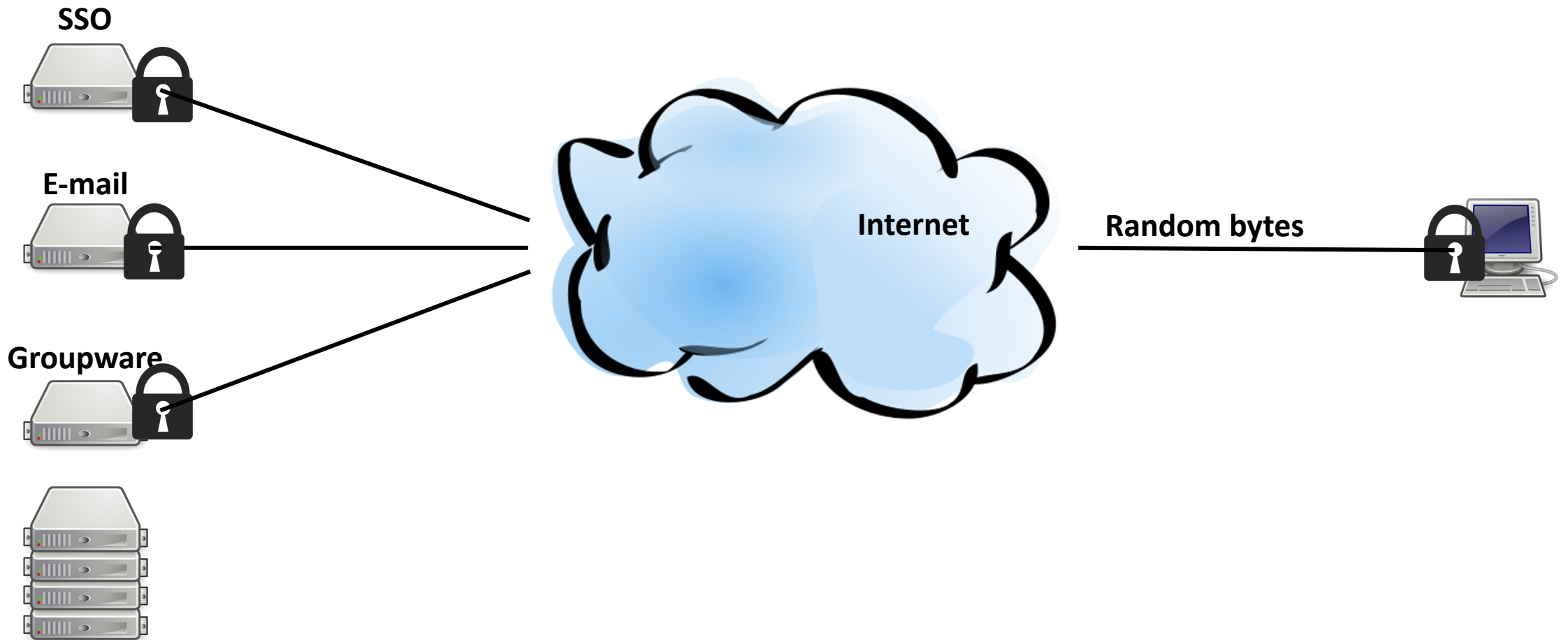
Single Sign On



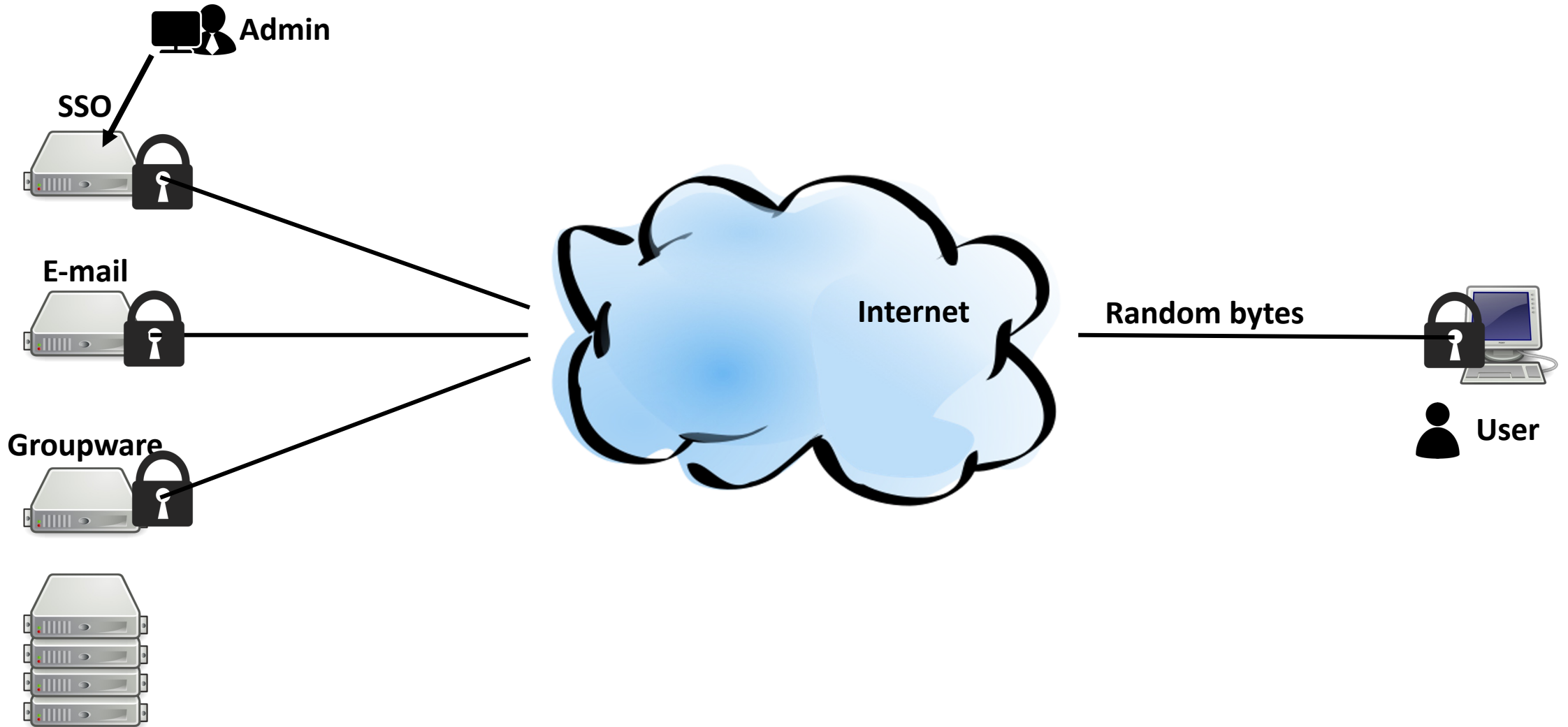
Single Sign On



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Single Sign On





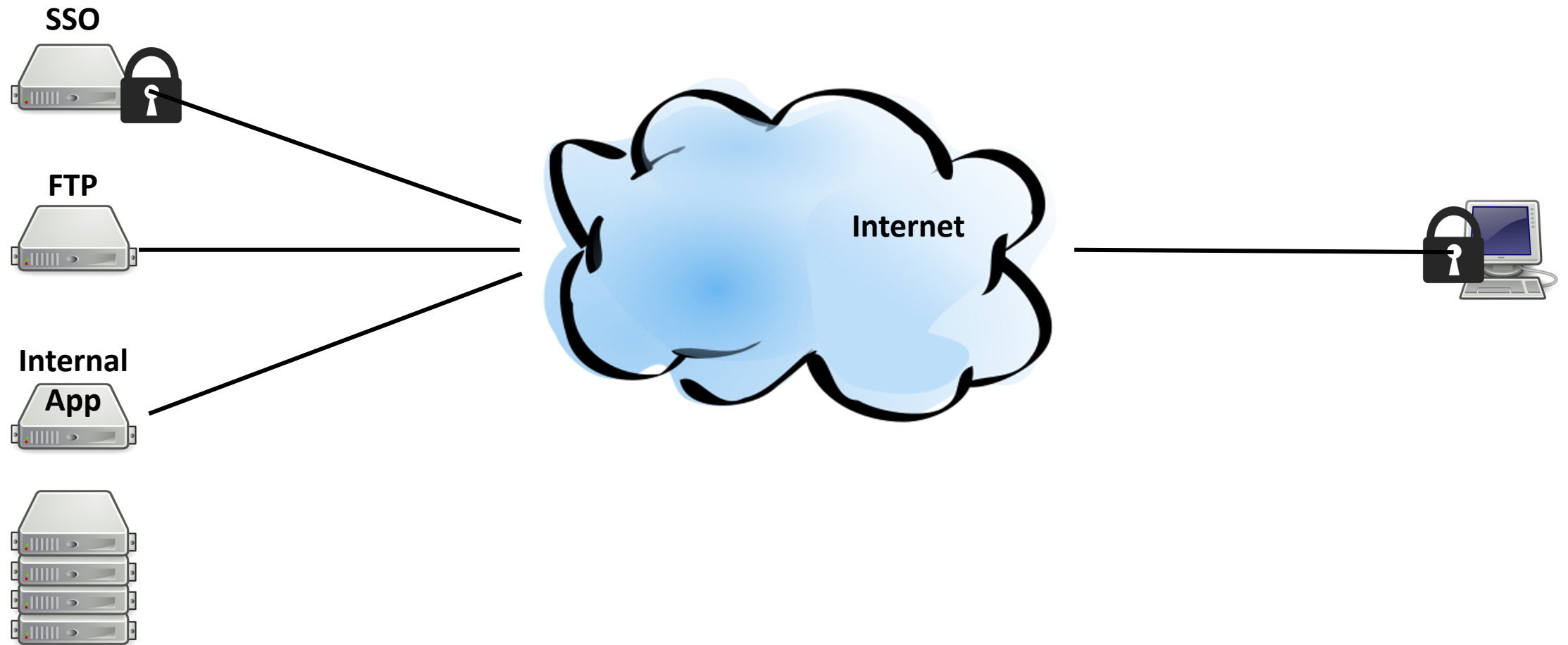
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Virtual Private Networks

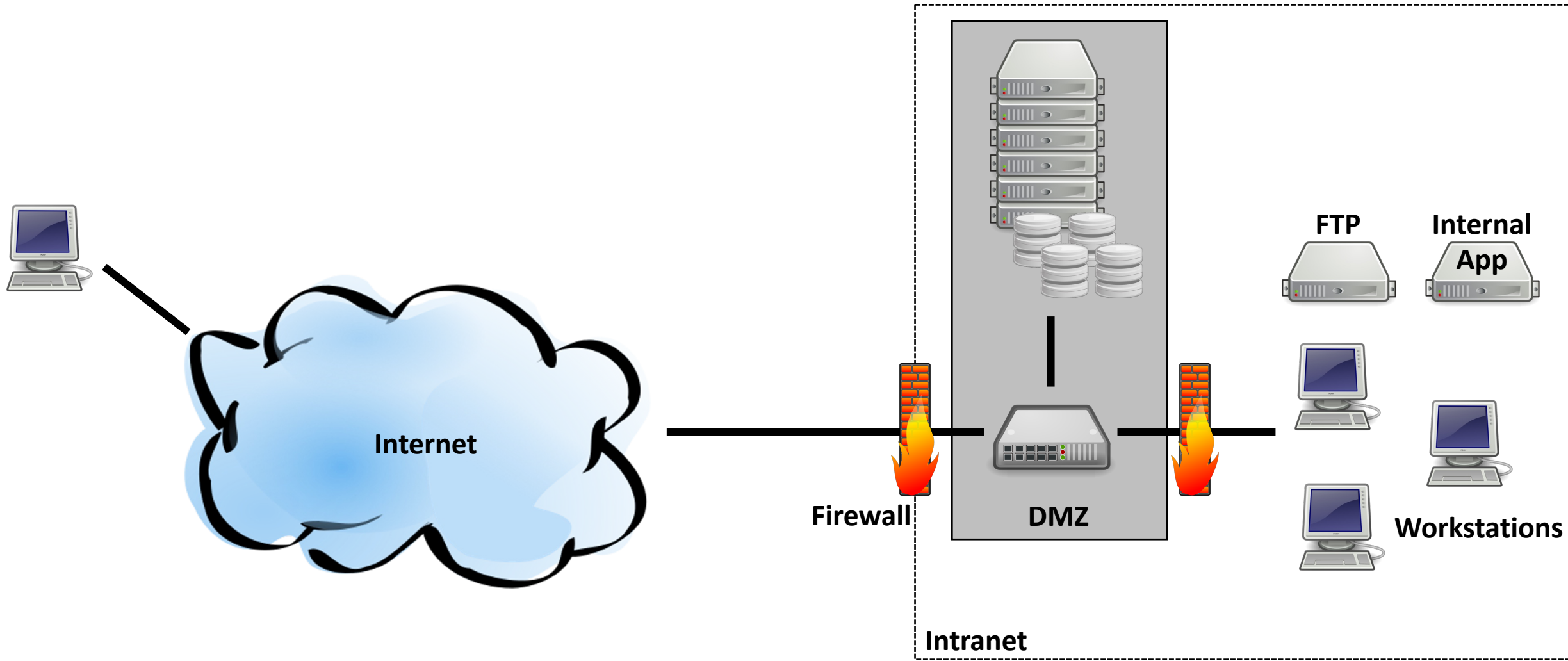
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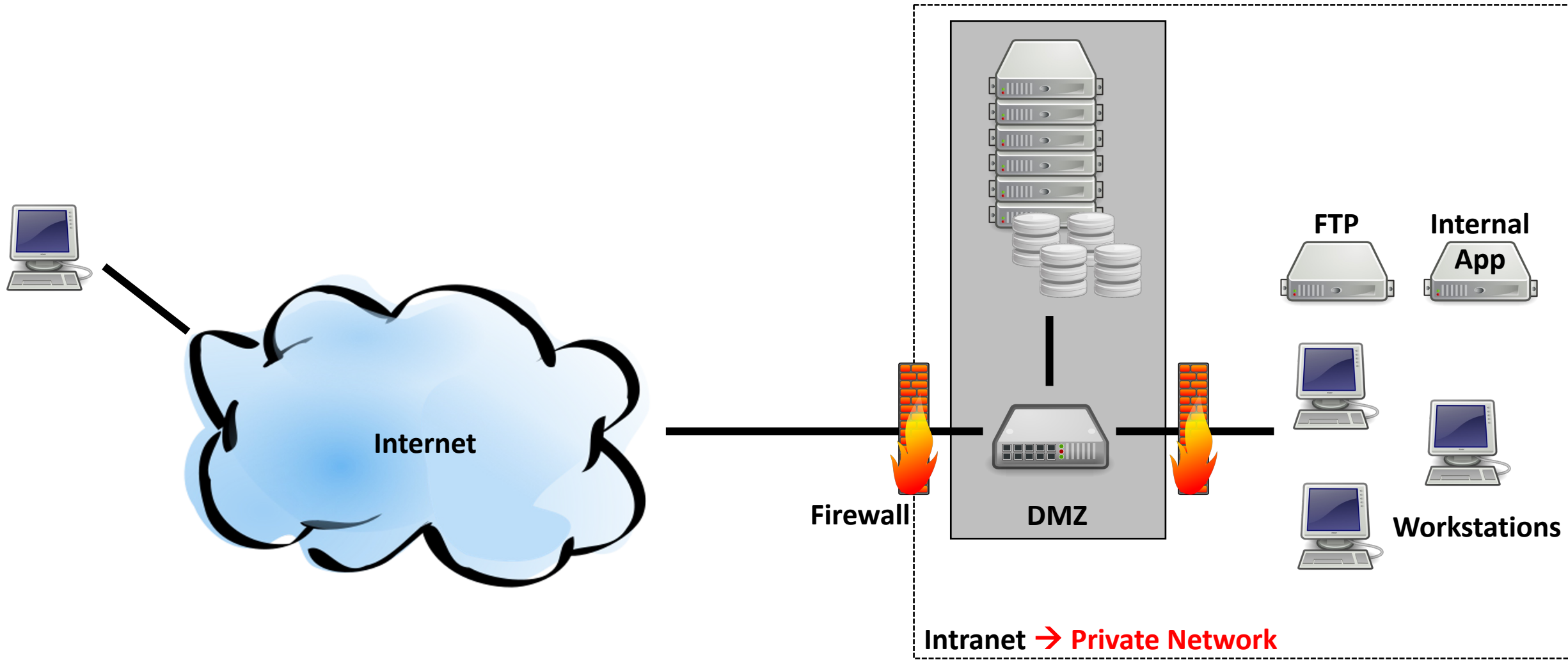
What about applications lacking security?



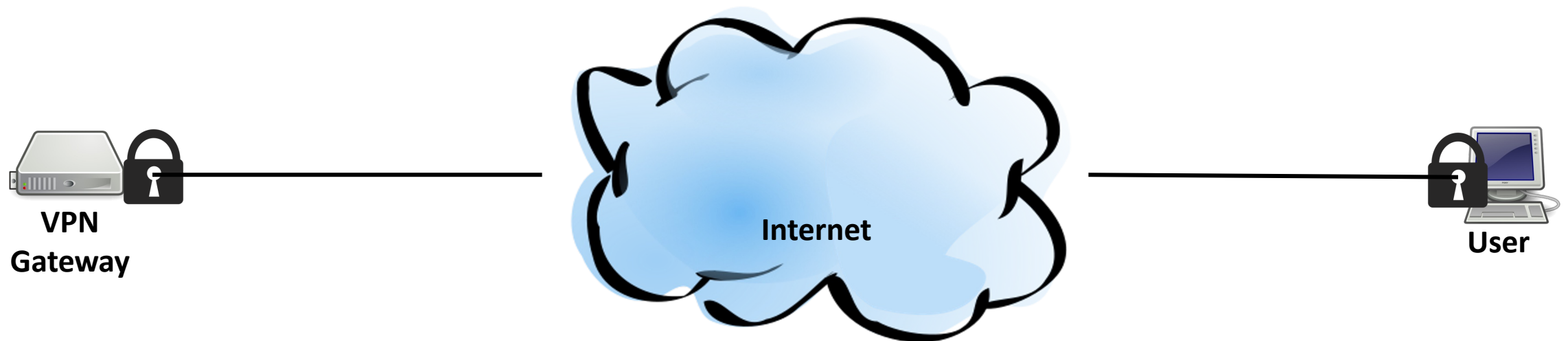
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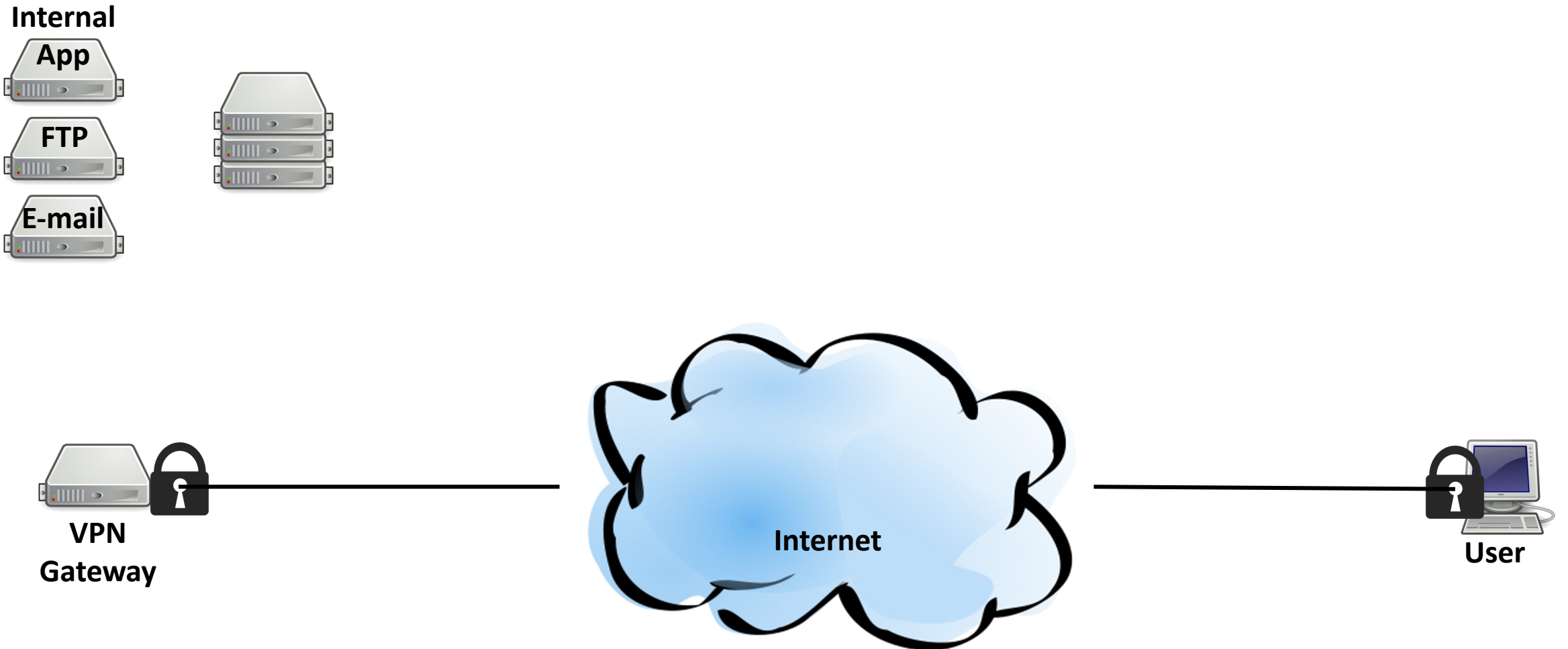
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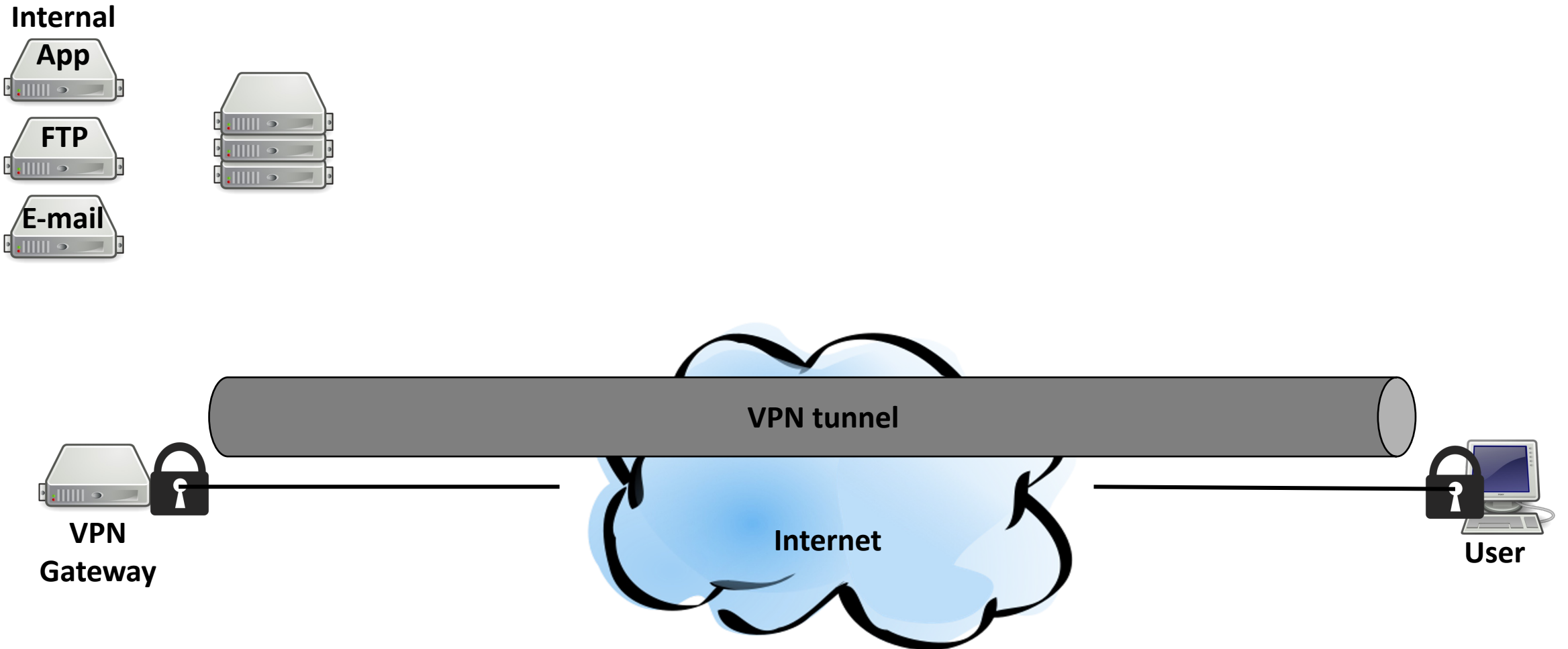
Virtual Private Network



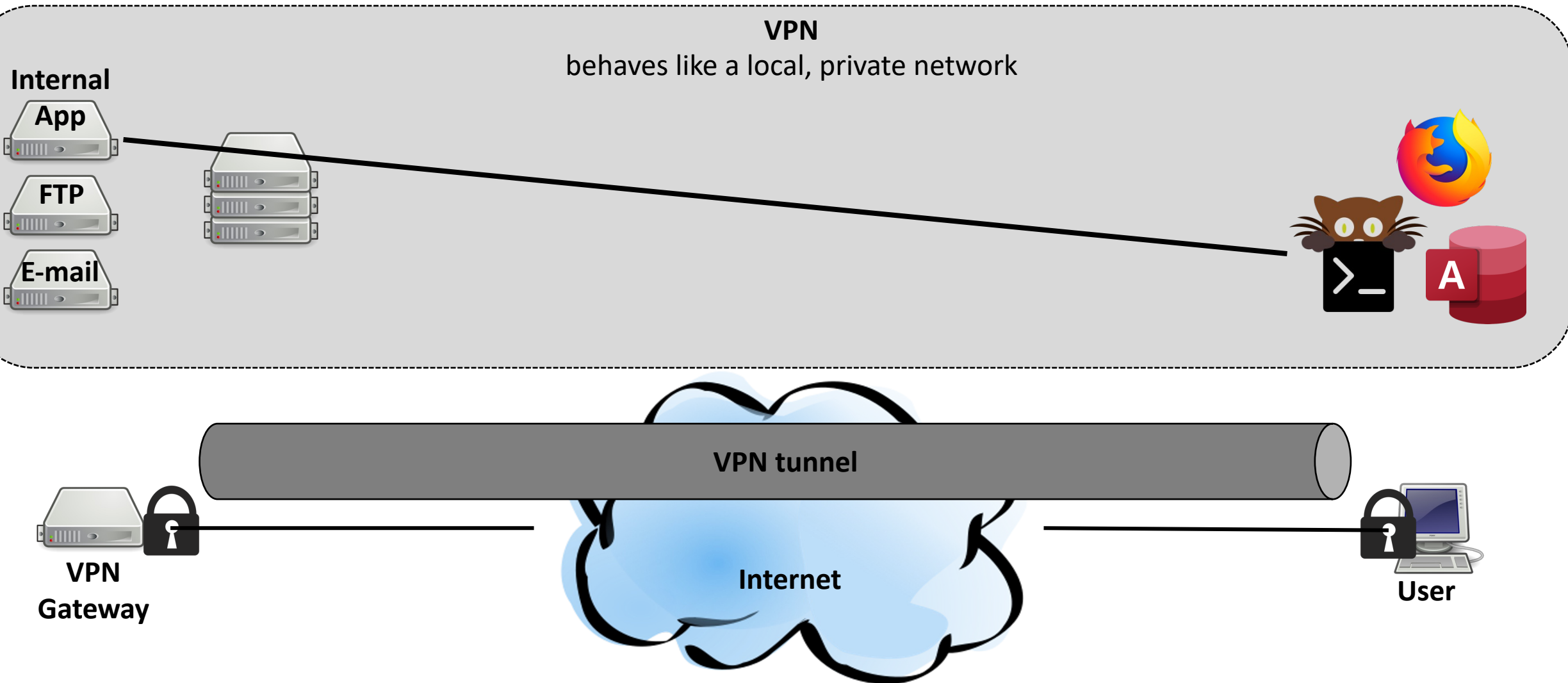
Virtual Private Network



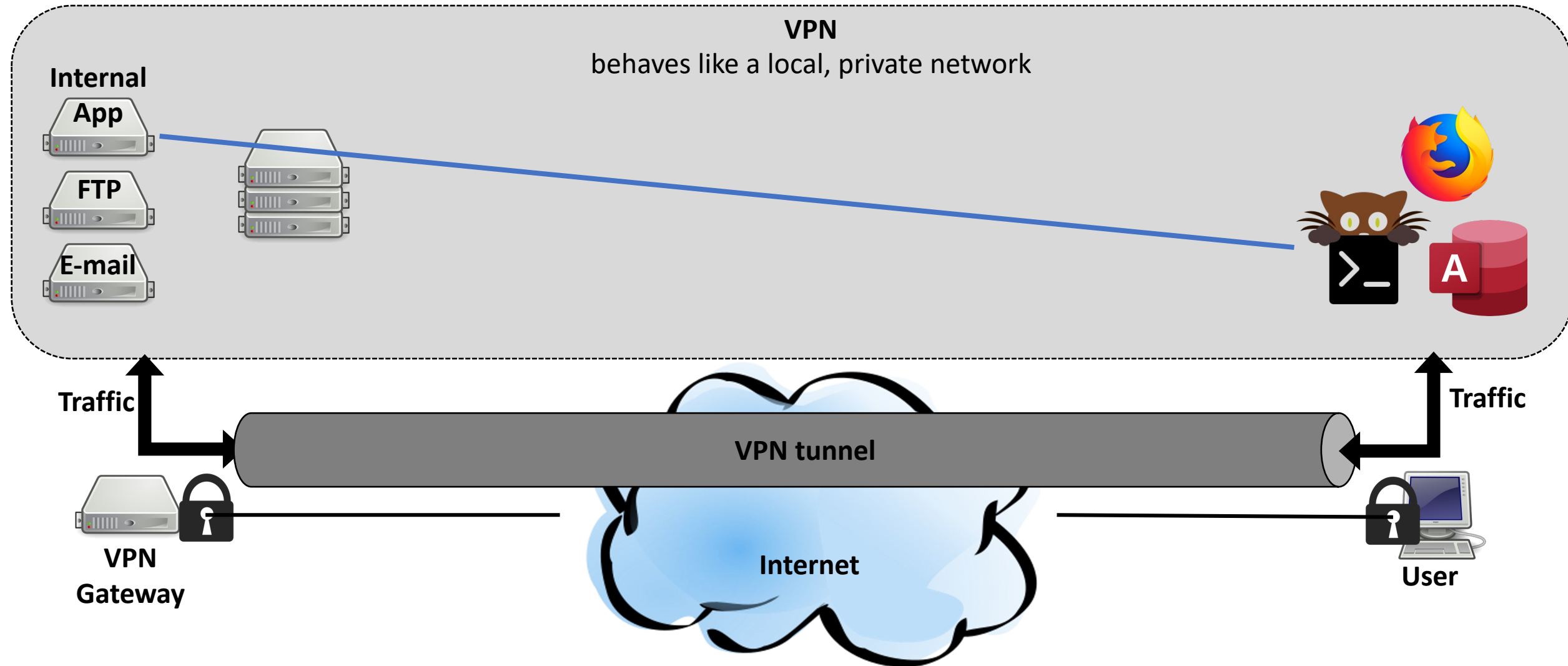
Virtual Private Network



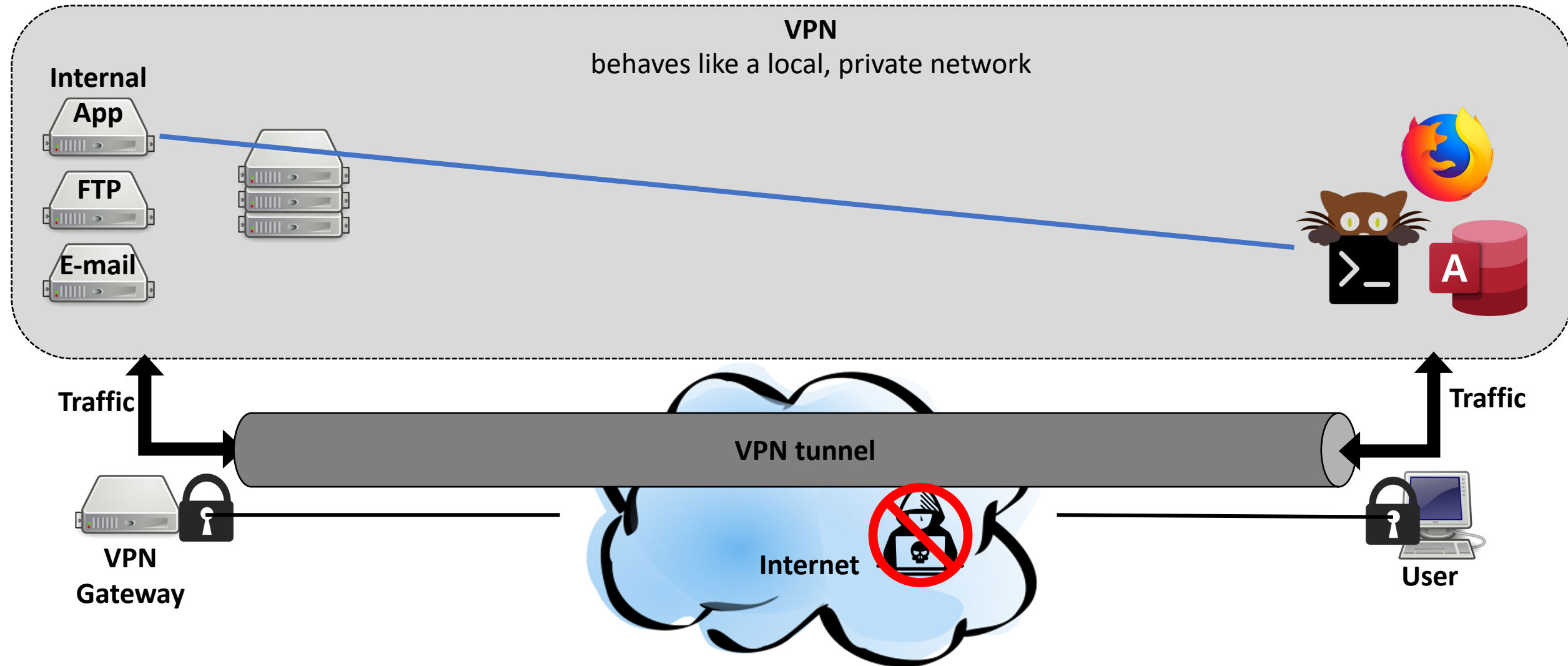
Virtual Private Network



Virtual Private Network



Virtual Private Network



SSH tunnels

- Simpler, but some concepts in common with VPNs
 - Does not create a local, private network
 - Only allows communication between specific IP:port pairs

