FIREWALLS & CBAC

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Implementing a Firewall

- Personal software firewall – a software that is installed on a single PC to protect only that PC
- All-in-one firewall – can be a single device that offers the following features and functionality : router, Ethernet switch, wireless access point, firewall
- Small-to medium office firewalls , Enterprise firewalls – dedicated firewalls devices

Firewalls

All firewalls fall within three classes:

- **Appliance-based firewalls** – Appliance-based firewalls are hardware platforms that are designed specifically as dedicated firewalls. The appliance may serve other functions, but they are secondary to the firewall feature set.
- **Server-based firewalls** – A server-based firewall consists of a firewall application that runs on a network operating system (NOS) such as UNIX, NT or Win2K, or Novell. The underlying operating system is still present, so vulnerabilities and resource use of the operating system must be taken into consideration when implementing a this type of firewall.
- **Integrated firewalls** – An integrated firewall is implemented by adding firewall functionality to an existing device.

Most common rules and features of firewalls

- Packet filtrering
- Block incoming network traffic based on sourse or destination
- Block outgoing network traffic based on sourse or destination
- Block network traffic based on content
- Make internal resourse available (DMZ)
- Allow connections to internal network
- Report on network traffic and firewall activites

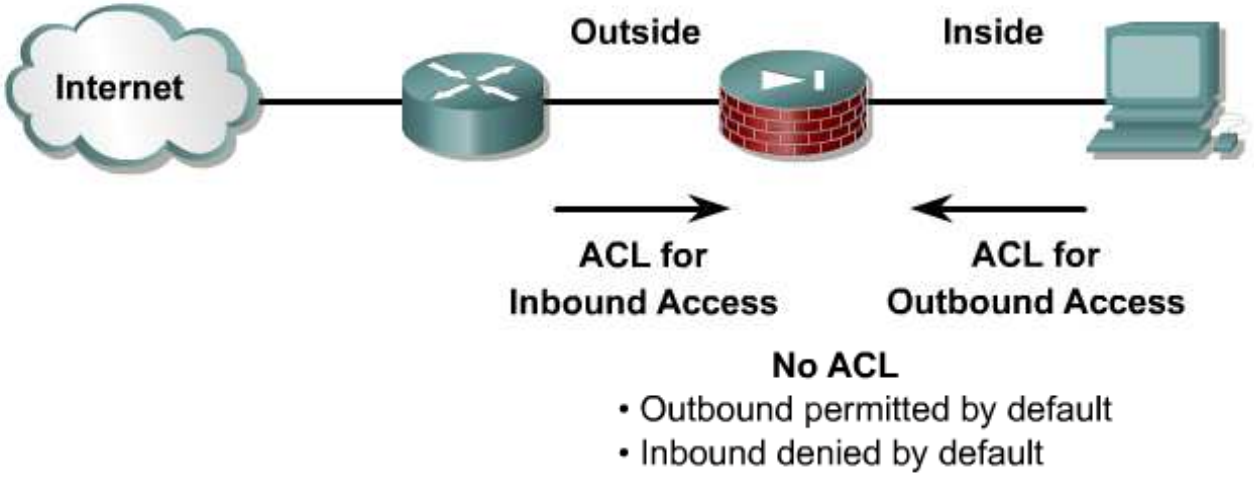
Packet filtering

- Packet filtering is the selective passing or blocking of data packets as they pass through a network interface. The criteria that uses when inspecting packets are based on the Layer 3 (IPv4 and IPv6) and Layer 4 (TCP, UDP, ICMP, and ICMPv6) headers.
- The most often used criteria are source and destination address, source and destination port, and protocol.

Access control list (ACL)

- Firewall can use packet filtering to limit information entering a network, or information moving from one segment of a network to another.
- Packet filtering uses access control lists (ACLs), which allow a firewall to accept or deny access based on packet types and other variables

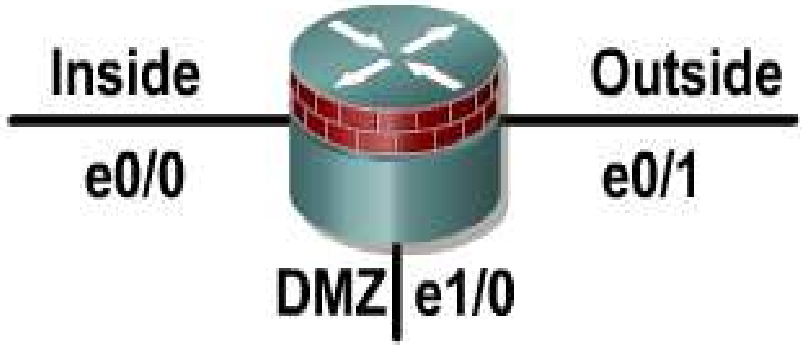
Access Policy
Access control list



Firewall appliance access-control policy is interface dependant.

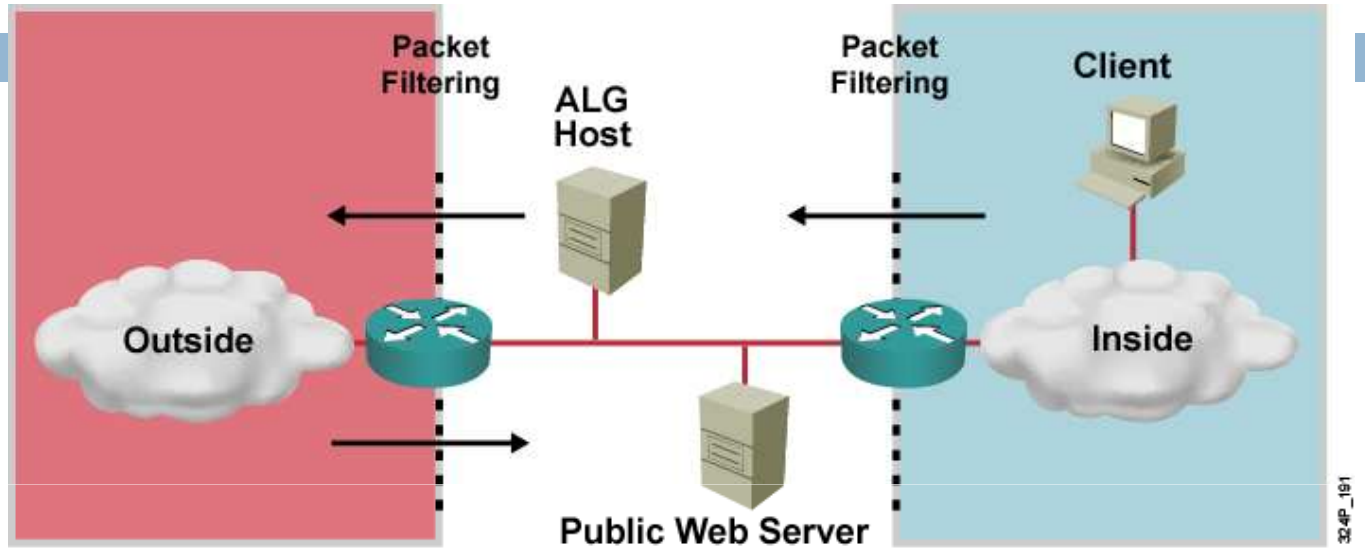
- Interface ACL permits or denies the initial packet incoming on that interface.
- ACL needs to describe only the initial packet of the application; no need to think about return traffic.
- If no ACL is attached to an interface, the following ASA policy applies:
  - Outbound packet is permitted by default.
  - Inbound packet is denied by default.

DMZ demilitarized zone



A DMZ is an interface that sits between a trusted network segment (your network) and an untrusted segment network segment (Internet), providing physical isolation between the two networks that is enforced by a series of connectivity rules within the firewall.

DMZ



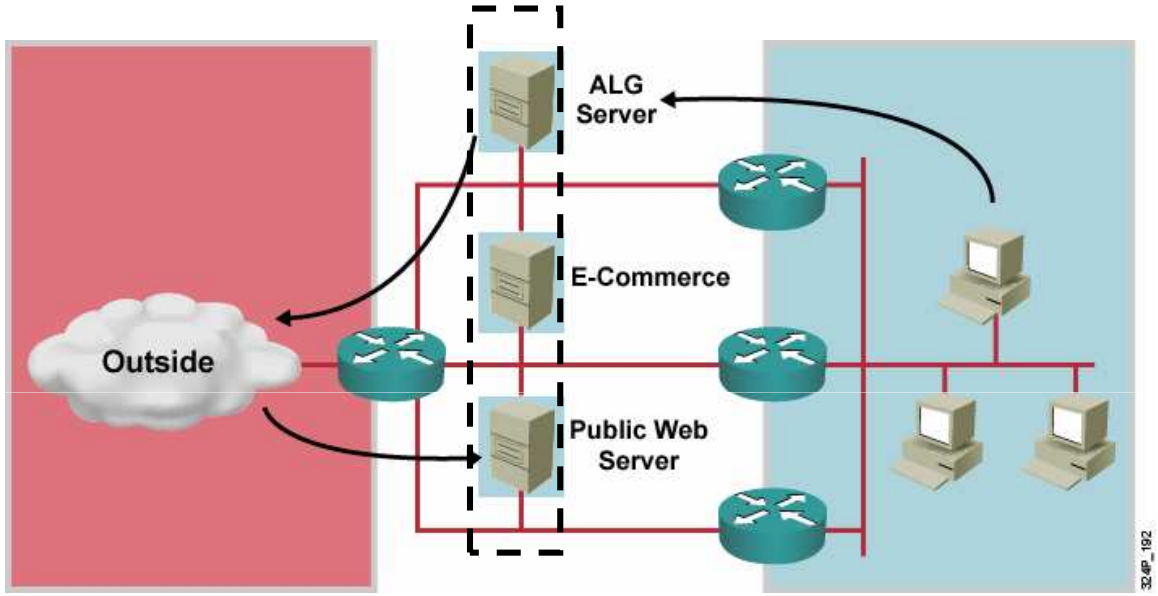
- A DMZ is established between security zones.
- DMZs are buffer networks that are neither the Inside nor the Outside network.

Layered Defense Features

- Access control is enforced on traffic entering and exiting the buffer network to all security zones by:
  - Classic routers
  - Dedicated firewalls
- DMZs are used to host services:
  - Exposed public services are served on dedicated hosts inside the buffer network.
  - The DMZ may host an application gateway for outbound connectivity.
- A DMZ blocks and contains an attacker in the case of a break-in.

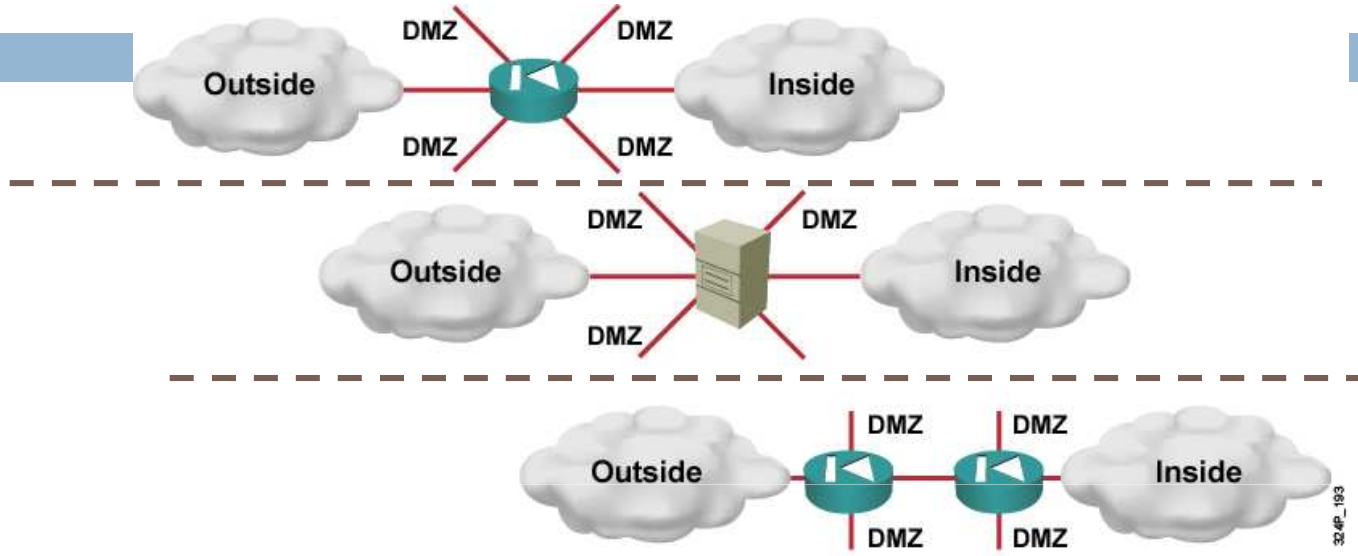
Multiple DMZs

Three Separate DMZs



- Multiple DMZs provide better separation and access control:
  - Each service can be hosted in a separate DMZ.
  - Damage is limited and attackers contained if a service is compromised.

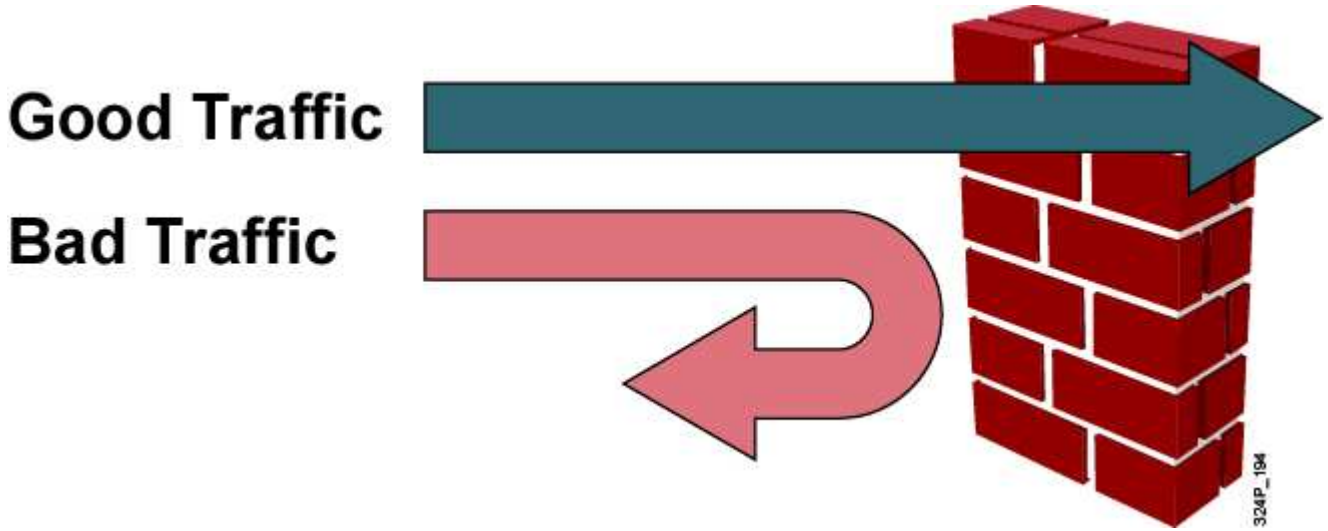
Modern DMZ Design



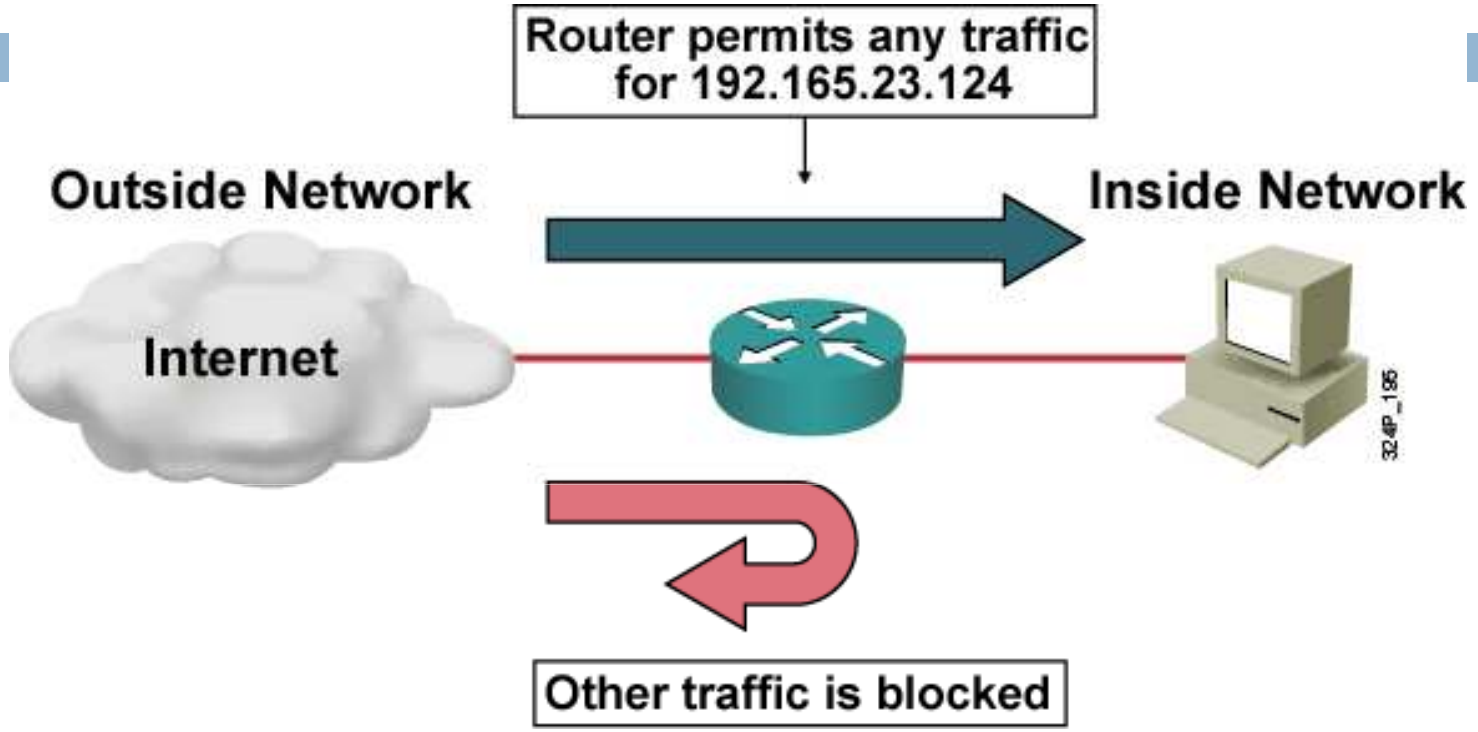
- Various systems (a stateful packet filter or proxy server) can filter traffic.
- Proper configuration of the filtering device is critical.

Firewall Technologies

- Firewalls use three technologies:
  - Packet filtering
  - Application layer gateway (ALG)
  - Stateful packet filtering

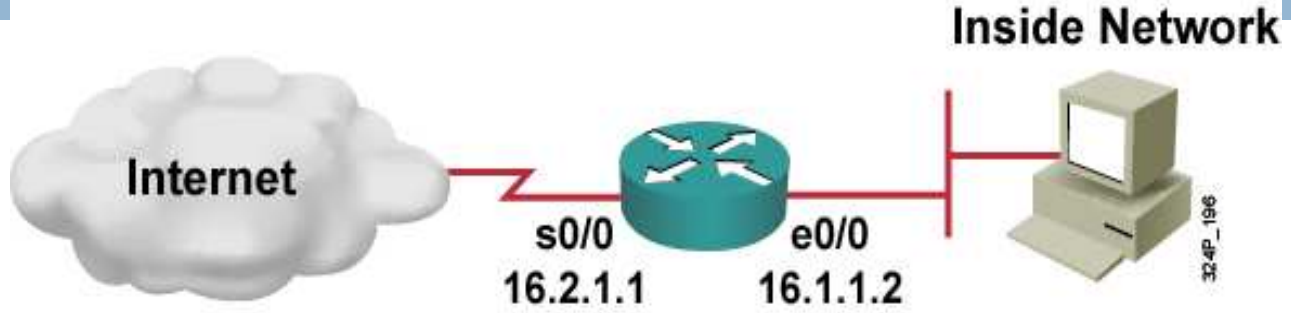


Packet Filtering



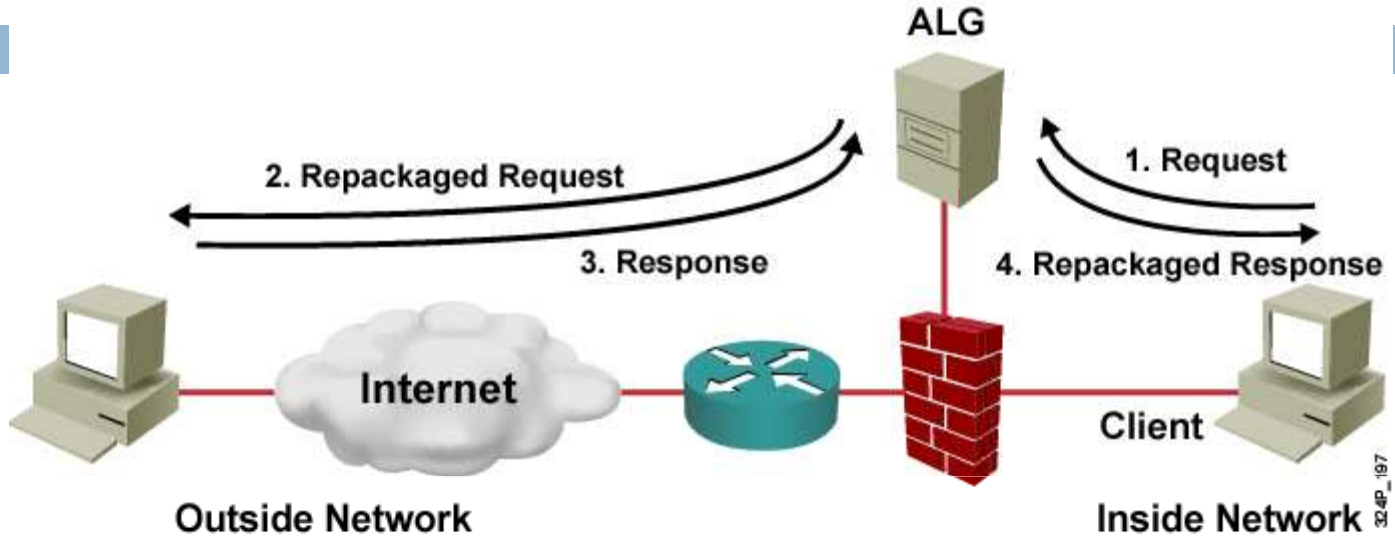
- Packet filtering limits traffic into a network based on the destination and source addresses, ports, and other flags that you compile in an ACL.

Packet Filtering Example



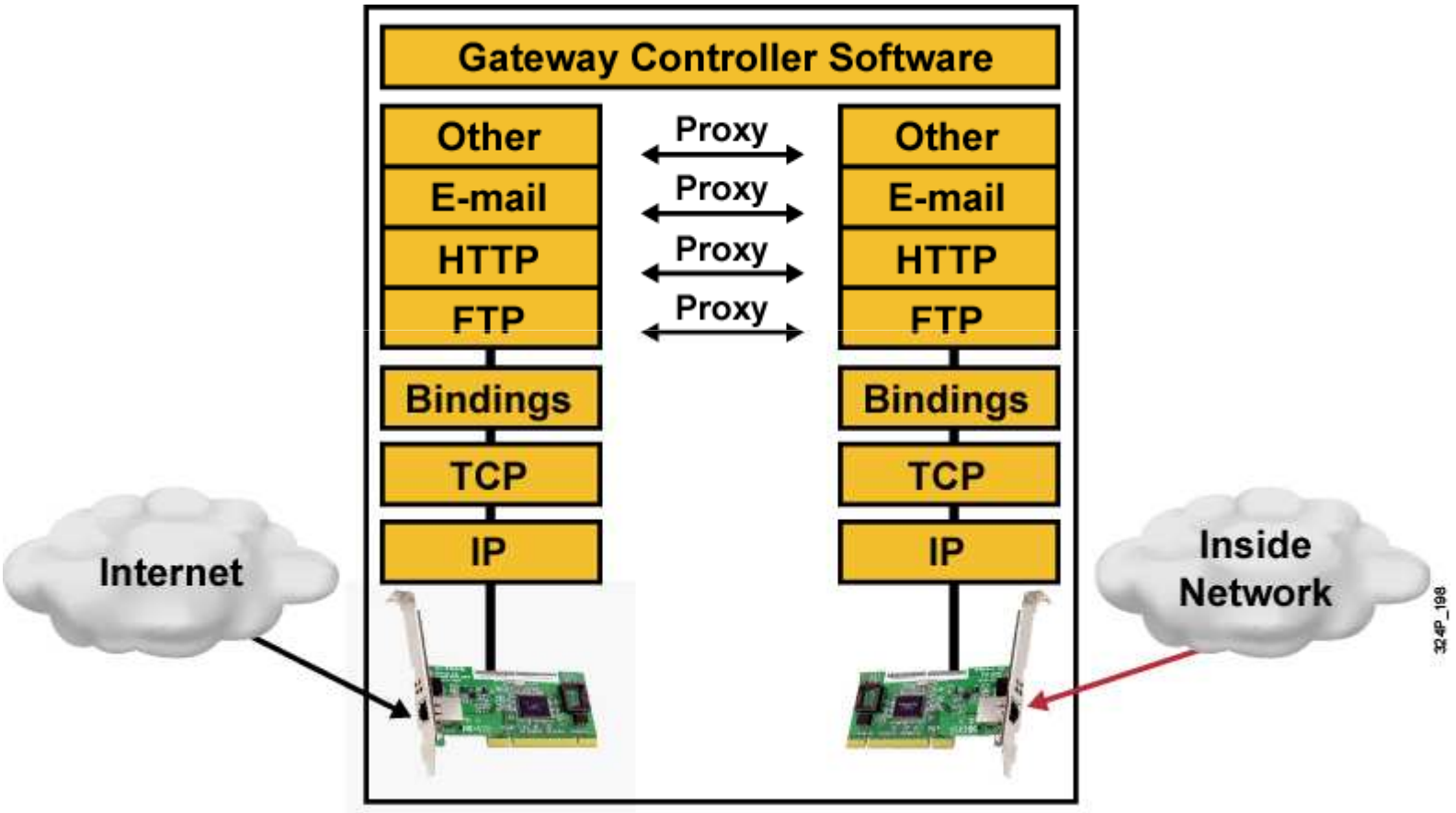

```
Router(config)# access-list 100 permit tcp any 16.1.1.0
0.0.0.255 established
Router(config)# access-list 100 deny ip any any log
Router(config)# interface Serial0/0
Router(config-if)# ip access-group 100 in
Router(config-if)# end
```

Application Layer Gateway

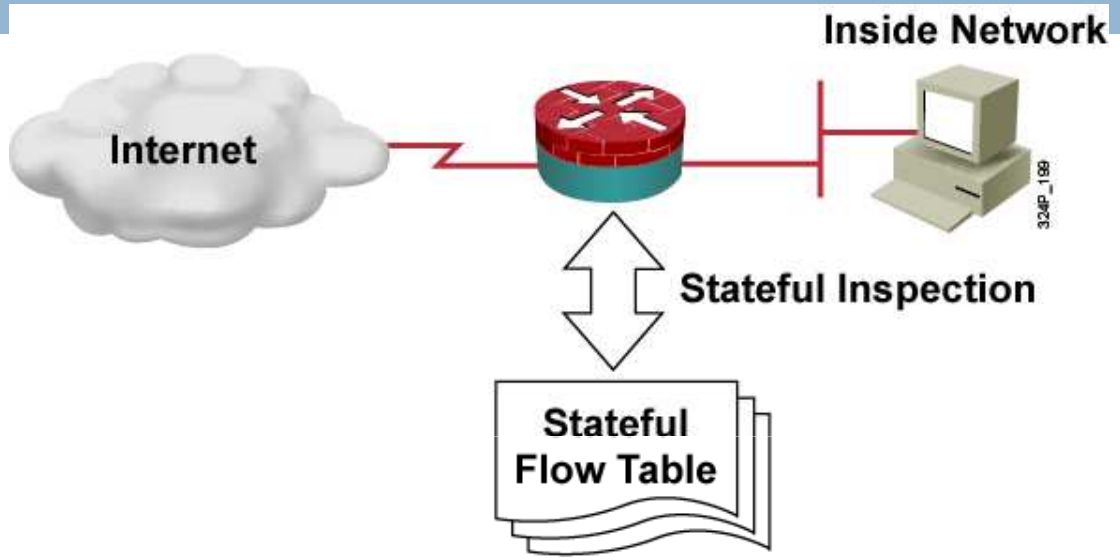


- The ALG intercepts and establishes connections to the Internet hosts on behalf of the client.

ALG Firewall Device



Stateful Packet Filtering



- Stateless ACLs filter traffic based on source and destination IP addresses, TCP and UDP port numbers, TCP flags, and ICMP types and codes.
- Stateful inspection then remembers certain details, or the state of that request.

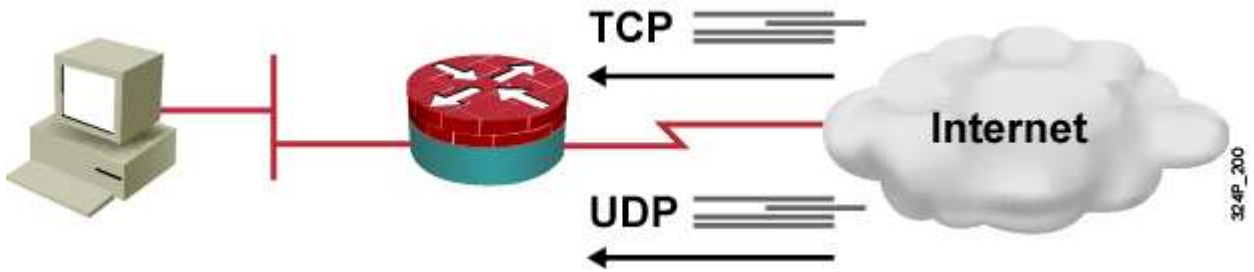
Stateful Firewalls

- Also called “stateful packet filters” and “application-aware packet filters.”
- Stateful firewalls have two main improvements over packet filters:
  - They maintain a session table (state table) where they track all connections.
  - They recognize dynamic applications and know which additional connections will be initiated between the endpoints.
- Stateful firewalls inspect every packet, compare the packet against the state table, and may examine the packet for any special protocol negotiations.
- Stateful firewalls operate mainly at the connection (TCP and UDP) layer.

The Cisco IOS Firewall Feature Set

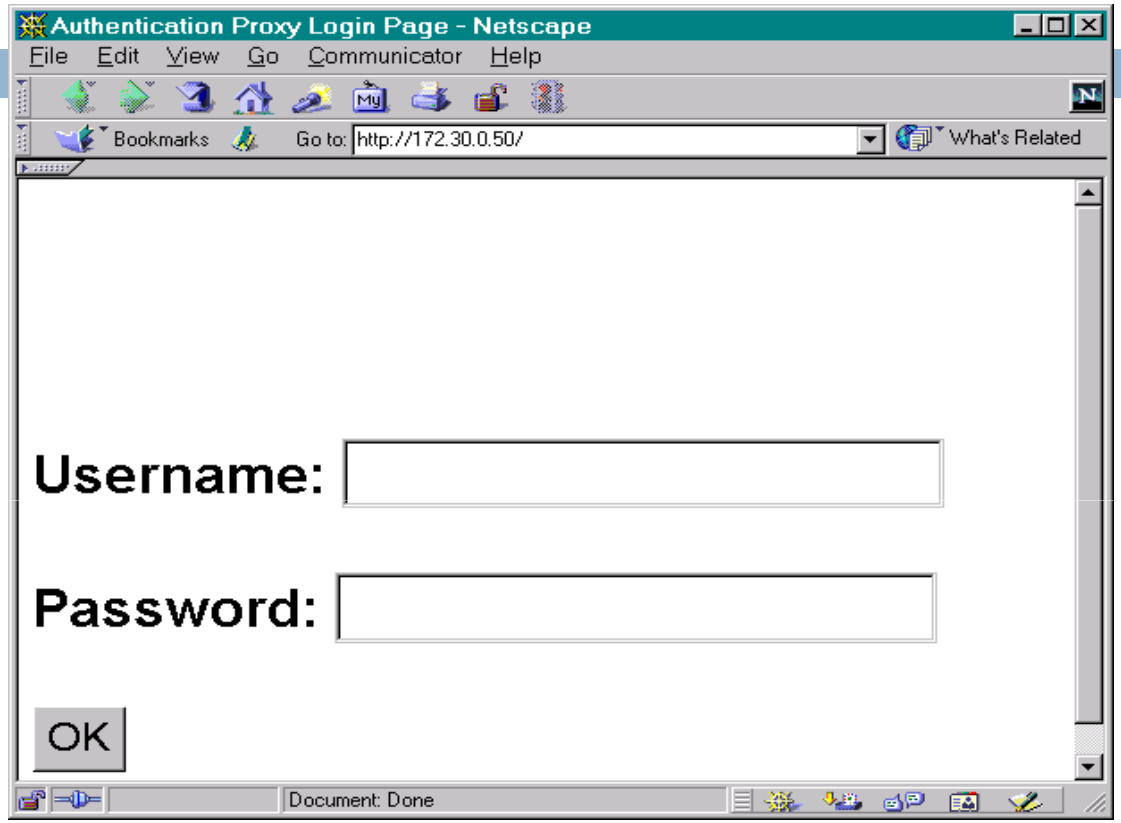
- The Cisco IOS Firewall Feature Set contains these features:
  - Standard and extended ACLs
  - Cisco IOS Firewall
  - Cisco IOS Firewall IPS
  - Authentication proxy
  - Port-to-Application Mapping (PAM)
  - NAT
  - IPsec network security
  - Event logging
  - User authentication and authorization

Cisco IOS Firewall



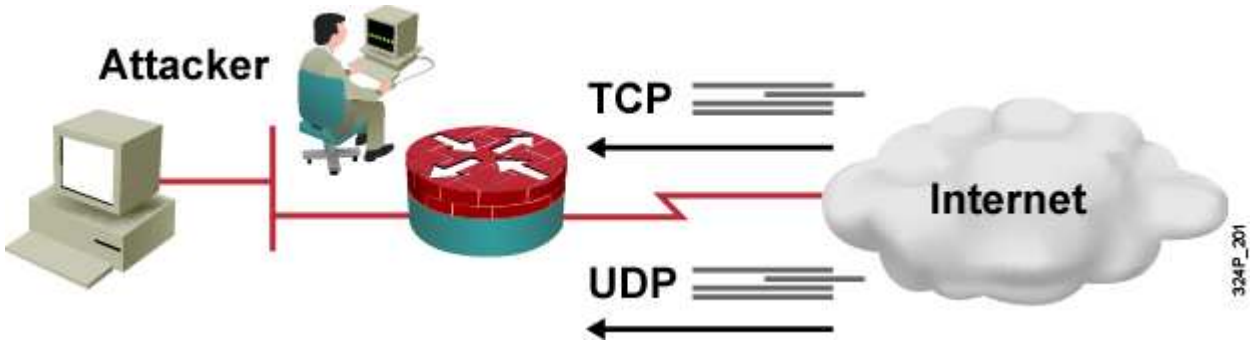
- Packets are inspected when entering the Cisco IOS firewall if the packets are not specifically denied by an ACL.
- Cisco IOS Firewall permits or denies specified TCP and UDP traffic through a firewall.
- A state table is maintained with session information.
- ACLs are dynamically created or deleted.
- Cisco IOS Firewall protects against DoS attacks.

Cisco IOS Authentication Proxy



- HTTP, HTTPS, FTP, and Telnet authentication
- Provides dynamic, per-user authentication and authorization via TACACS+ and RADIUS protocols

Cisco IOS IPS



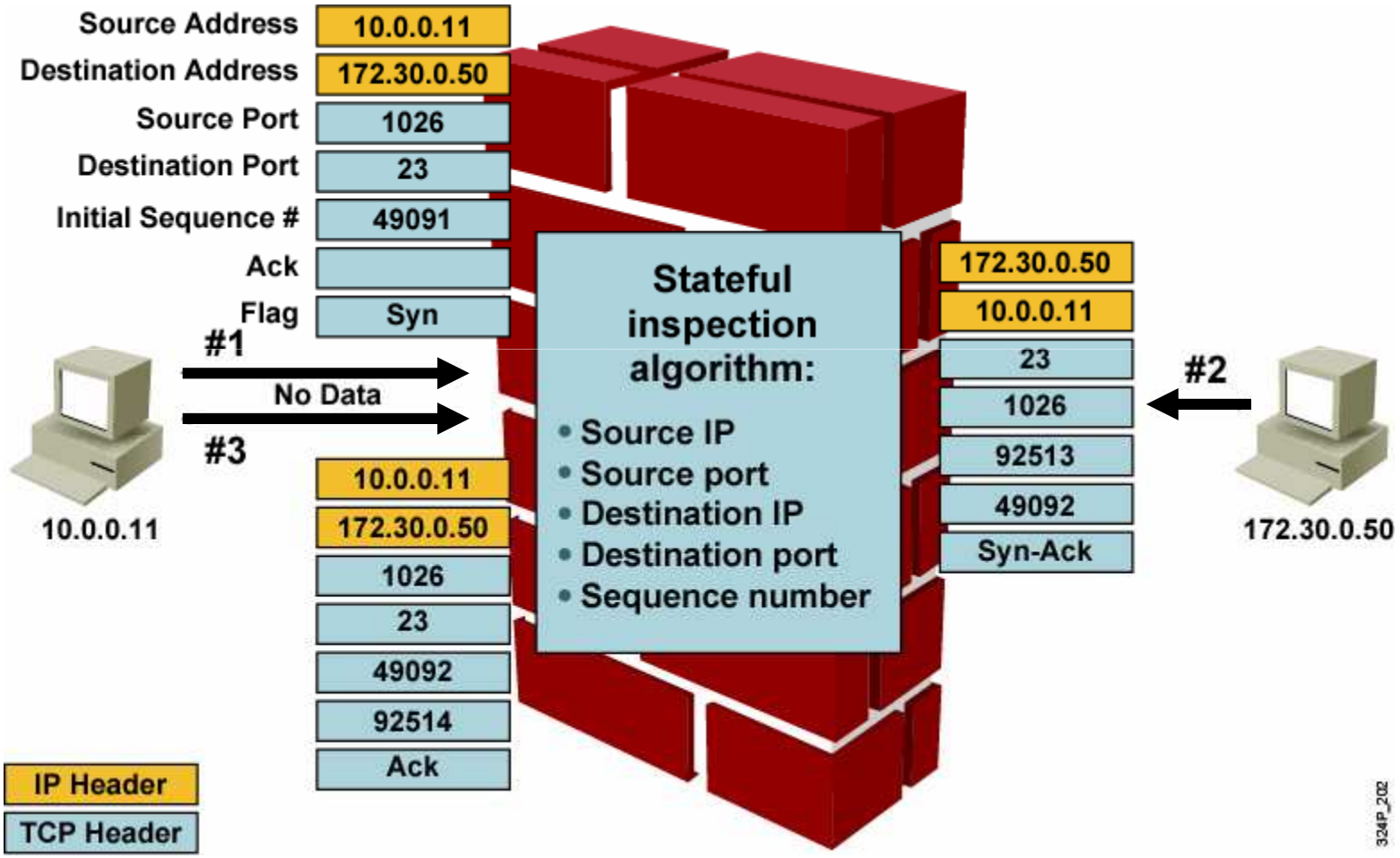
- Acts as an inline intrusion prevention sensor—traffic goes through the sensor
- When an attack is detected, the sensor can perform any of these actions:
  - Alarm: Send an alarm to SDM or syslog server.
  - Drop: Drop the packet.
  - Reset: Send TCP resets to terminate the session.
  - Block: Block an attacker IP address or session for a specified time.
- Identifies 700+ common attacks

Cisco IOS ACLs Revisited

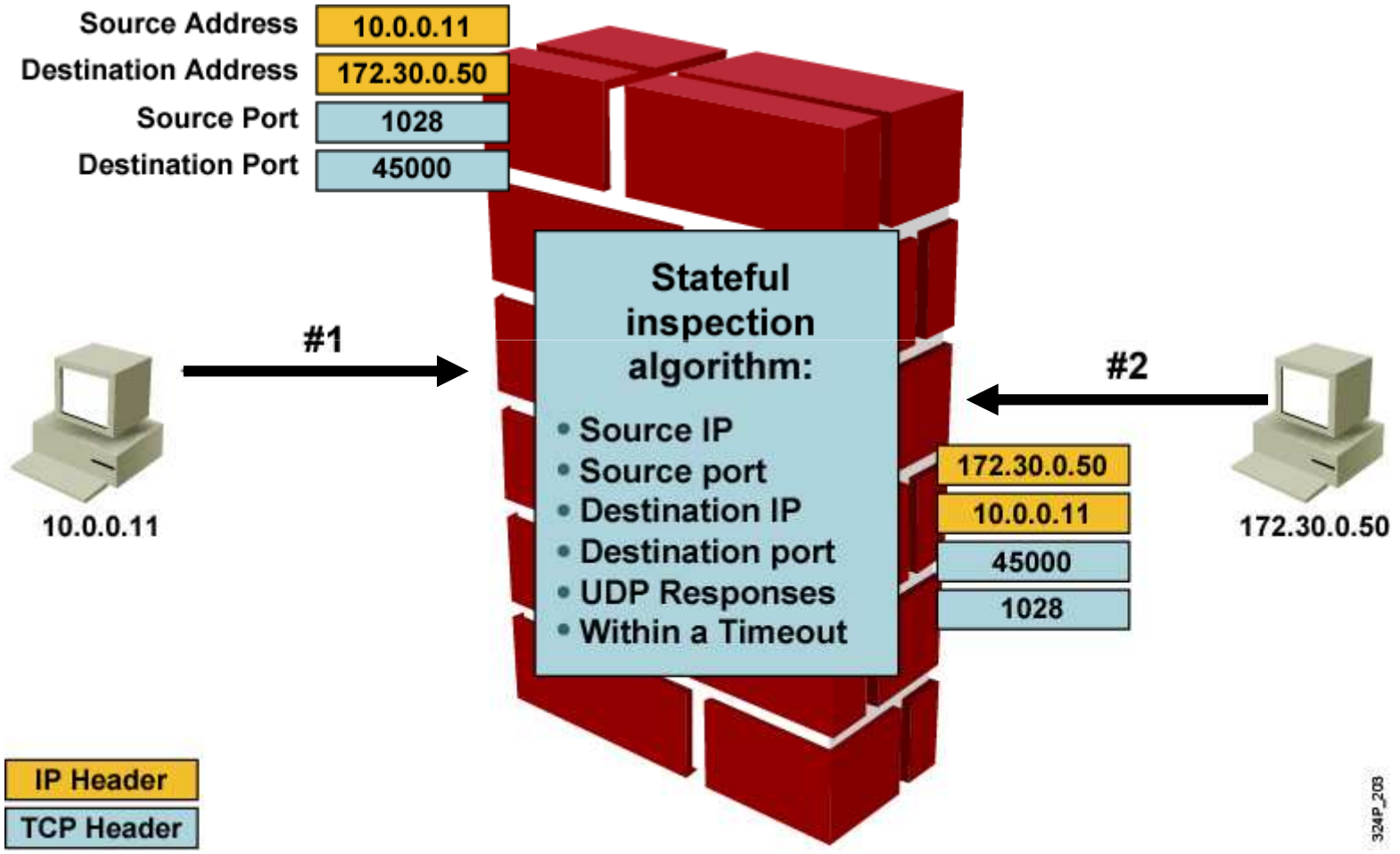
- ACLs provide traffic filtering by these criteria:
  - Source and destination IP addresses
  - Source and destination ports

- ACLs can be used to implement a filtering firewall leading to these security shortcomings:
  - Ports opened permanently to allow traffic, creating a security vulnerability.
  - The ACLs do not work with applications that negotiate ports dynamically.

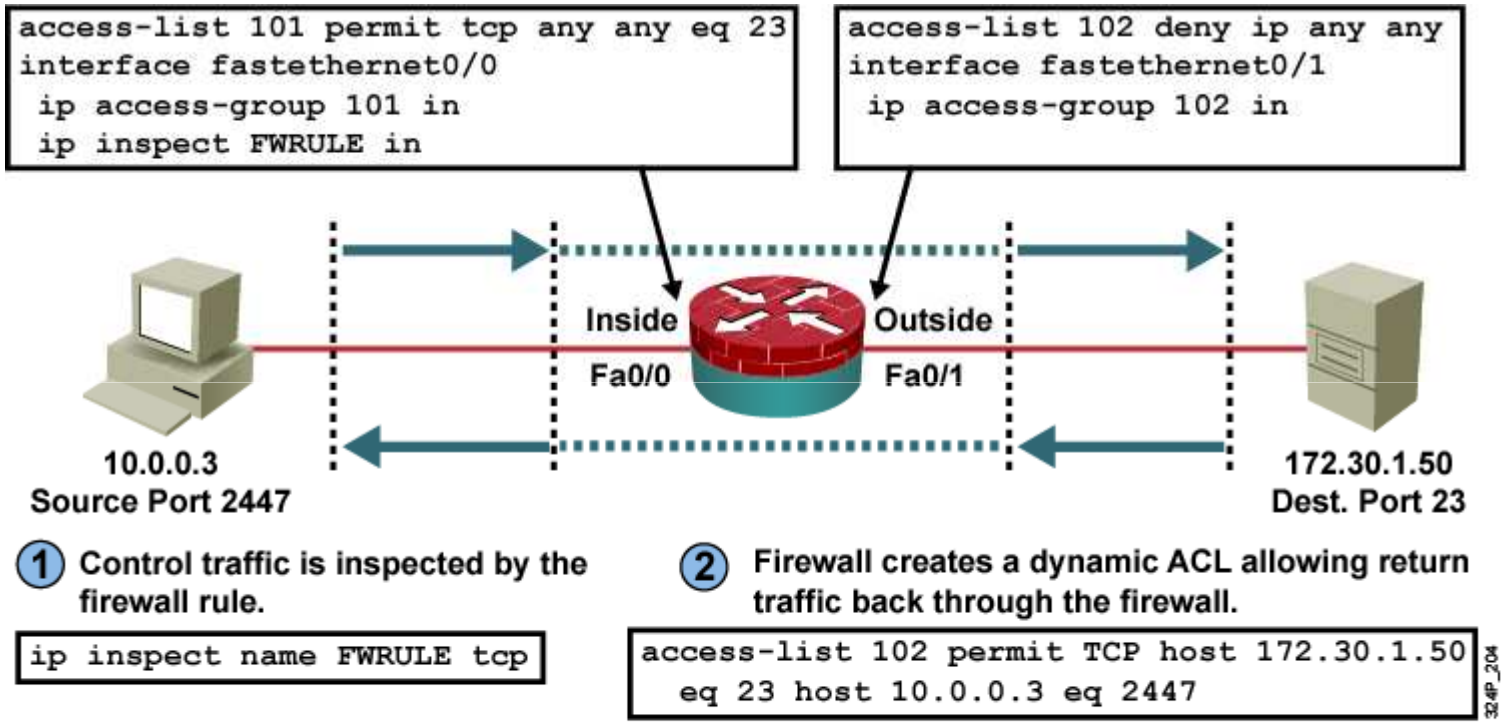
Cisco IOS Firewall TCP Handling



Cisco IOS Firewall UDP Handling

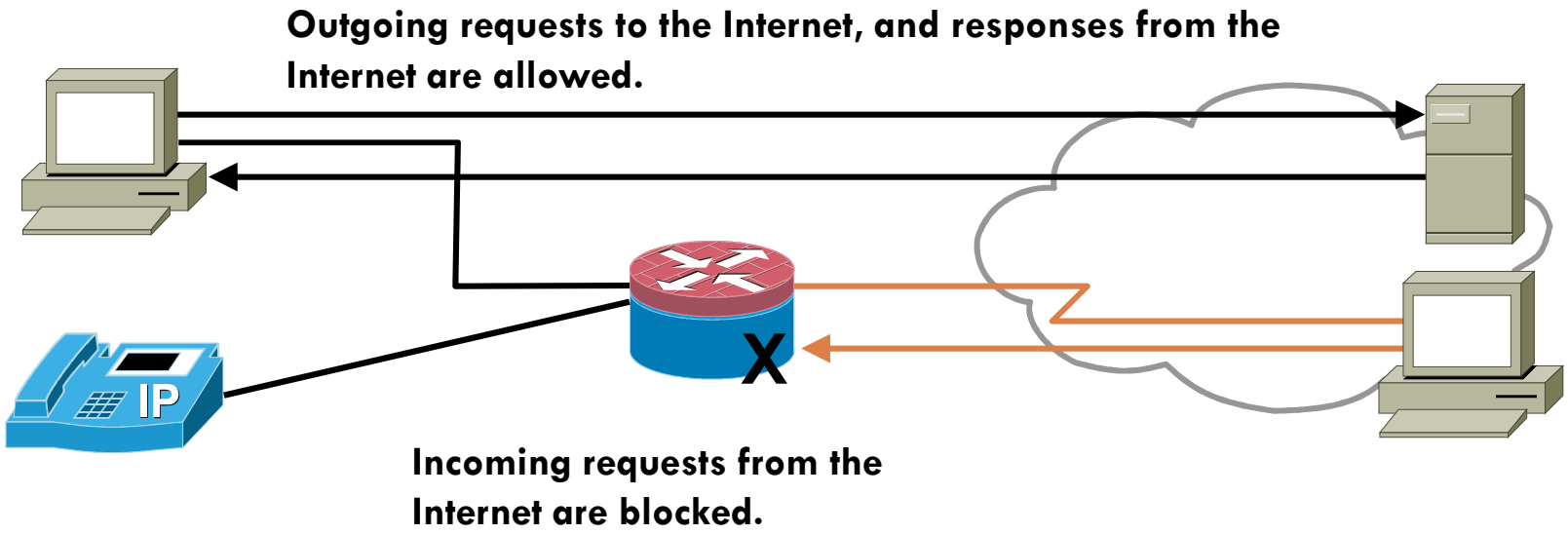


How Cisco IOS Firewall Works



Cisco IOS Firewall Supported Protocols

- Regardless of the application layer protocol, Cisco IOS Firewall will inspect:
  - All TCP sessions
  - All UDP connections
- Enhanced stateful inspection of application layer protocols



Alerts and Audit Trails

- Cisco IOS Firewall generates real-time alerts and audit trails.
- Audit trail features use syslog to track all network transactions.
- With Cisco IOS Firewall inspection rules, you can configure alerts and audit trail information on a per-application protocol basis.