CompSci 401: Cloud Computing

Security in Local Infrastructures

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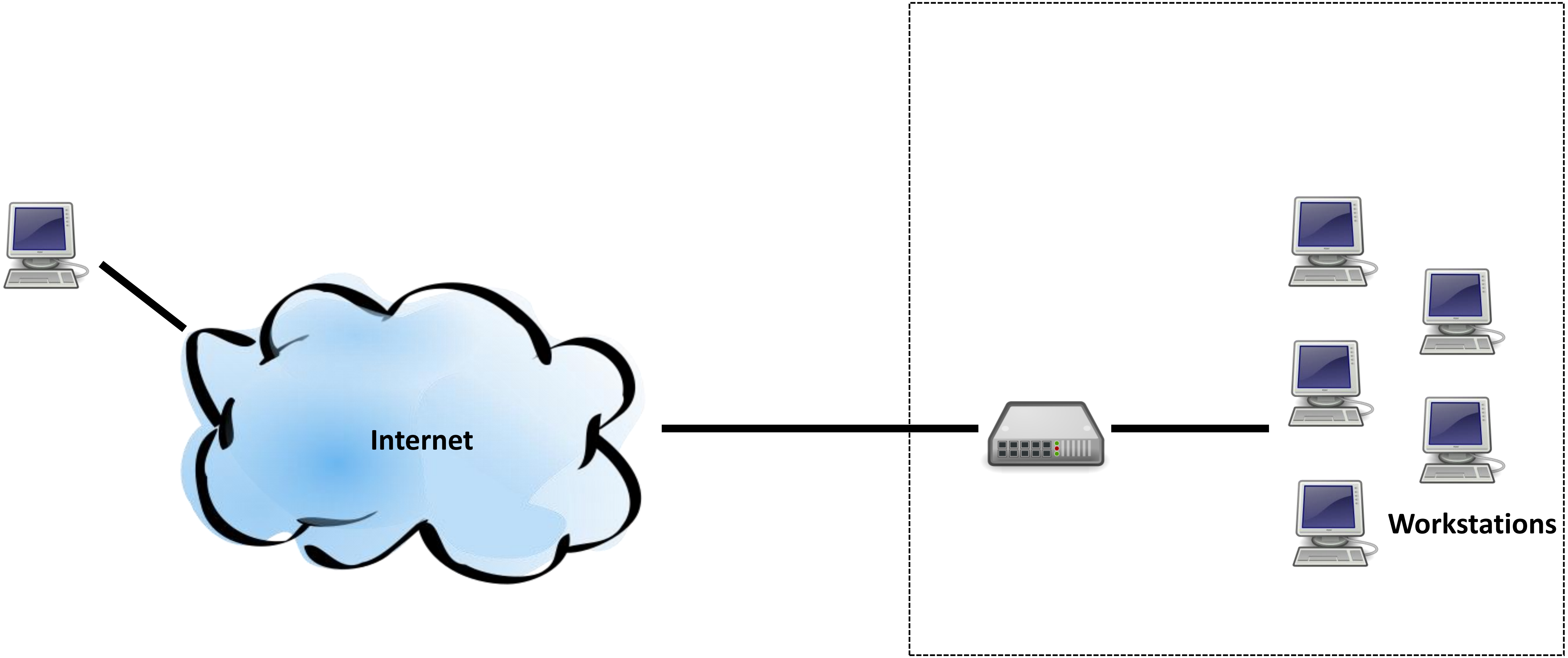
Security in Local Infrastructures



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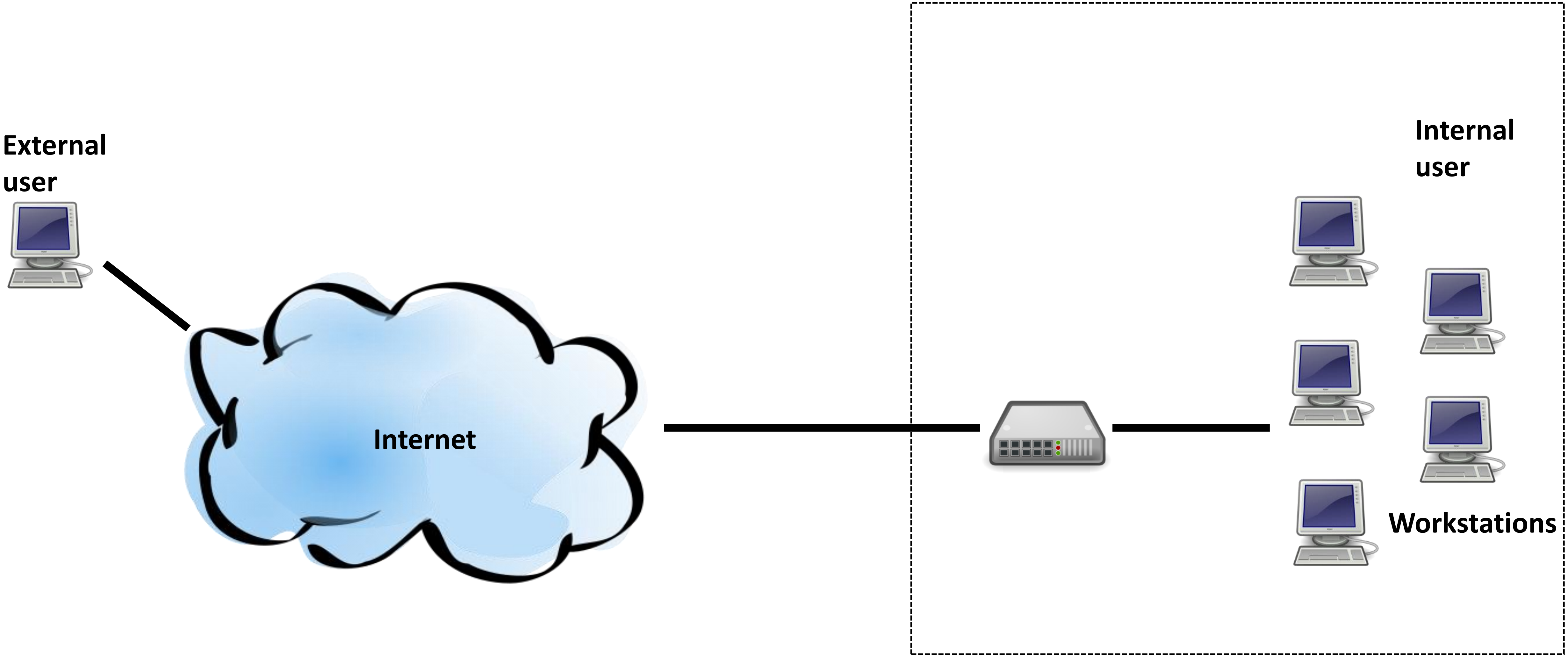

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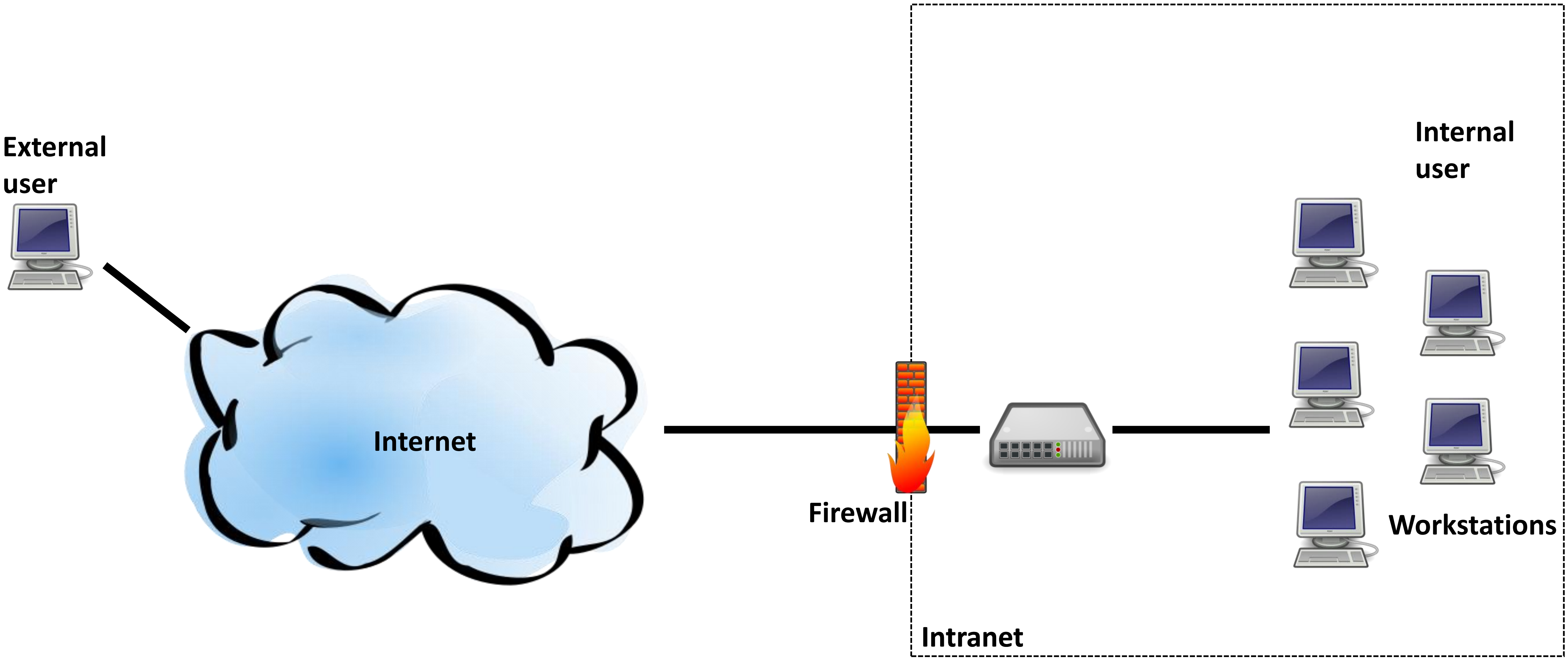

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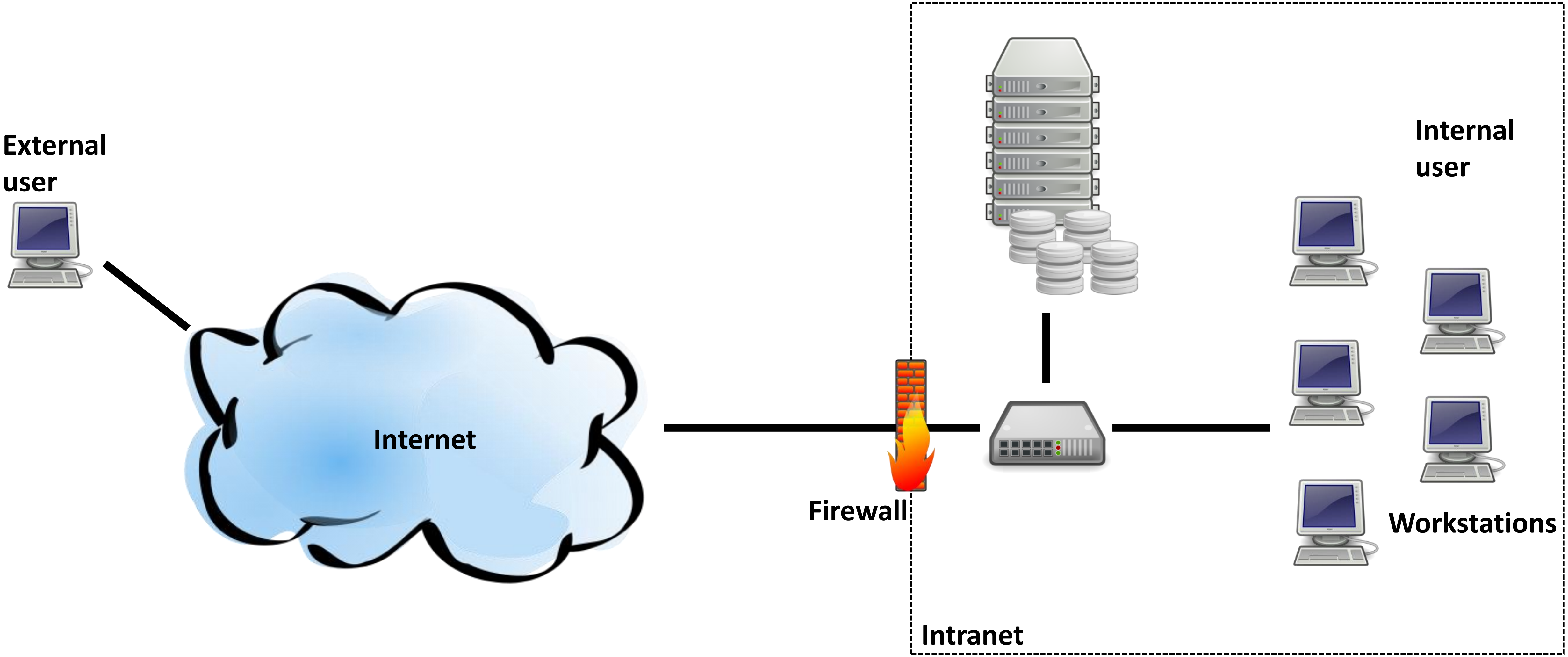

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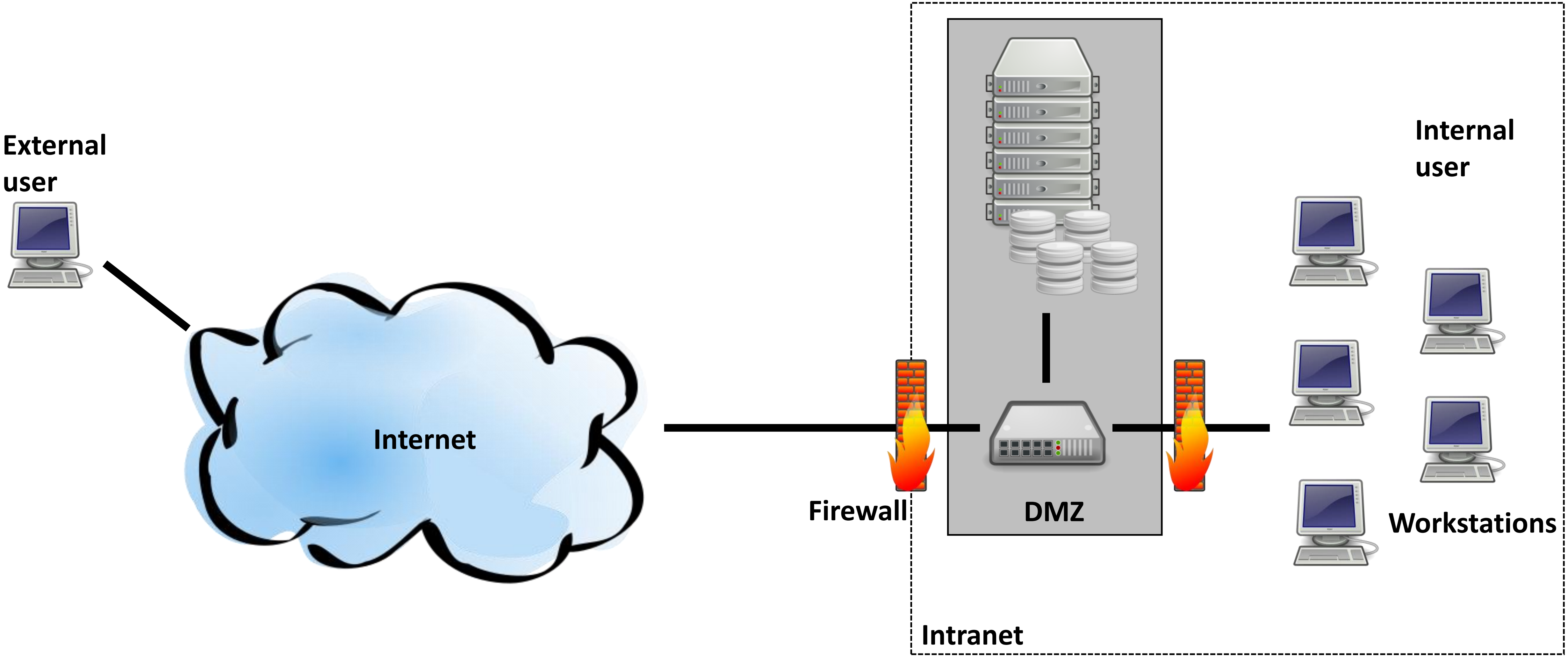

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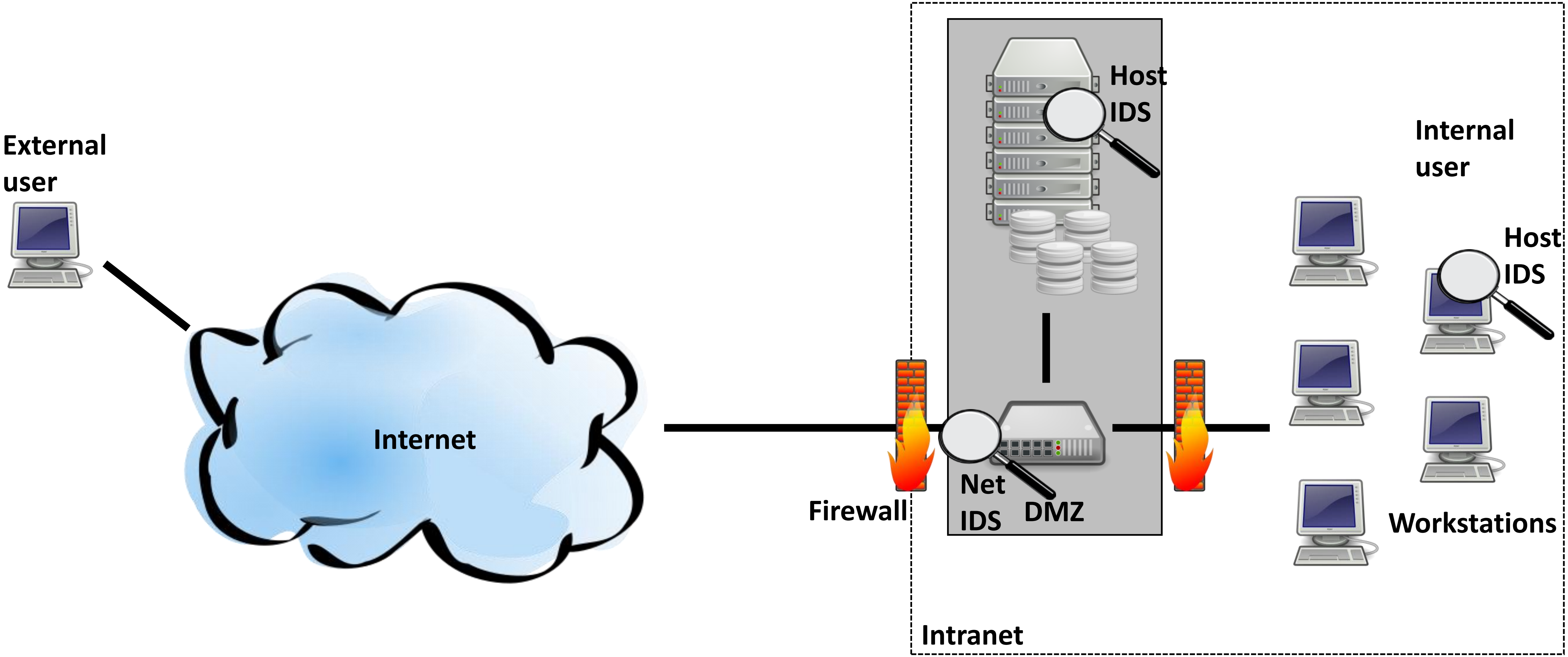

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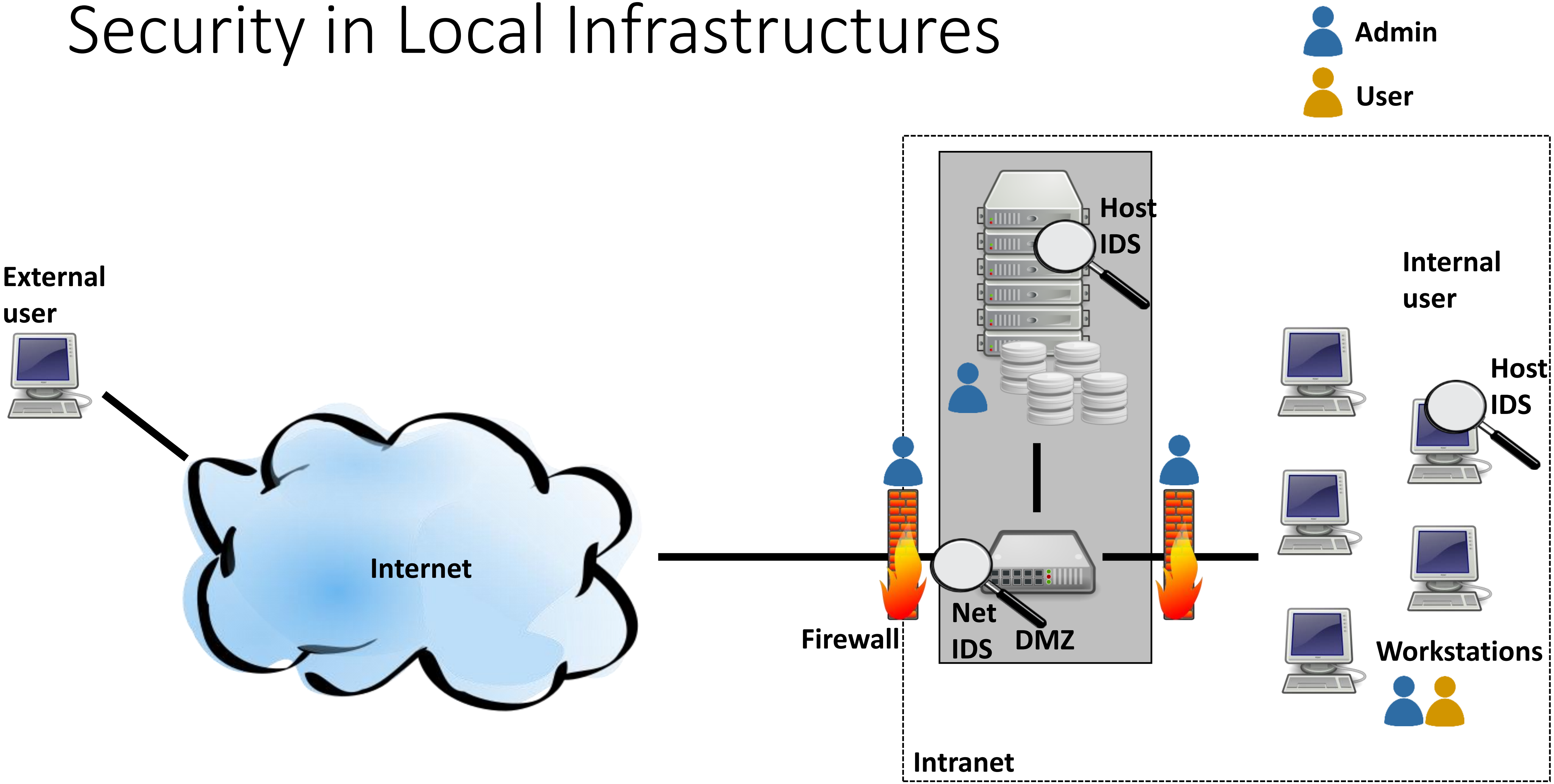

Incompatibilities of the classical approach with cloud computing

- 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

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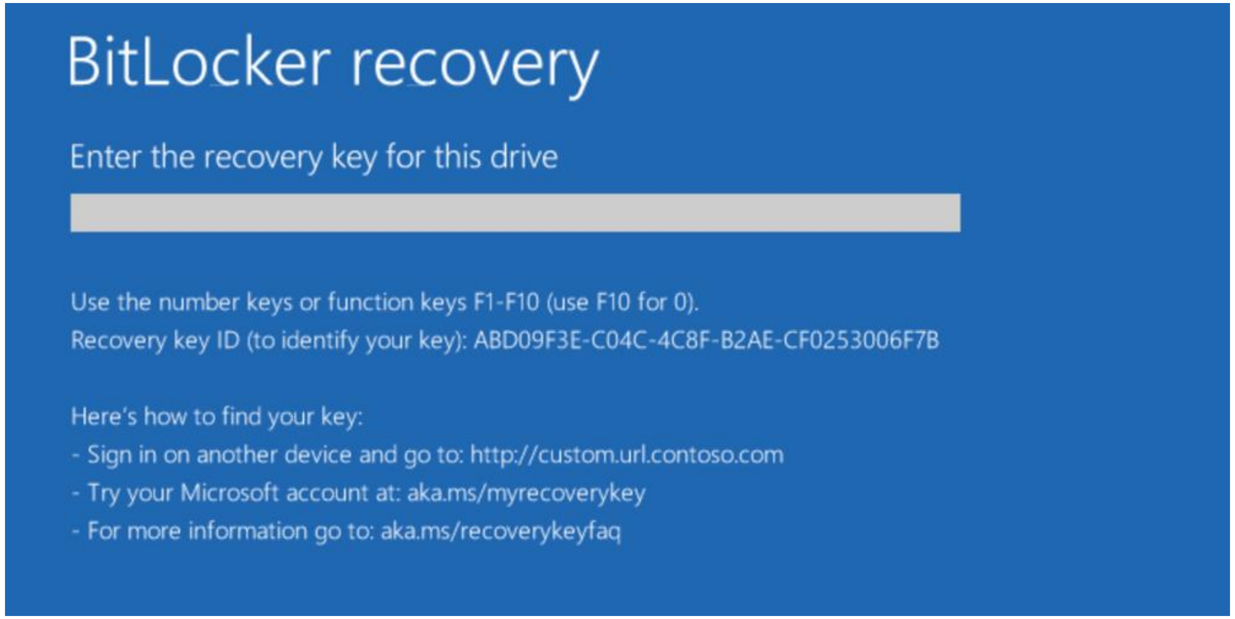

BitLocker recovery

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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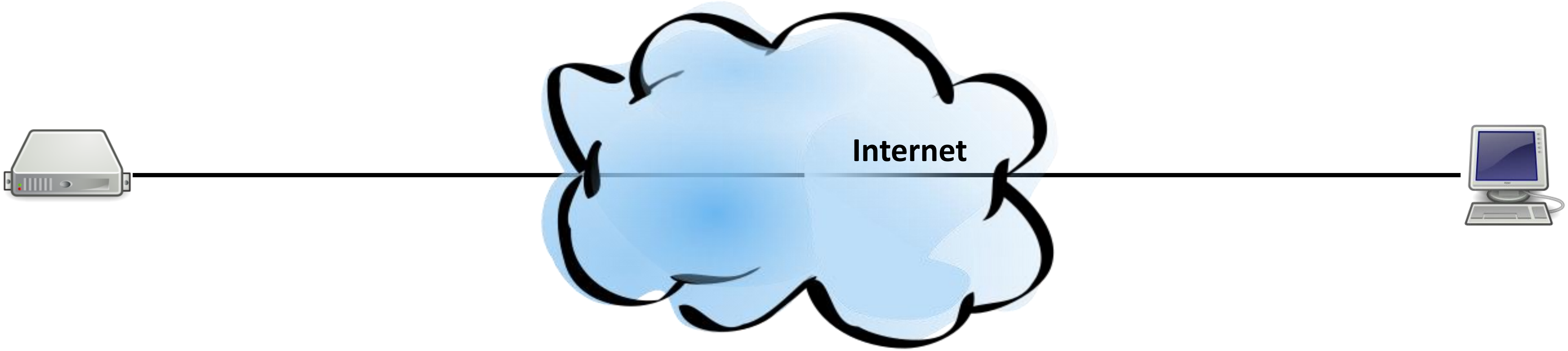
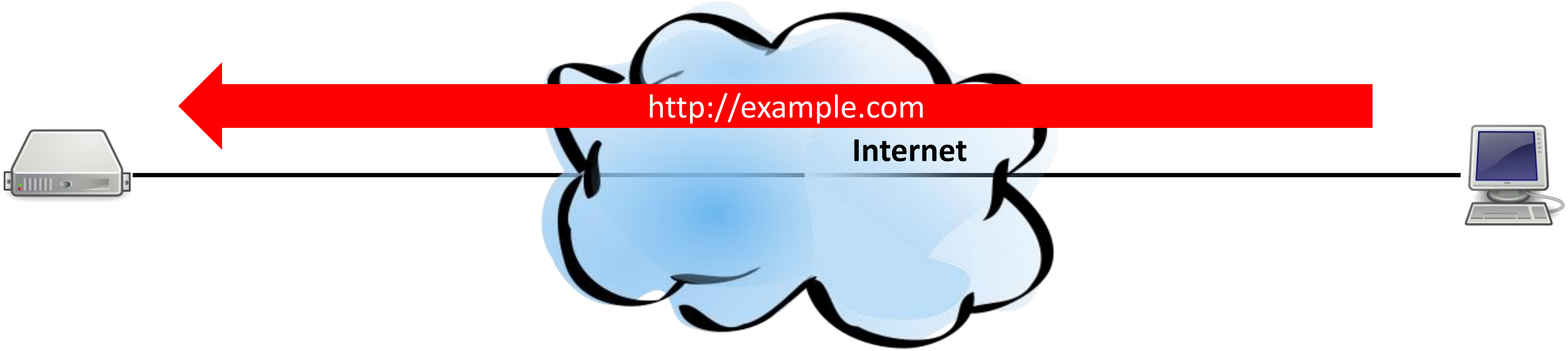
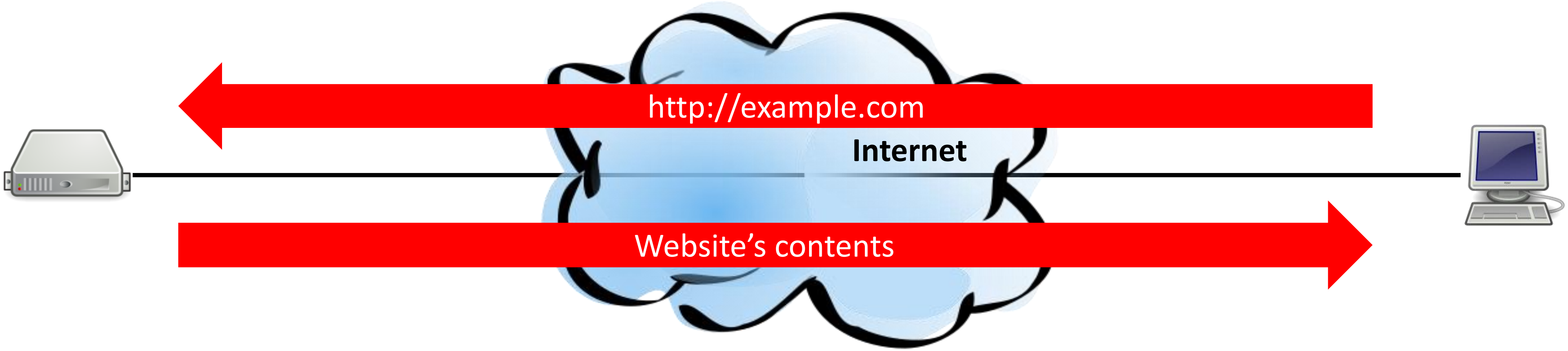
End-to-end encryption



End-to-end encryption



End-to-end encryption

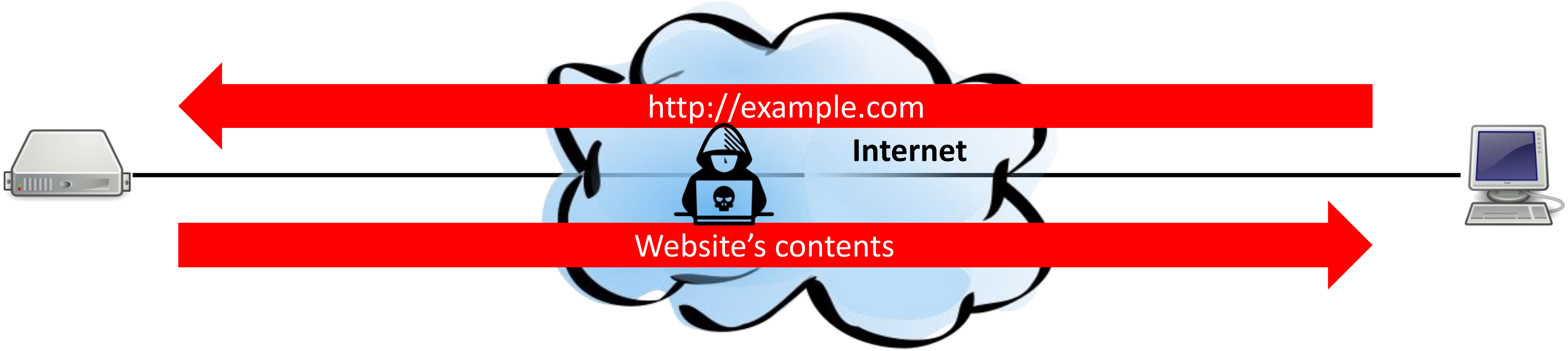


http://example.com

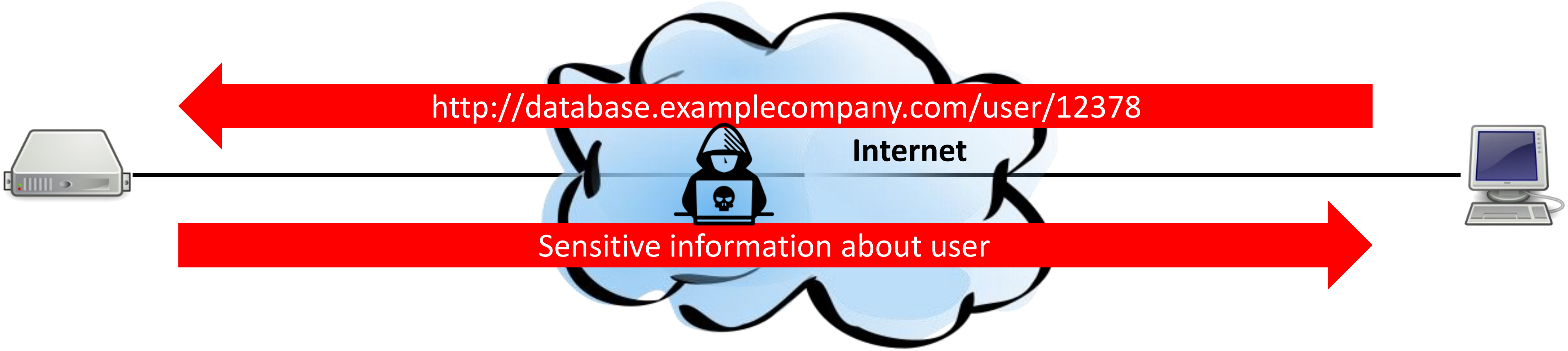
Internet

Website’s contents

End-to-end encryption

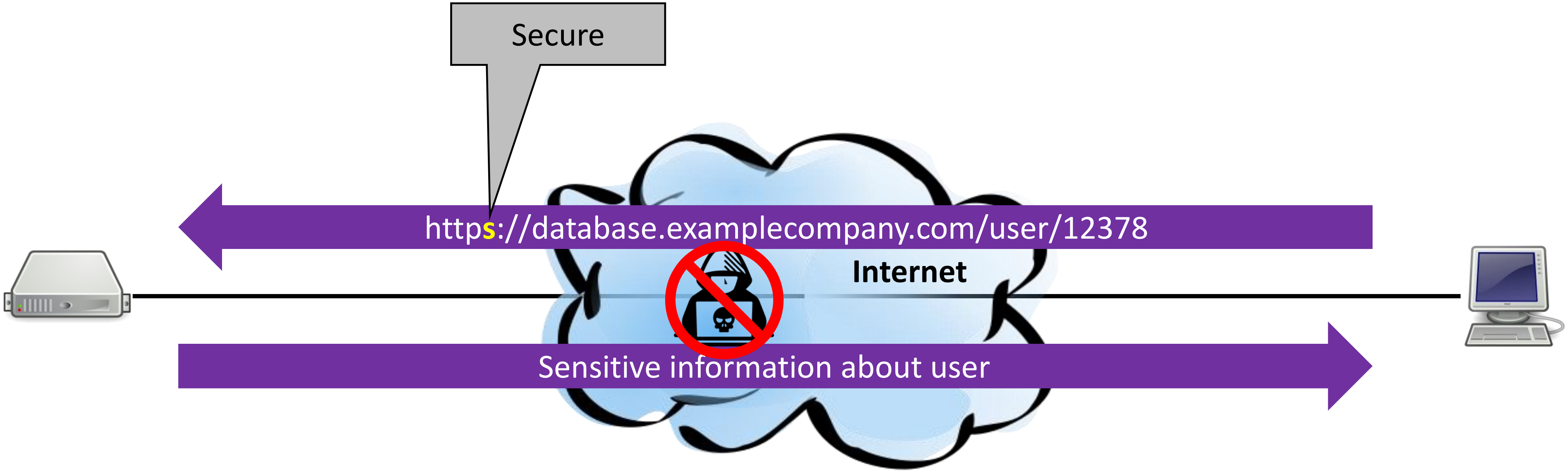


End-to-end encryption



http://database.examplecompany.com/user/12378
Internet
Sensitive information about user

End-to-end encryption



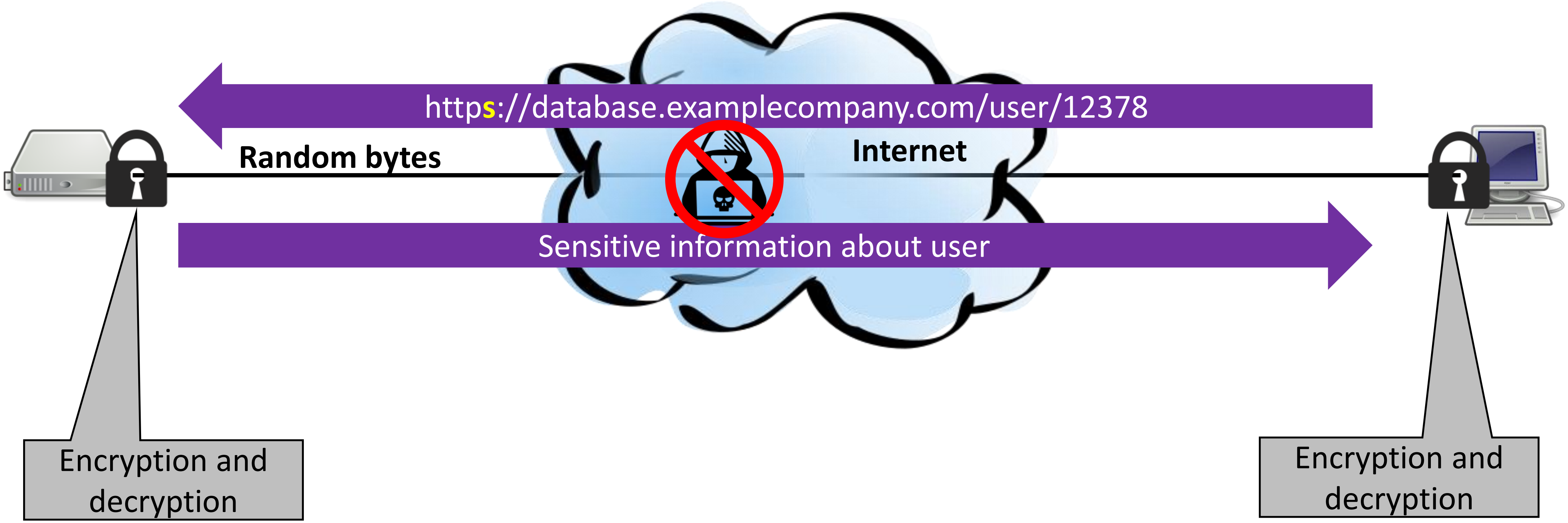
Secure

https://database.examplecompany.com/user/12378

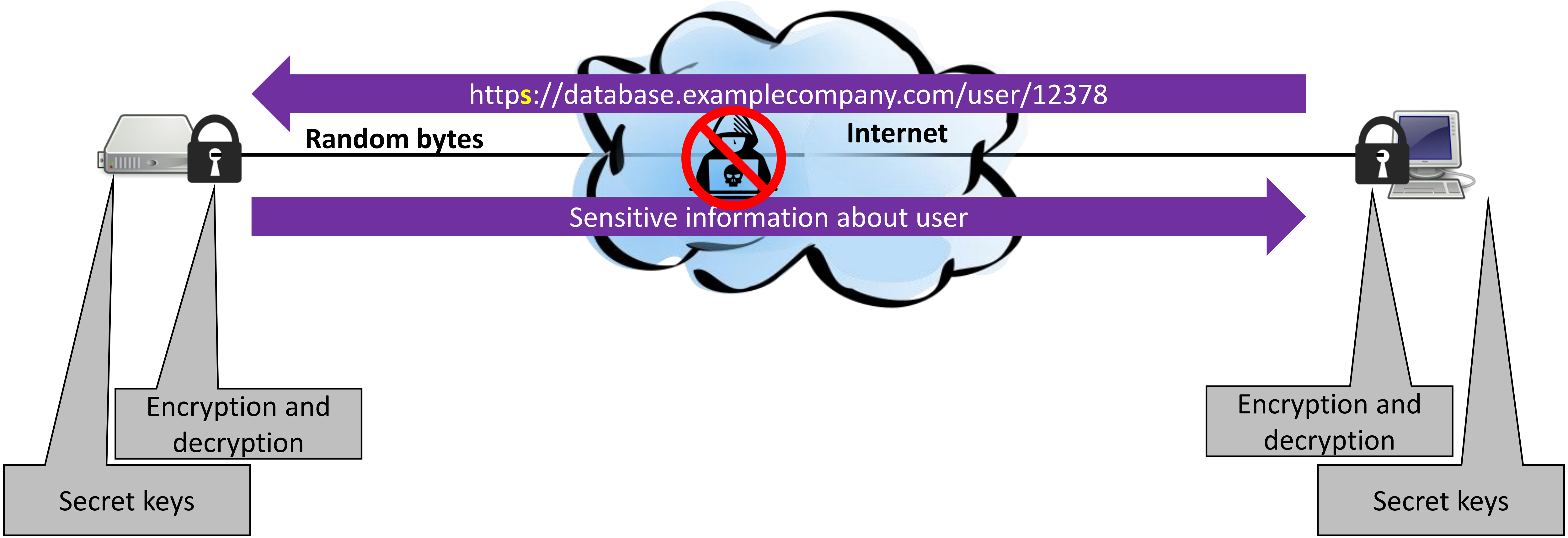
Internet

Sensitive information about user

End-to-end encryption


https://database.examplecompany.com/user/12378
Random bytes
Internet
Sensitive information about user
Encryption and decryption
Encryption and decryption

End-to-end encryption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Random bytes
Internet
Sensitive information about user
Encryption and decryption
Secret keys
Encryption and decryption
Secret keys

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Identity Management

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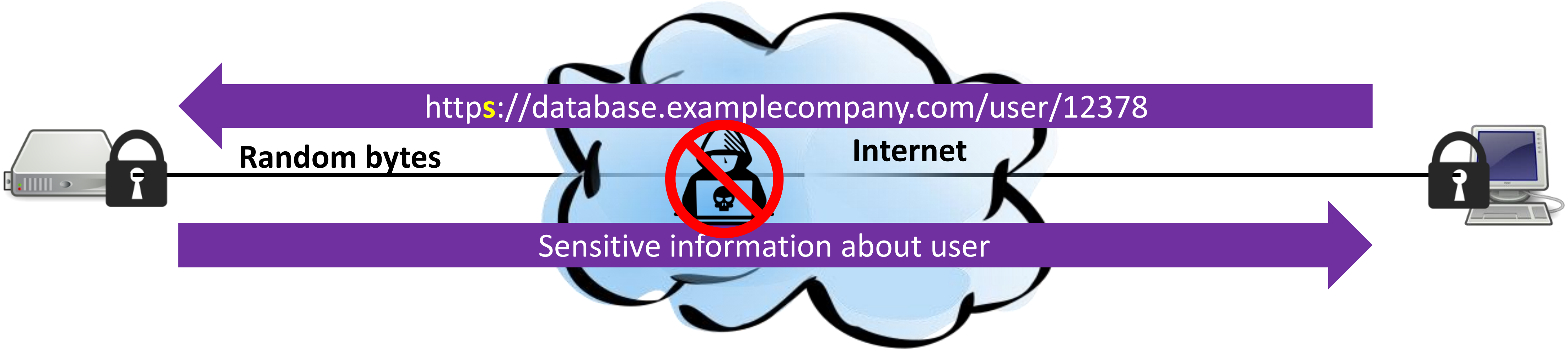
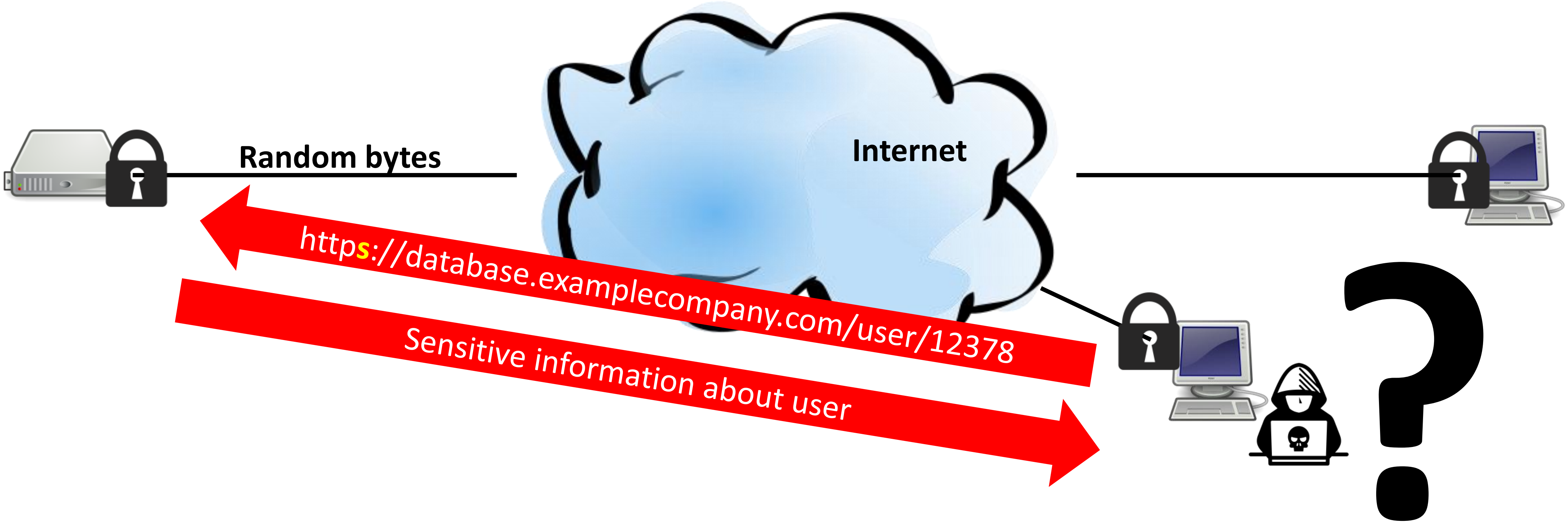
End-to-end encryption


https://database.examplecompany.com/user/12378
Random bytes
Internet
Sensitive information about user

User authentication

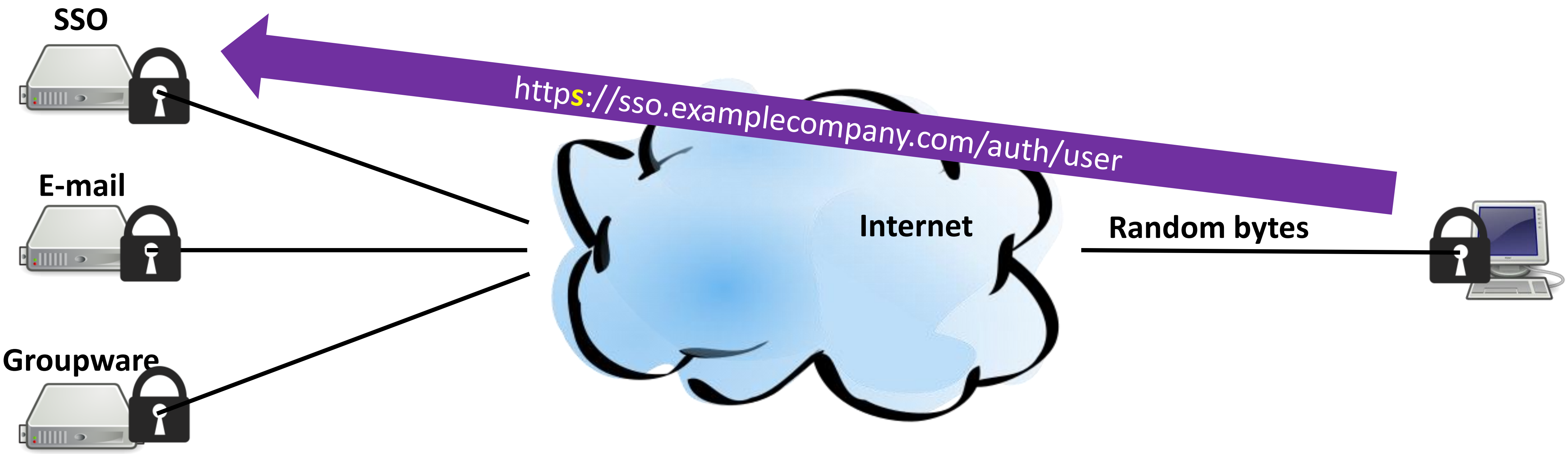


Random bytes
Internet
https://database.examplecompany.com/user/12378
Sensitive information about user
?

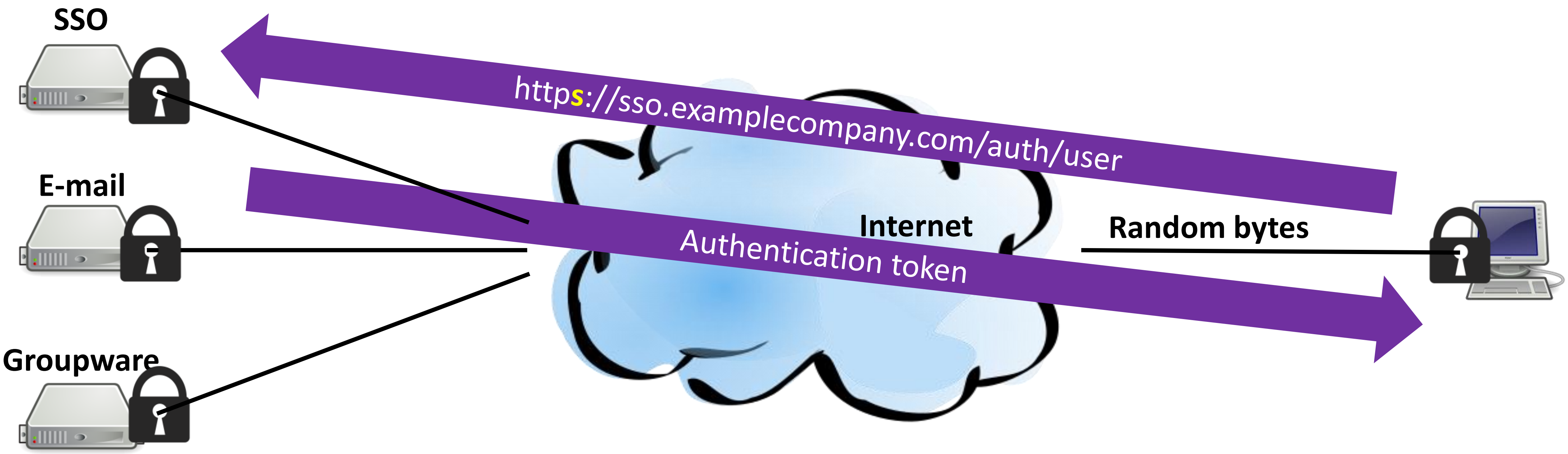
Zero-trust model

- 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)

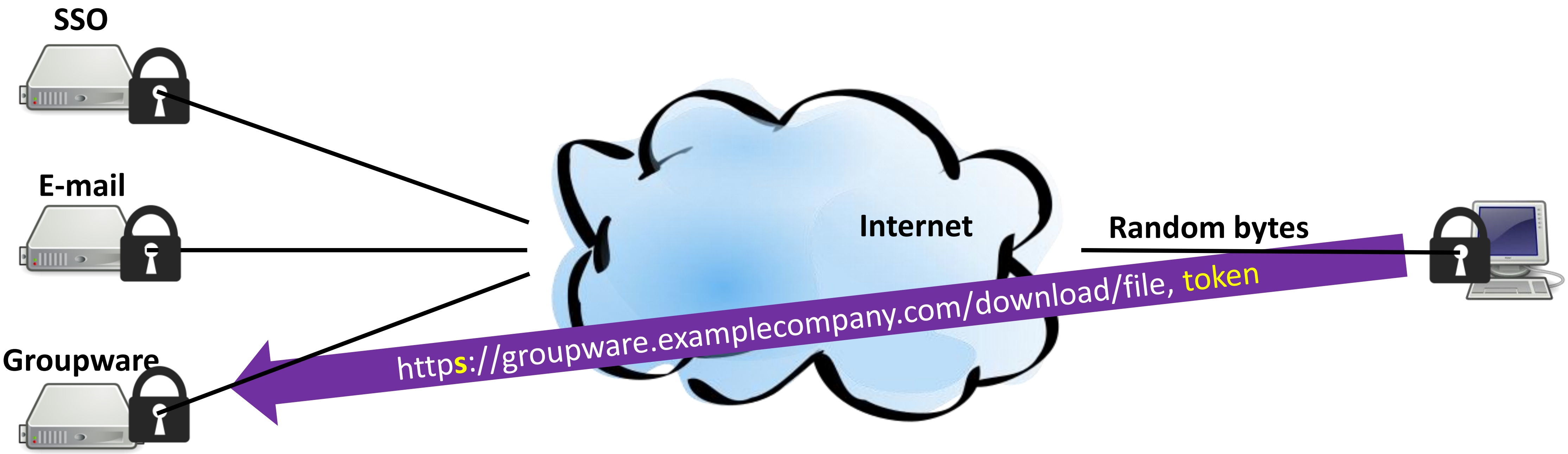
Single Sign On



Single Sign On



Single Sign On



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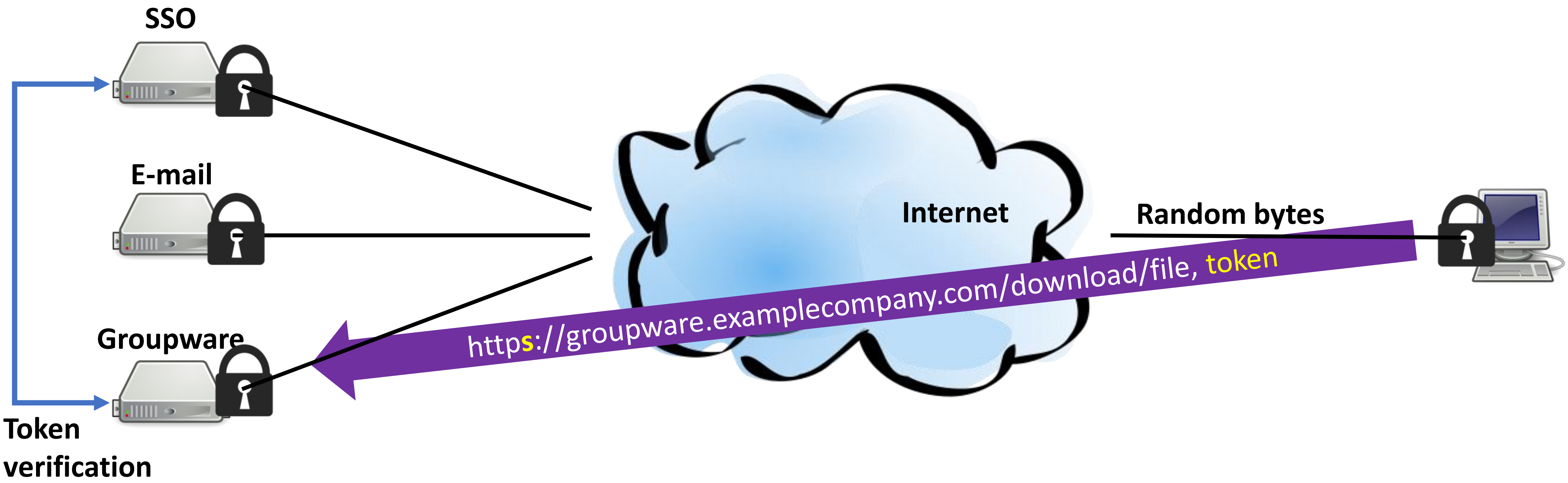

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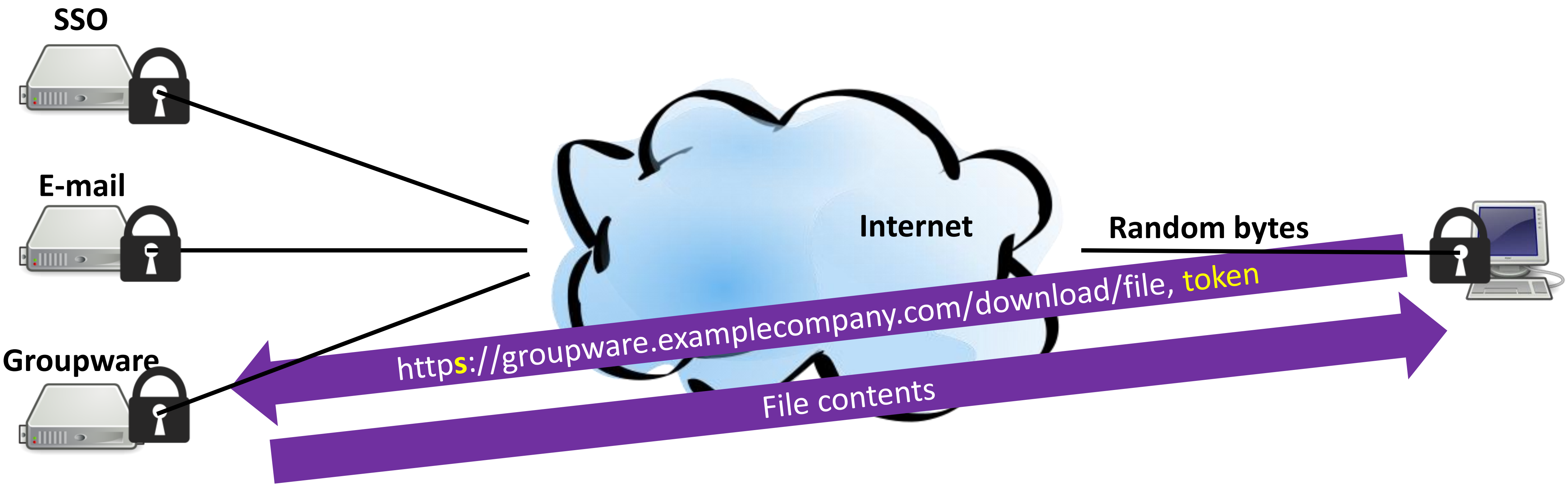
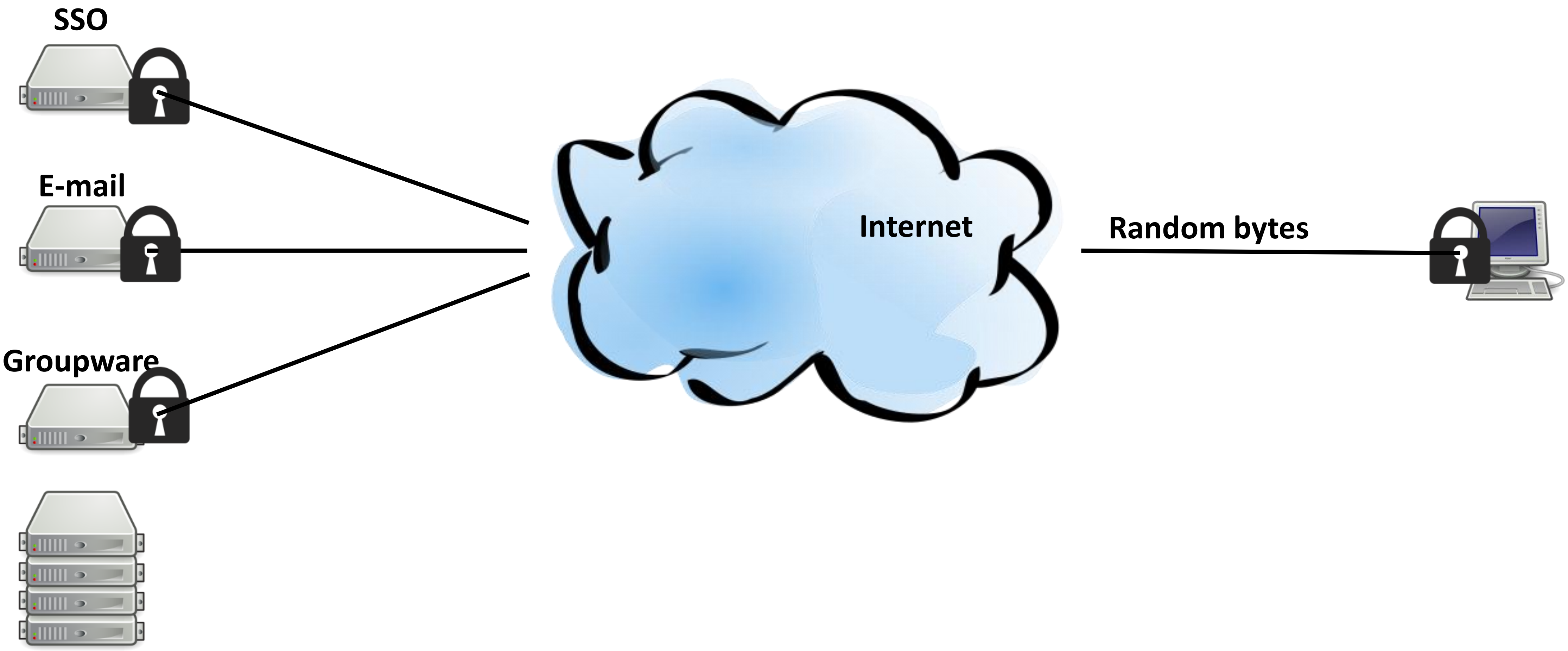
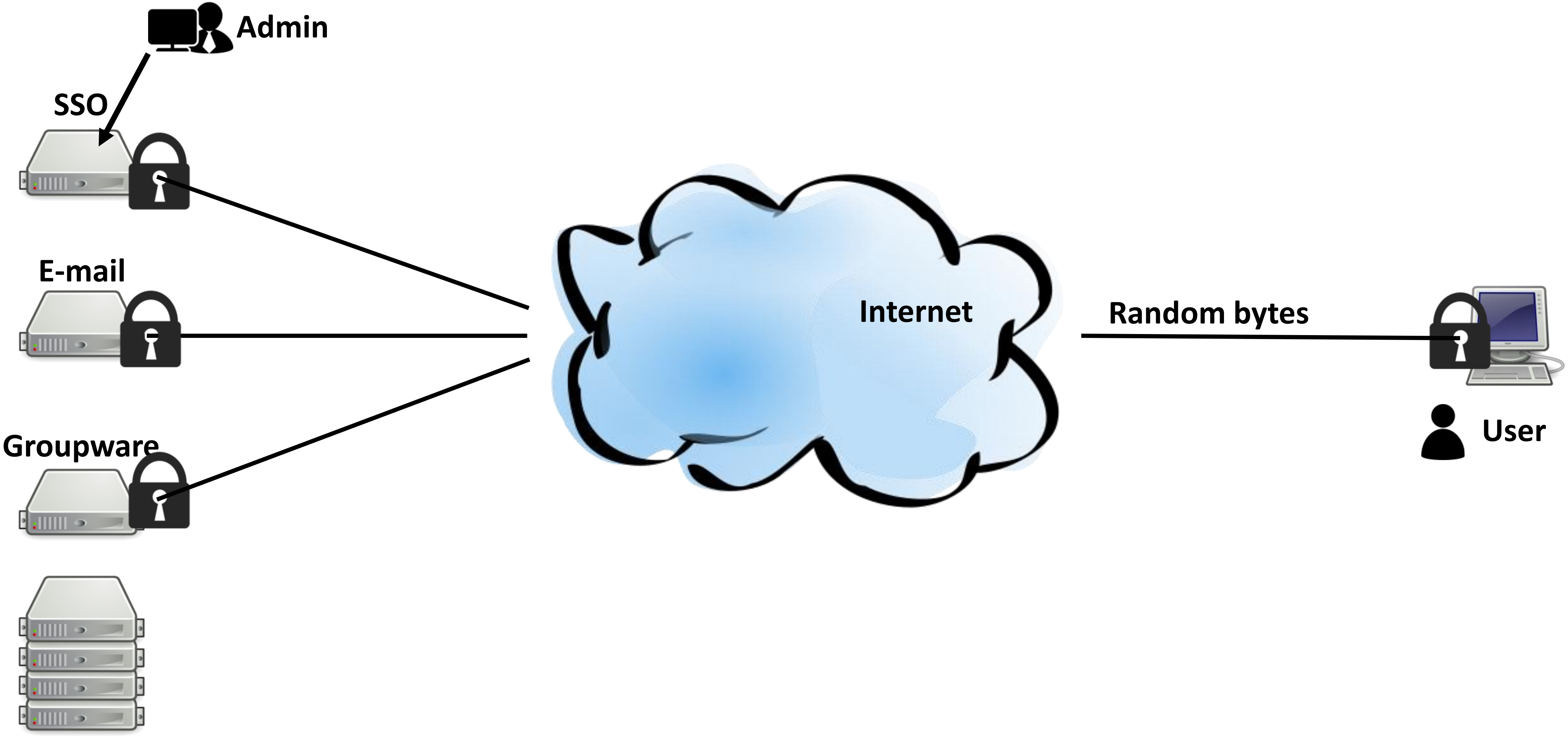


Single Sign On



Single Sign On



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Virtual Private Networks

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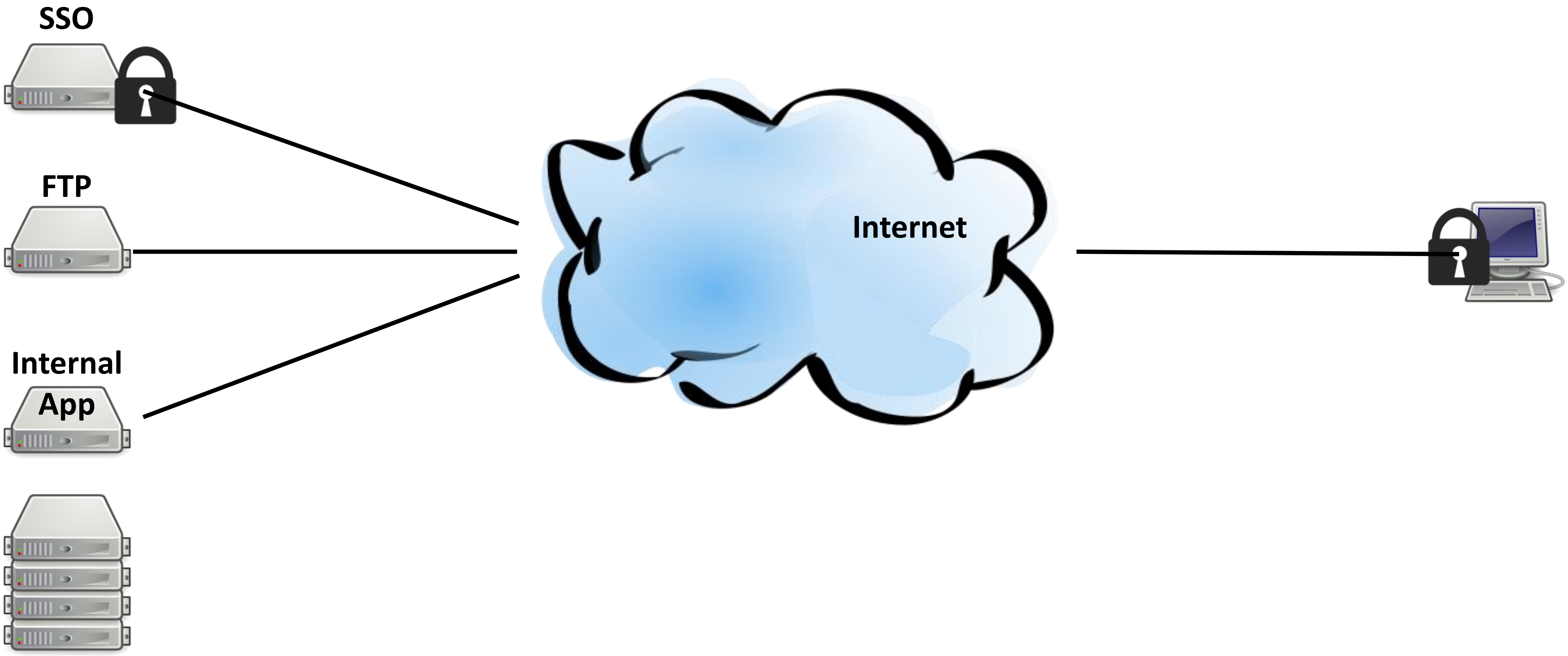
What about applications lacking security?



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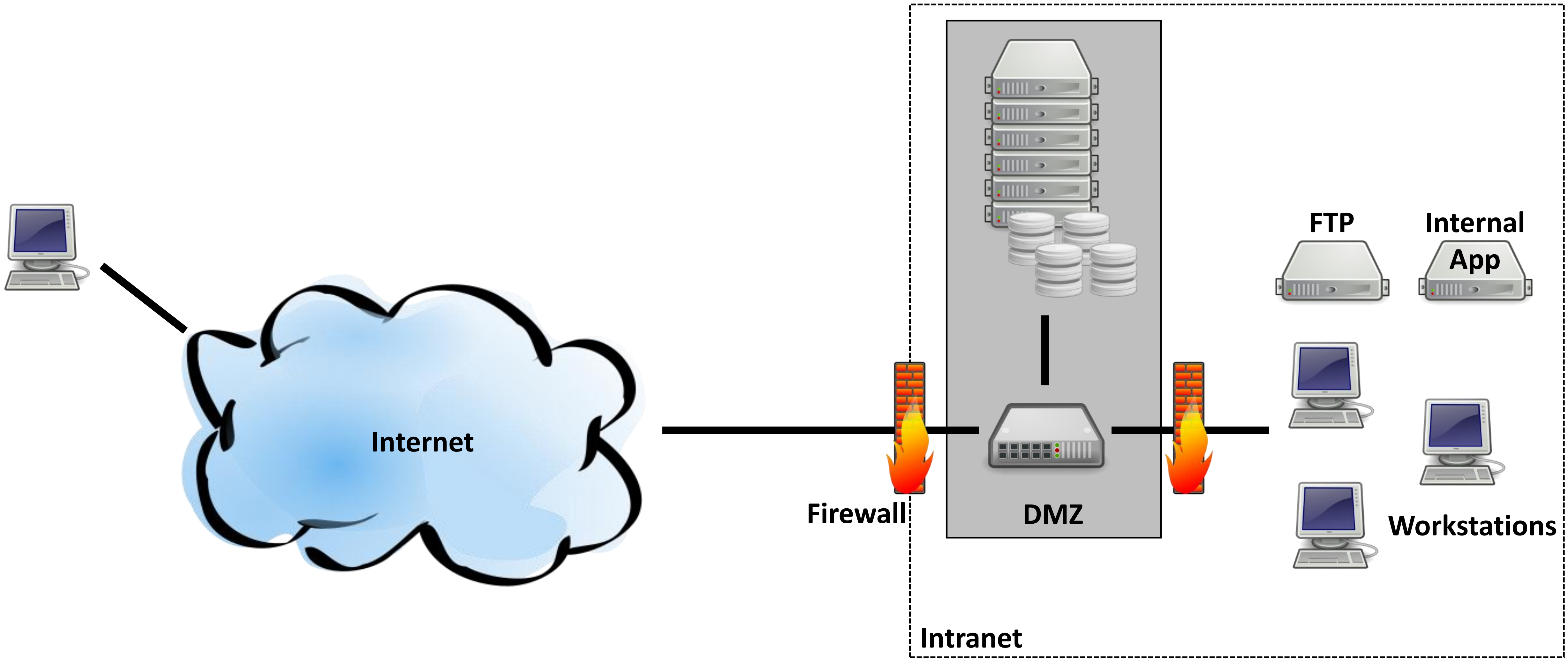

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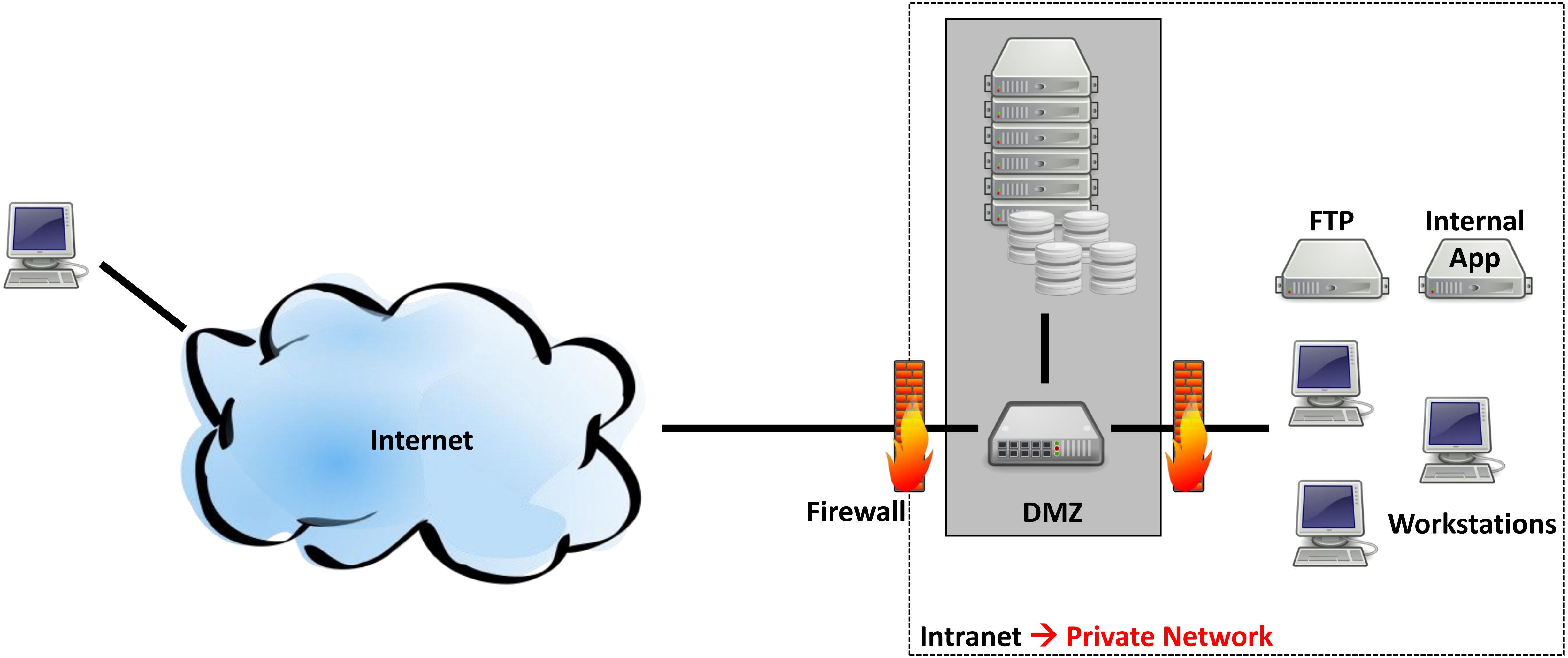
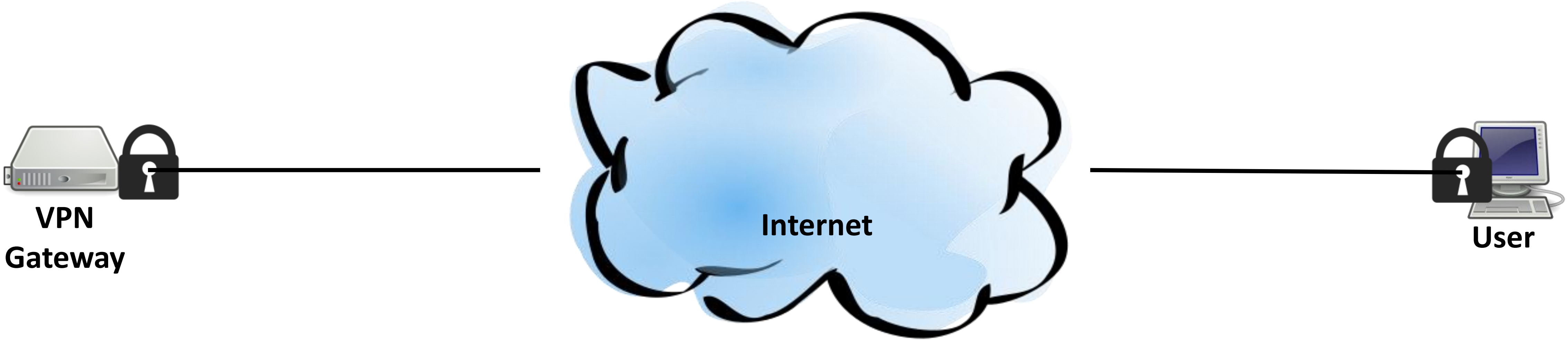
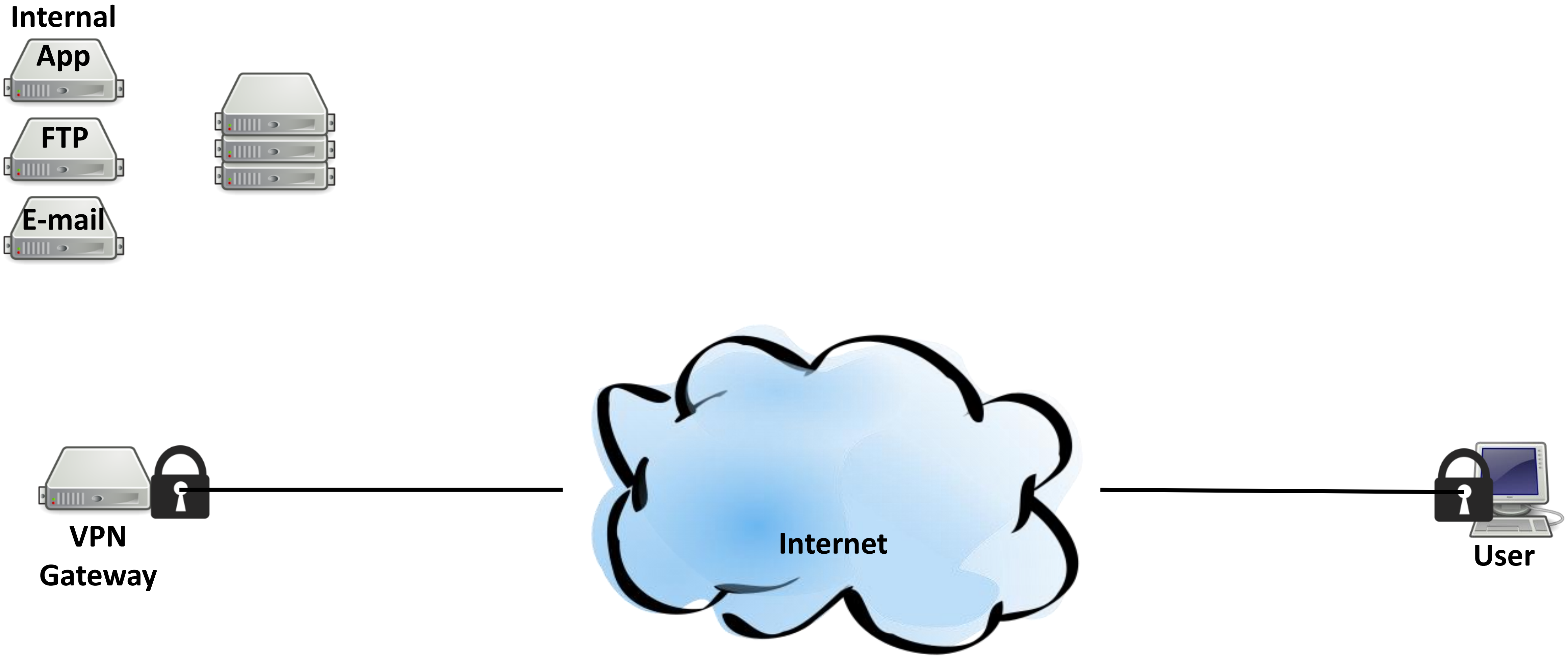


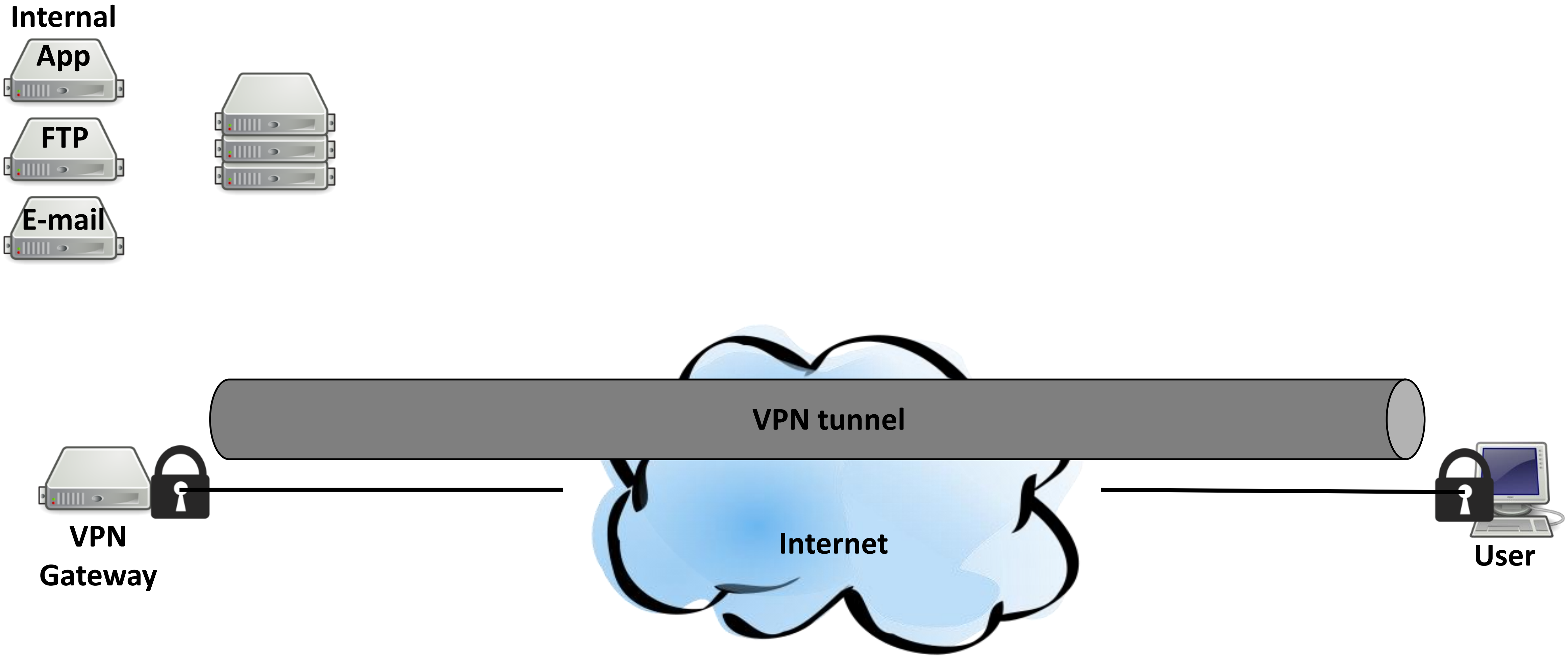
Virtual Private Network



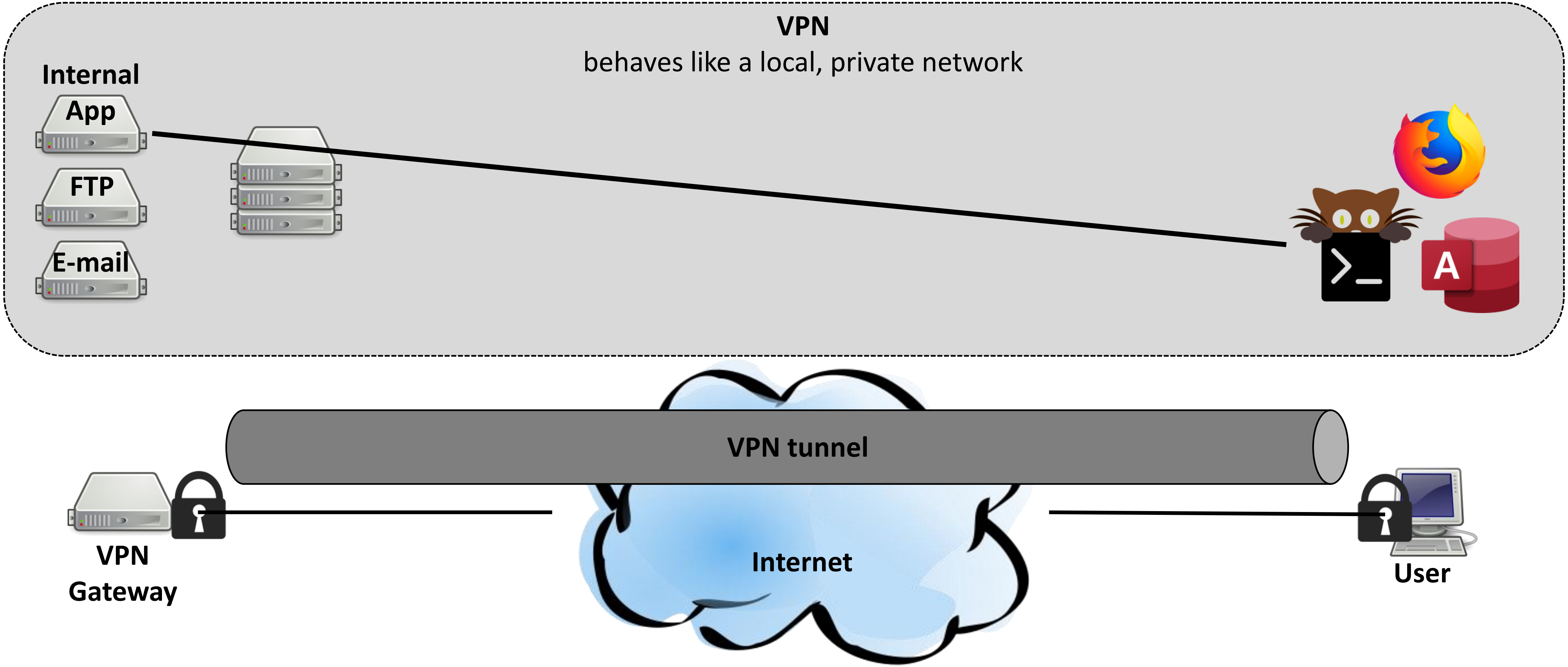
Virtual Private Network



Virtual Private Network



Virtual Private Network



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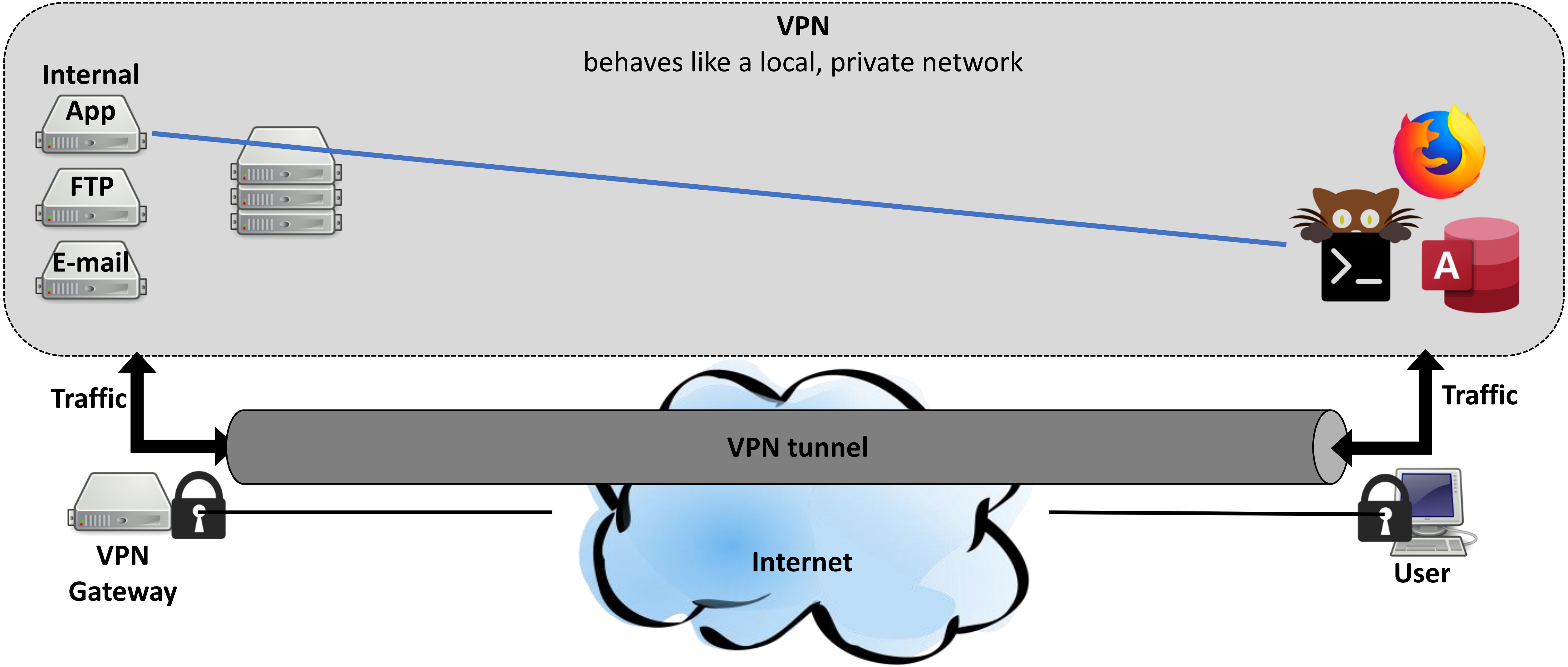
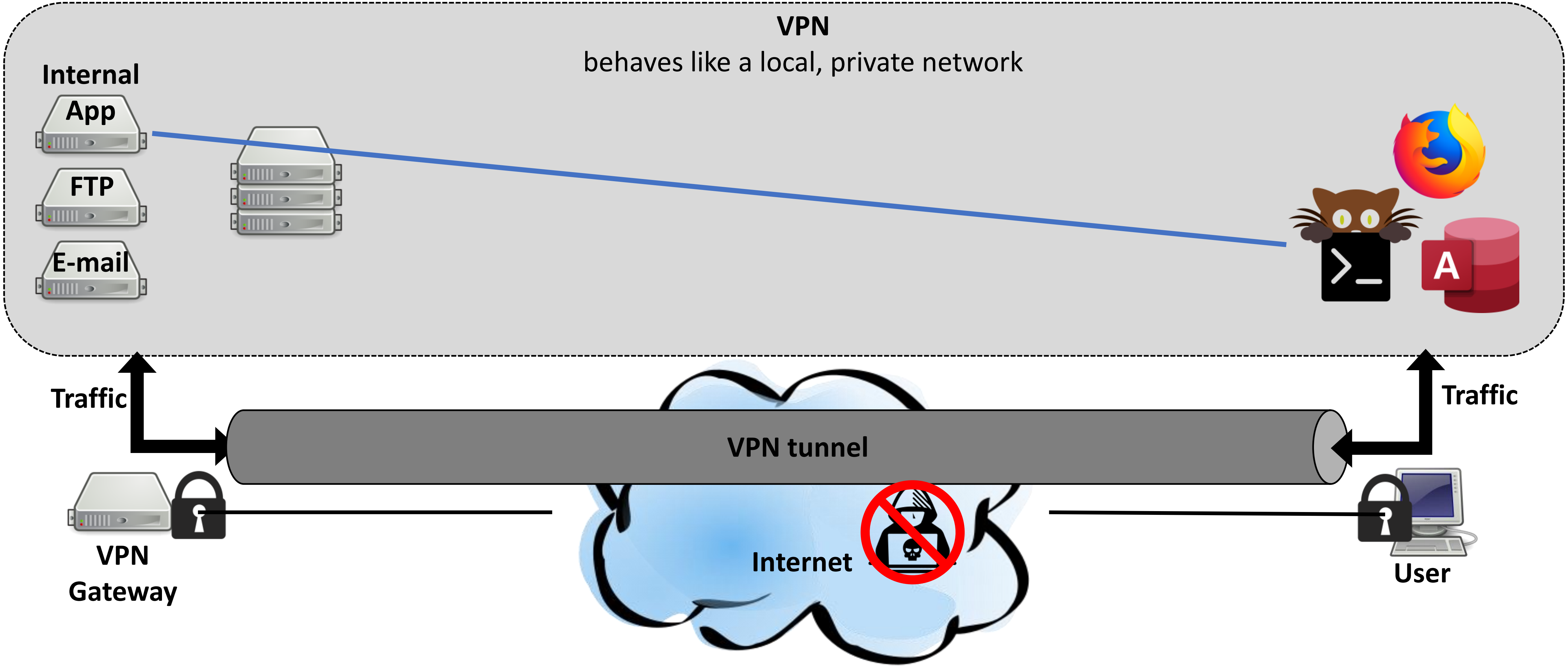
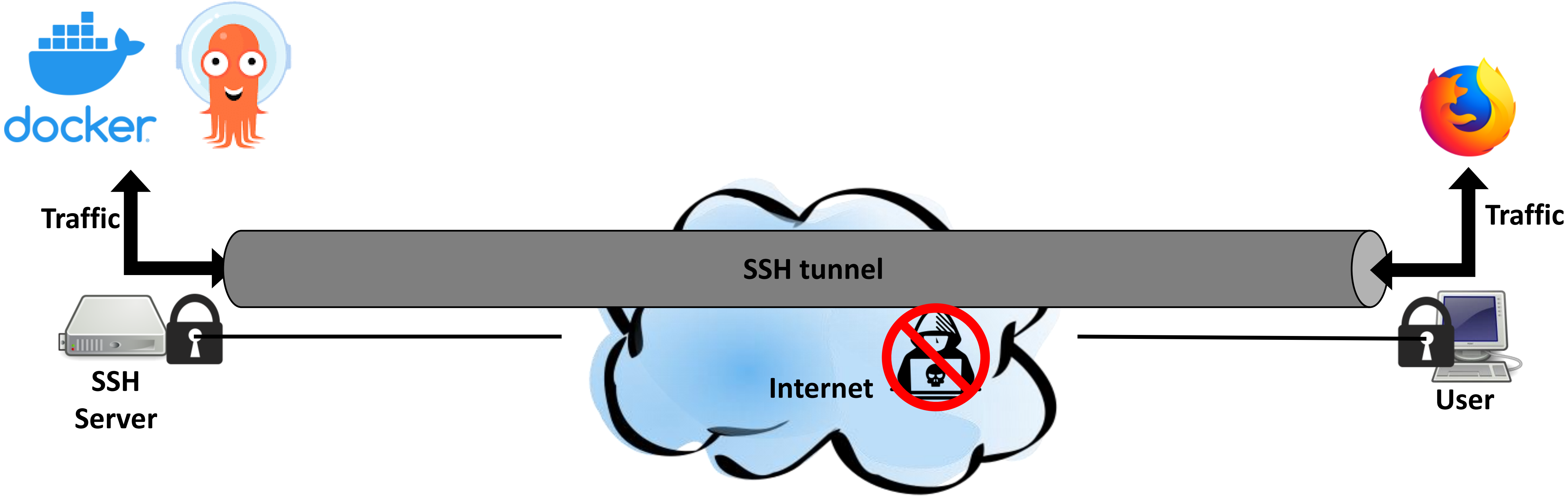


Virtual Private Network



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


docker
Traffic
SSH tunnel
Traffic
SSH
Server
Internet
User