IPSec
Internet Protocol Security

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Overview

- Application layer security
  - Security e-mail
    - S/MIME
  - DNS security extensions
  - SSH (Secure SHell): secure telnet
- Transport layer security
  - SSL (Secure Socket Layer)
- Network layer Security
  - IPSec
    - Protection of IP, TCP, and UDP headers
    - Authentication of IP, TCP, and UDP headers

Problemi di sicurezza

- IPSec
  - Privacy
  - Integrità
  - Authentication
  - Tunneling
- IKE (Internet Key Exchange)
  - Key management - gestione delle chiavi di cifratura
    - Le chiavi vengono cambiate periodicamente
  - Gli estremi dei tunnel sono certificati da una Certification Authority

Trasparente per gli utenti

IPSec and IKE

IPSec supports

- manual (out-of-band) key exchange
- IKE

Ingredients:

- Diffie-Hellman key exchanges
- Public key cryptography to sign key exchanges
  - Guarantees for identities of the two parties
- Digital certificates to validate public keys
- DES (Data Encryption Standard) to encrypt data

Security Association (SA)

- Agreements that enable data exchange
- An exchange providing authentication and privacy requires a separate SA for each

An SA includes

- Session keys
- IP address of each endpoint
  - It can be a subnet prefix
- IP address of each IPSec gateway
- Expiration of session keys
  - Upon session keys expiration a new Security Association is to be created

IKE (Internet Key Exchange)

- Means to agree upon
  - Protocols
  - Algorithms
    - Encryption
      - DES
      - 3DES
      - RC5
      - Cast
    - Authentication: message digest
      - MD5
      - SHA1
  - Keys
    - Shared secret
      - Communicated off-line
    - Digital certificates

IKE (Internet Key Exchange)

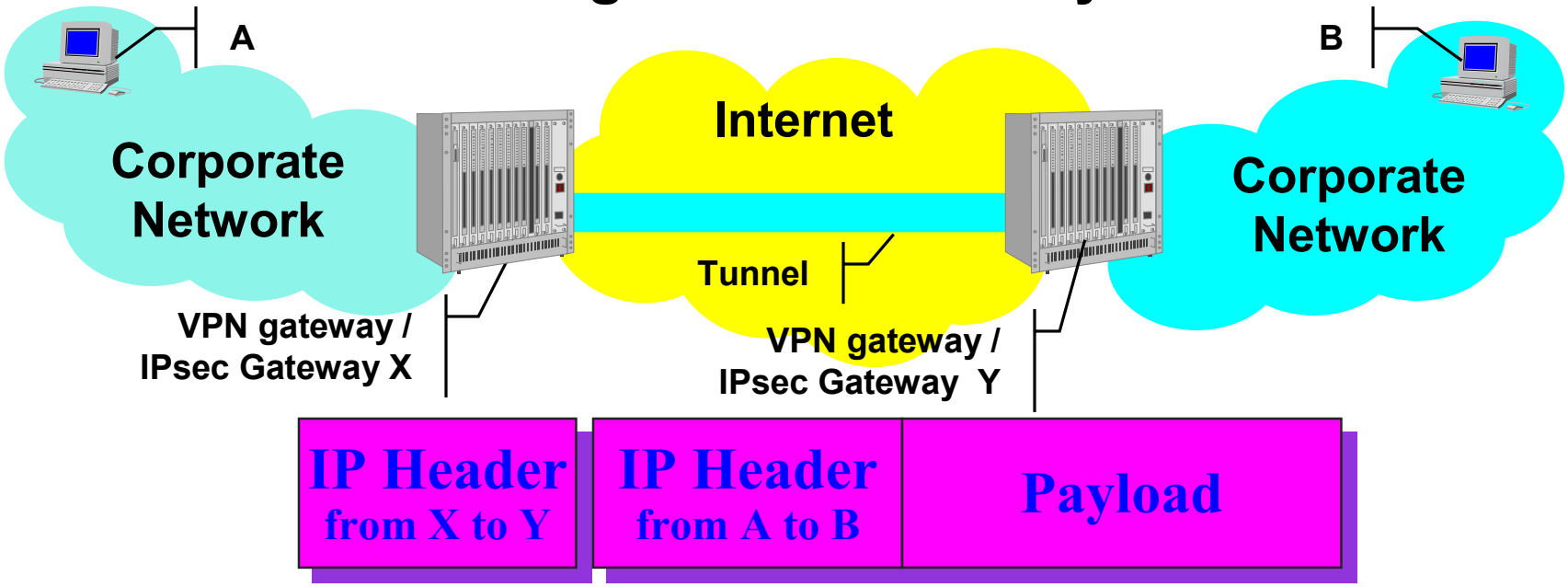
- Authentication of the other communicating party
- Management of keys agreed upon
  - Session keys are changed regularly
  - One shared pair of session keys per communicating direction
    - one for data encryption
    - one for authentication

Implementation

- Client implementation
- Gateway implementation
  - Software: on firewall or router
  - Hardware: special purpose box
- Algorithm independence

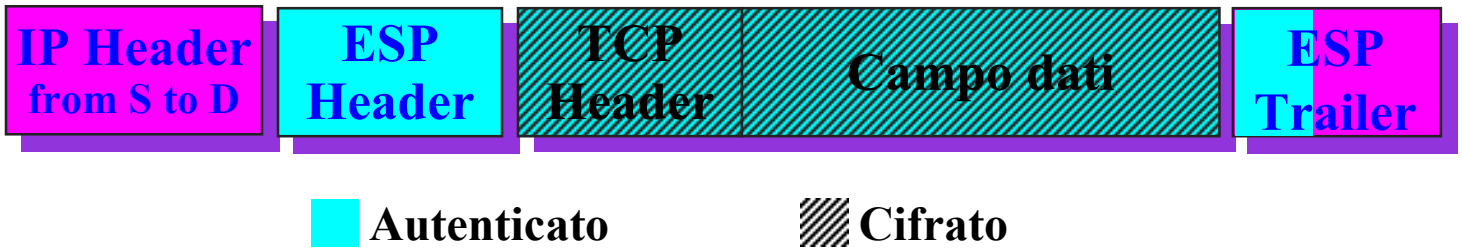
(IPsec) Tunneling VPN

- A and B are enterprise addresses
  - they do not have to satisfy the public system requirements
- Tunneling enables operation
- IPsec tunneling ensures security



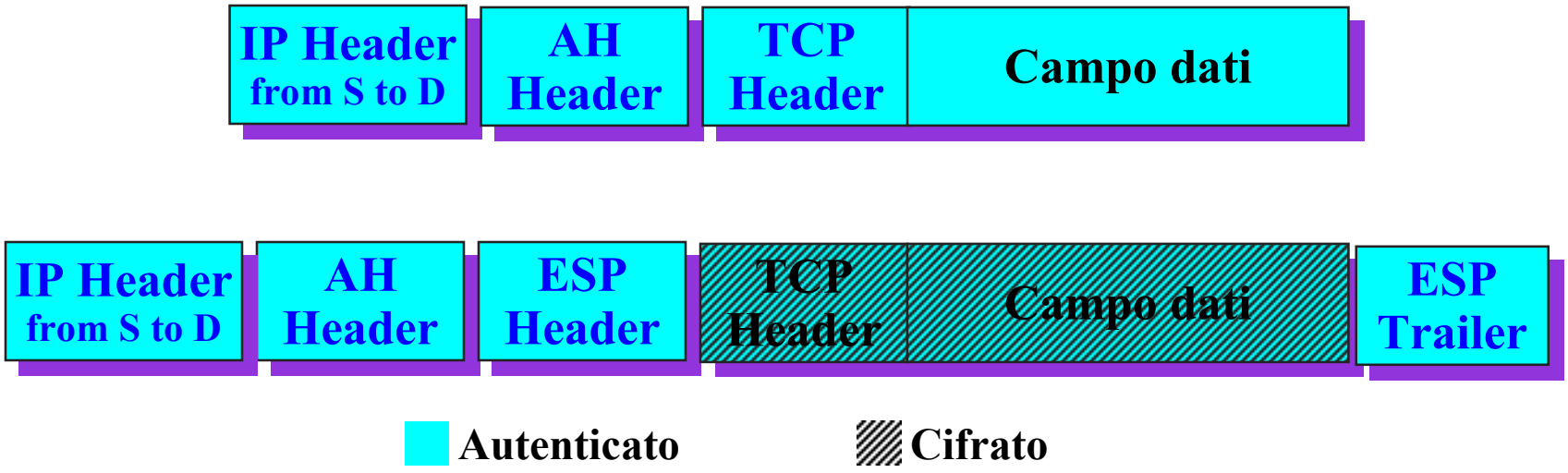
Transport Mode Encapsulation

- Comunicazione tra terminale e terminale
- Le informazioni tra l'intestazione ESP (Encapsulation Security Payload) e il trailer è cifrata
  - Security Parameter Index (SPI)
    - Puntatore nel SA database → tipo di cifratura
- ESP trailer: autenticazione
  - Message authentication code (MAC)
  - Dal trasporto (TCP/UDP) al MAC (escluso)



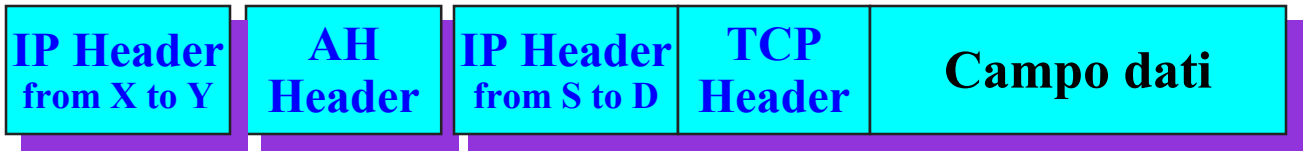
Transport Mode Encapsulation

- Authentication header
  - SPI
  - Con e senza ESP
  - MAC sull'intero pacchetto
    - no TTL, ToS, informazioni di frammentazione, ecc.



Tunnel Mode Encapsulation

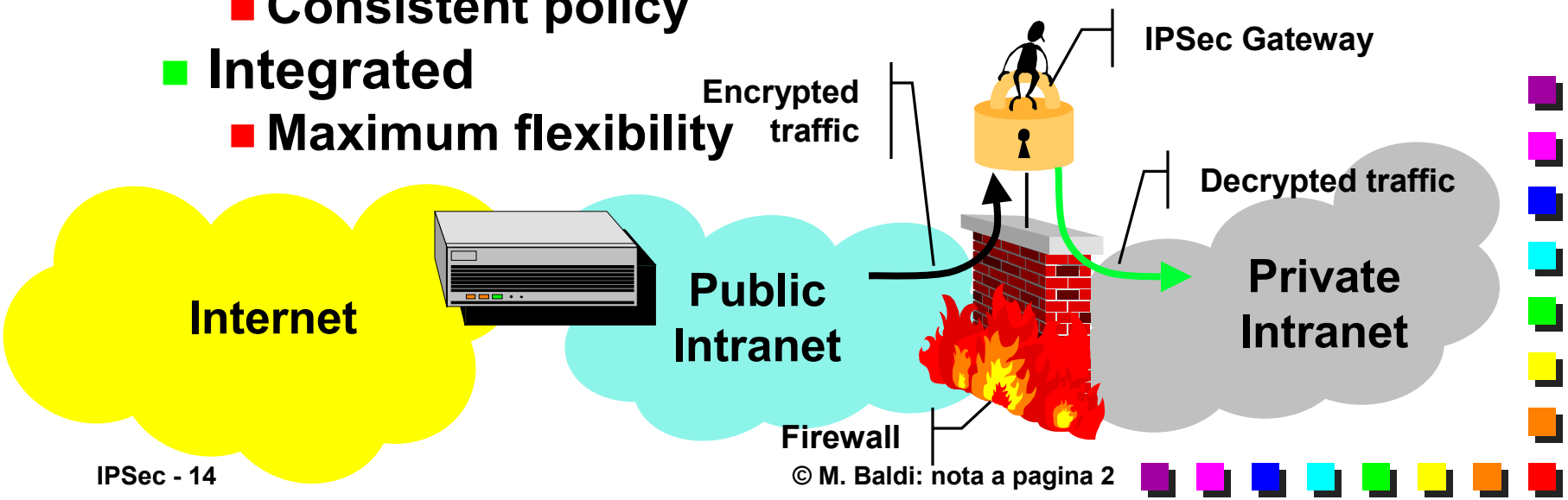
Comunicazioni tra il Gateway (X) e il gateway (Y)



Autenticato Cifrato

IPSec Gateway and Firewall

- Inside
  - No inspection of encrypted traffic
  - IPSec gateway protected by firewall
- Parallel
  - Potential uncontrolled access
- Outside
  - IPSec gateway protected by access router
  - Consistent policy
- Integrated
  - Maximum flexibility

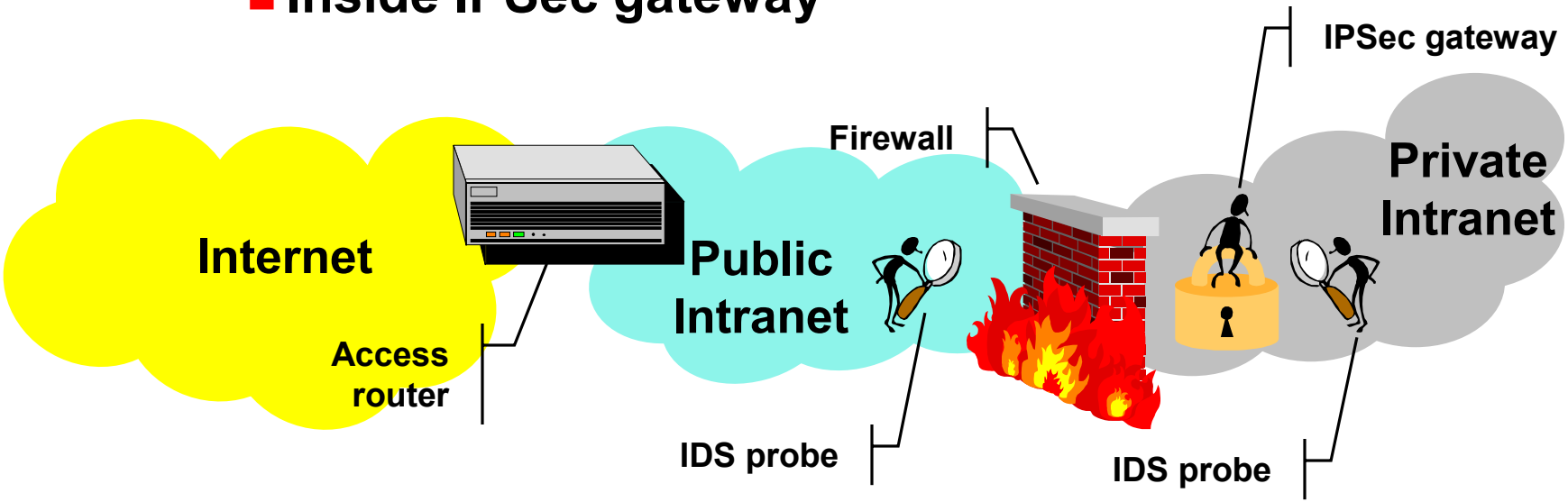


IPSec Gateway and NAT

- Authentication Header (AH)
  - IP addresses are part of AH checksum calculation → packets discarded
- Transport mode
  - IP address of IPSec tunnel peer is not what expected → packets discarded
- No PAT (Protocol Address Translation)
- Tunnel mode
  - IP address within secure packet can be changed before entering the gateway
    - E.g., same addresses in two different VPN sites
  - Most often NAT is not needed on external packet

IPSec Gateway and IDS

- IDS is usually outside the firewall
- No control on encrypted traffic
- Multiple IDS probes
  - Outside firewall
  - Inside IPSec gateway



Riferimenti bibliografici

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