METHODS FOR COMBATING MESSAGING FRAUD

SESSION APP-1103

Agenda

- Introduction
  - Problem Statement
  - Goals (and Non-Goals) of Message Authentication
  - Terminology
- Solution Classes
  - Path-Based (SPF, Sender ID)
  - Signature-Based (DKIM)
  - Miscellaneous (CSV, BATV)
- Deployment
  - Software Availability
  - Publishing and Verification of Records
- Q and A

What Is Messaging Fraud?

- **Fraud relating to the source or description of a message**
  - **“Message” may be e-mail, IM, or telephony**
- **Content may be fraudulent too**
  - **Difficult to automatically interpret content to detect fraud**
  - **Some specialized detection tools available**

Message Authentication

Message Authentication is the process of determining whether a message is actually from its claimed source

Why Message Authentication?

- Makes it harder to hide—improves accountability
- Ability to claim message came from another is integral to some fraud schemes
  - Many types of phishing
  - Confidence schemes
- Want to improve users' trust of the Internet
- Required to support reputation and accreditation of senders

What Message Authentication Won't Do

- **Solve the spam problem**
  - **Spammers will send messages from throwaway addresses**
  - **Accountability is limited by that of domain registration**
- **Solve the phishing problem**
  - **Human-engineered and look-alike domain names still exist**
  - **alerts@bigbank-security.com, fraud@examp1e.com**

Emerging Attack Vectors

- **Domain names are being internationalized**

  Unicode characters can be used to represent domains using non-ASCII alphabets

  These characters are sometimes hard to distinguish from ASCII counterparts

- **Internationalized domain names can look like other familiar domains**

  security@bigbank.com

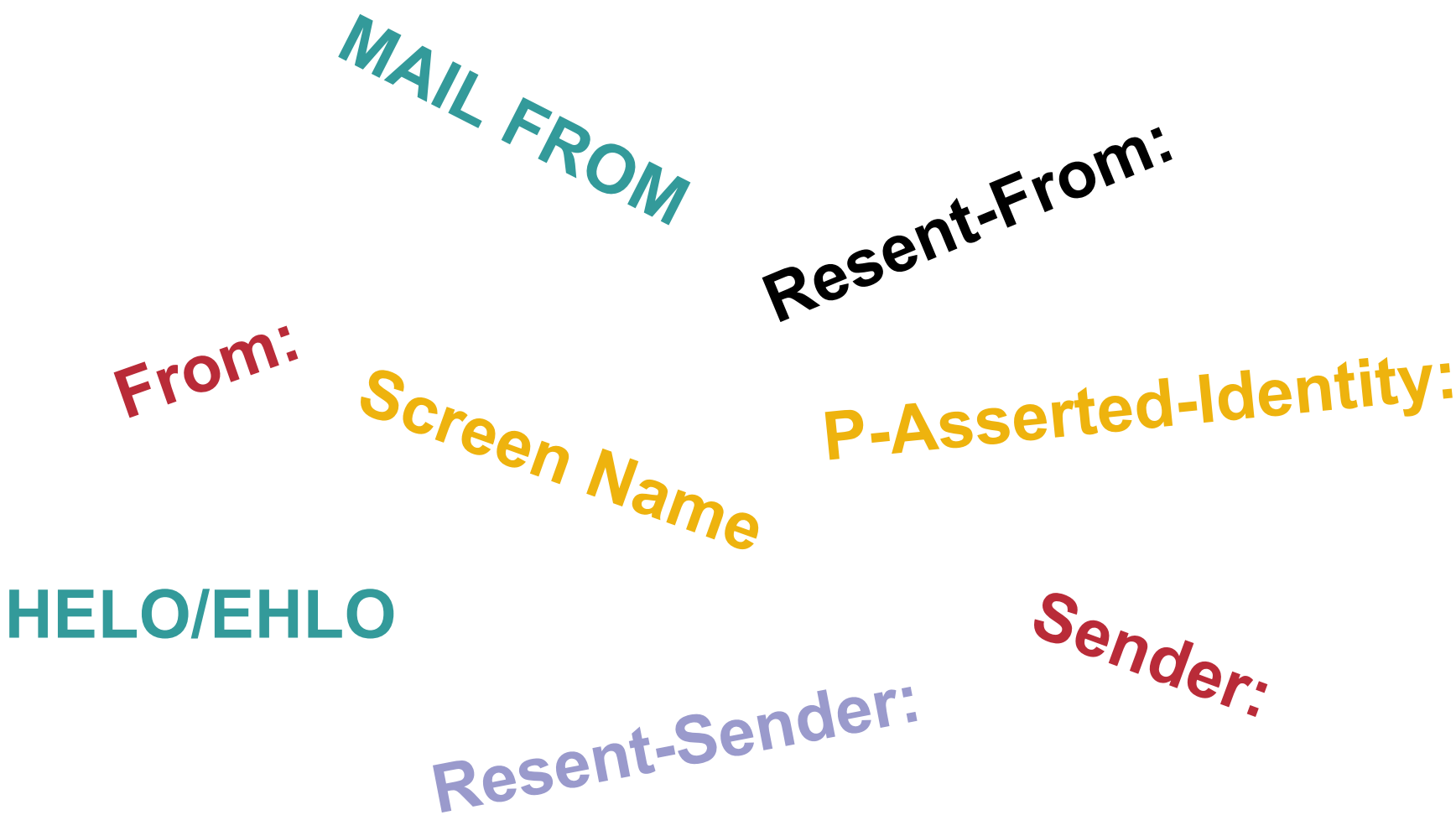
  Cyrillic small letter a (Unicode 0430)

- **Ambiguity is often font-dependent**

Some Terminology

- MTA (Mail Transfer Agent)—a “mail server”
- MUA (Mail User Agent)—what a user uses to send/receive mail
- Message Envelope—addressing information sent with a message
- Transparent forwarder—an MTA that resends a message without modification except to the envelope
- Phishing—use of e-mail to lead consumers to counterfeit websites (source: Anti-Phishing Working Group, antiphishing.org)

What Is a Message's Source?



Message Source

- A number of different “sources” may exist, with different semantics
- The semantics are inconsistently used, especially for email
  - Mailing lists add/modify headers differently
  - Different client software adds/uses different headers
  - Some header semantics rarely used, but “standard”

Source Address Characteristics From/Sender

- **From:**
  - **Most frequently displayed to recipient**
  - **Outlook typically displays only the “friendly” address, a problem for “John Chambers” <biff@hacker.com>**
  - **Rarely used, but From can contain multiple addresses, e.g.,**
    - **From: <castor@twins.org>, <pollux@twins.org>**
    - **Sender: indicates origin in this case**
- **Sender:**
  - **Indicates who injected the message**
  - **Mailing lists are considered an injection, so many rewrite or add Sender**

Source Address Characteristics (Cont.) Resent Fields

- Used to indicate messages that have been reinjected into the mail system
- Resent-From:

  Address(es) which reintroduced the message
- Resent-Sender:

  Specific address that reintroduced the message
- Since messages can be resent more than once, multiple blocks of Resent headers may exist

Source Address Characteristics Envelope

Envelope From

- Also referred to as “MAIL FROM”, “2821 From”
- Address to which bounce messages should be sent
- Null if the message is already a bounce
  - Don’t send bounces in response to bounces
- May be rewritten by mailing lists
  - Particularly if list owner should get the bounce messages
- Not usually rewritten by transparent forwarders
  - Unless ultimate recipient wants anonymity
- May be an unrelated address used to track bounces
  - Particularly used by some commercial bulk mailers

Source Address Characteristics HELO/EHLO Domain

- Characteristic of the sending MTA, not the message itself
- MTA identity is often significant
  - Good mail tends to come from good MTAs
  - And vice versa (zombies?)
- Allows name of the MTA to be determined and verified (without reverse DNS)
- Frequently mis-implemented or misconfigured in MTAs, currently with little effect
  - Should say “HELO <my name>”
  - But often say “HELO <your name>”

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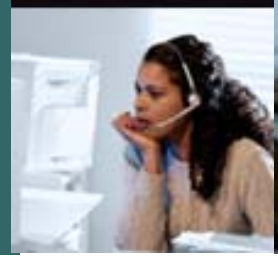
PATH-BASED TECHNIQUES



Path-Based Techniques: Introduction

- **Philosophy:**

  "All messages should come from an MTA authorized by the sending domain"

- **Predominant technologies**

  Sender Policy Framework (SPF)

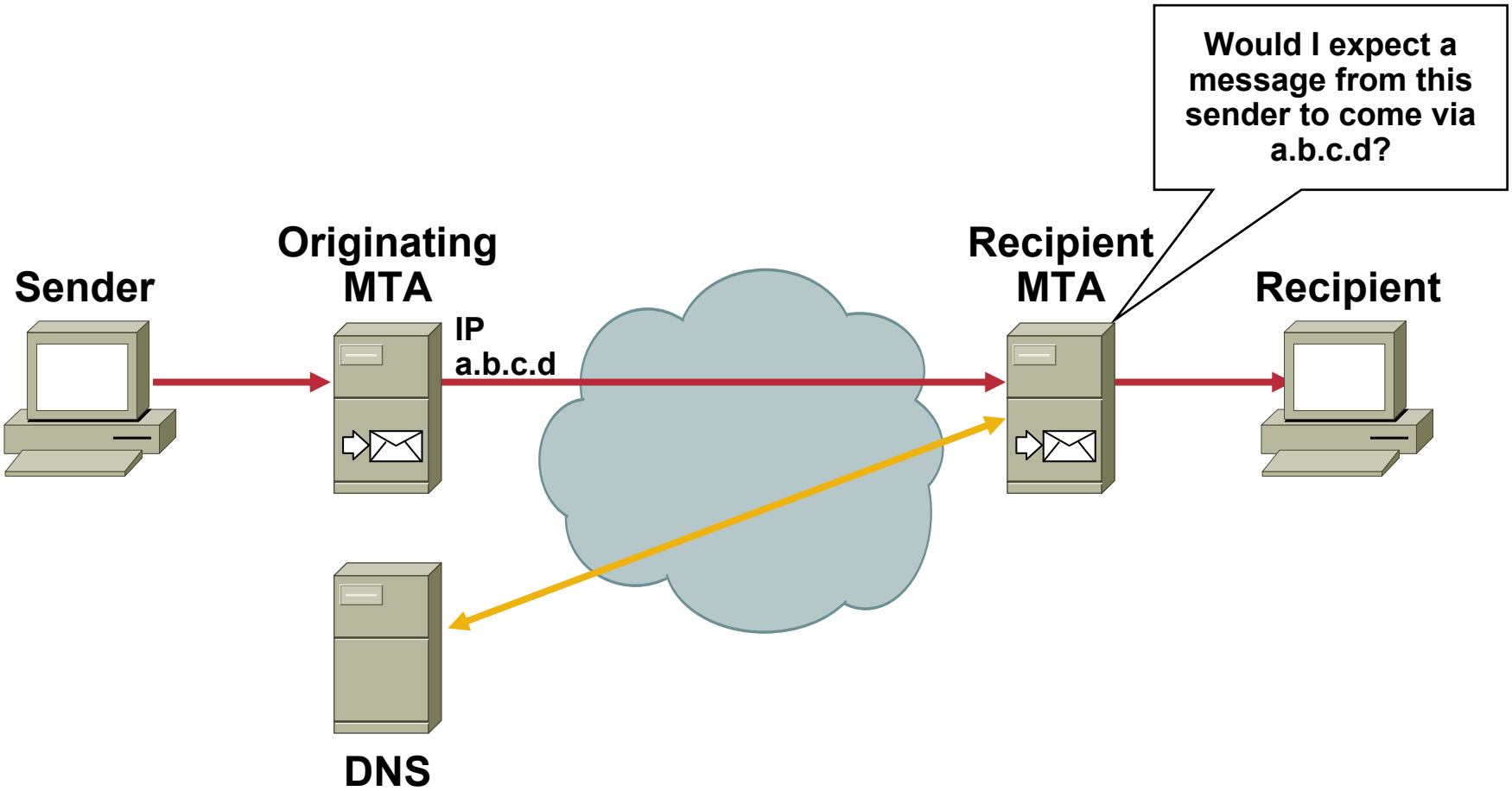
  Sender ID

- **SPF and Sender ID differ primarily on the message identity they use**

  SPF uses MAIL FROM address

  Sender ID uses selected header known as "Purported Responsible Address" (PRA)

Path-Based Techniques: General



How Path-Based Methods Work

- After (or if possible, during) receipt of a message, determine its origin address
  - Choice of origin address depends on method being used
- Look for a DNS TXT resource record from the originating domain
- If record exists, it gives information on outgoing mail servers used by that domain

SPF Record Format

v=spf1	Identifies the record as an SPF (version 1) record
a[:host.example.com]	Address the domain resolves to [or host.example.com resolves to] is valid
mx[:example.com]	Addresses corresponding to this domain's [or example.com's] Mail Exchanger records are valid
ptr[:example.com]	Addresses which reverse-resolve to an address in this domain [or example.com's domain] are valid
ip4:a.b.c.d/m	The address or subnet defined by a.b.c.d with netmask m are valid
include:example.com	Addresses permitted by example.com are valid

SPF Failure Types

?all	An SPF failure should be considered “neutral” (no information)
~all	Softfail: Messages should not be rejected on failure, but may be subjected to added scrutiny
-all	Hardfail: Messages may be rejected or subjected to added scrutiny

Sample SPF Record

Cisco's SPF Record:

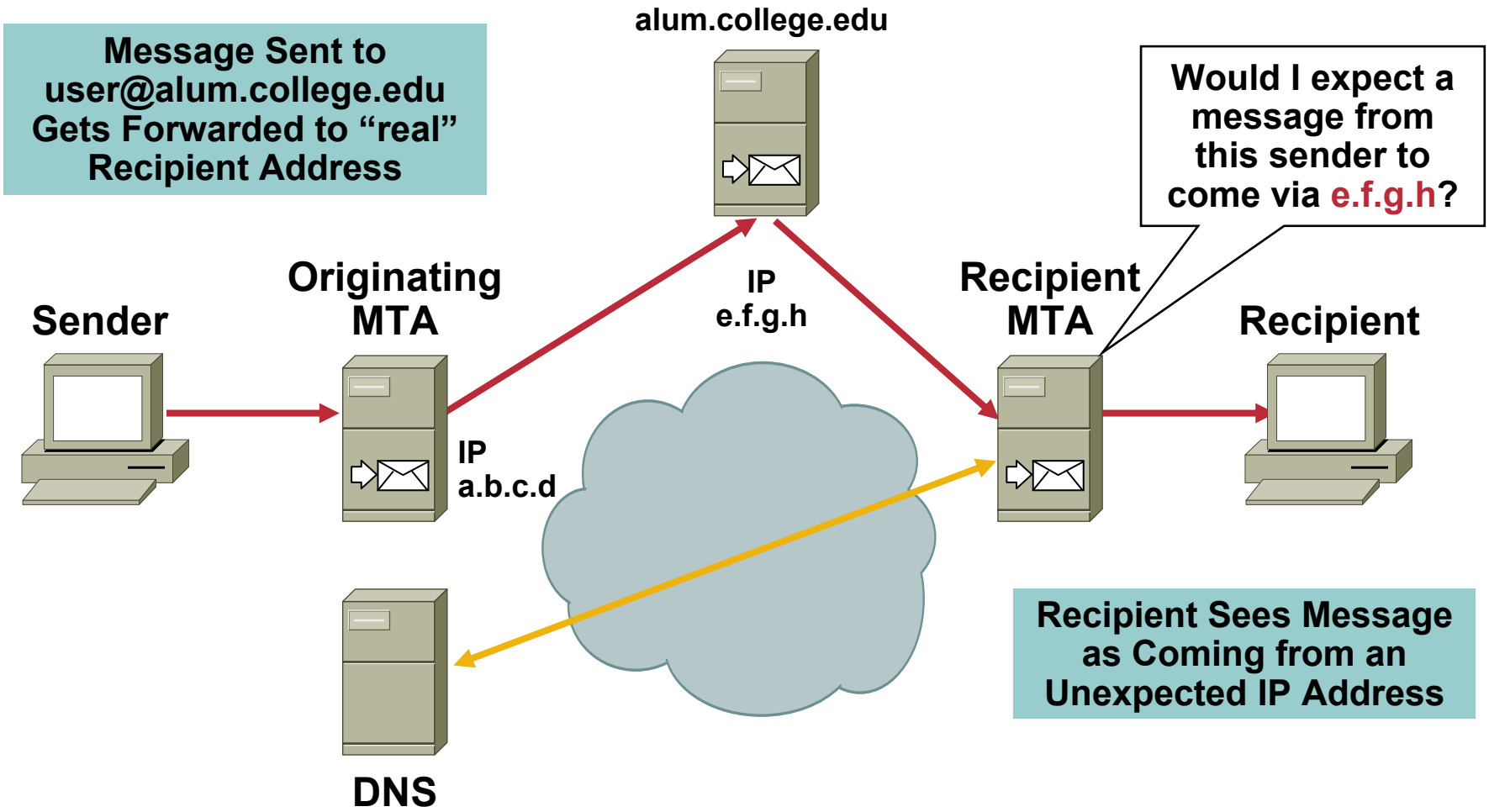
- cisco.com. IN TXT "v=spf1 ptr a:mustang1.netsolve.com ~all"

Field	Meaning
v=spf1	This is an SPF version 1 record
ptr	Any address which resolves to *.cisco.com is acceptable
a:mustang1.netsolve.com	Mail may also come from mustang1.netsolve.com
~all	Mail from other addresses should be treated with caution

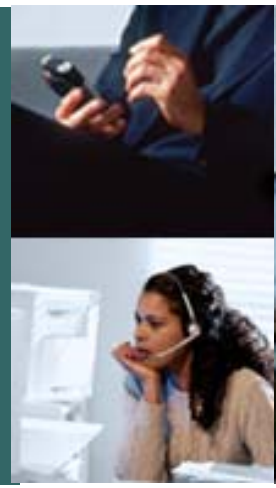
Purported Responsible Address (PRA)

- Used by Microsoft's Sender ID proposal to determine origin address
- Headers searched (approximate priority order):
  - Resent-Sender
  - Resent-From
  - Sender
  - From
- Details available at:
  - http://www.microsoft.com/mscorp/safety/technologies/senderid/resources.mspx
- Microsoft claims patent rights to the algorithm, but is licensing it under liberal terms

The Transparent Forwarding Problem



SIGNATURE-BASED TECHNIQUES

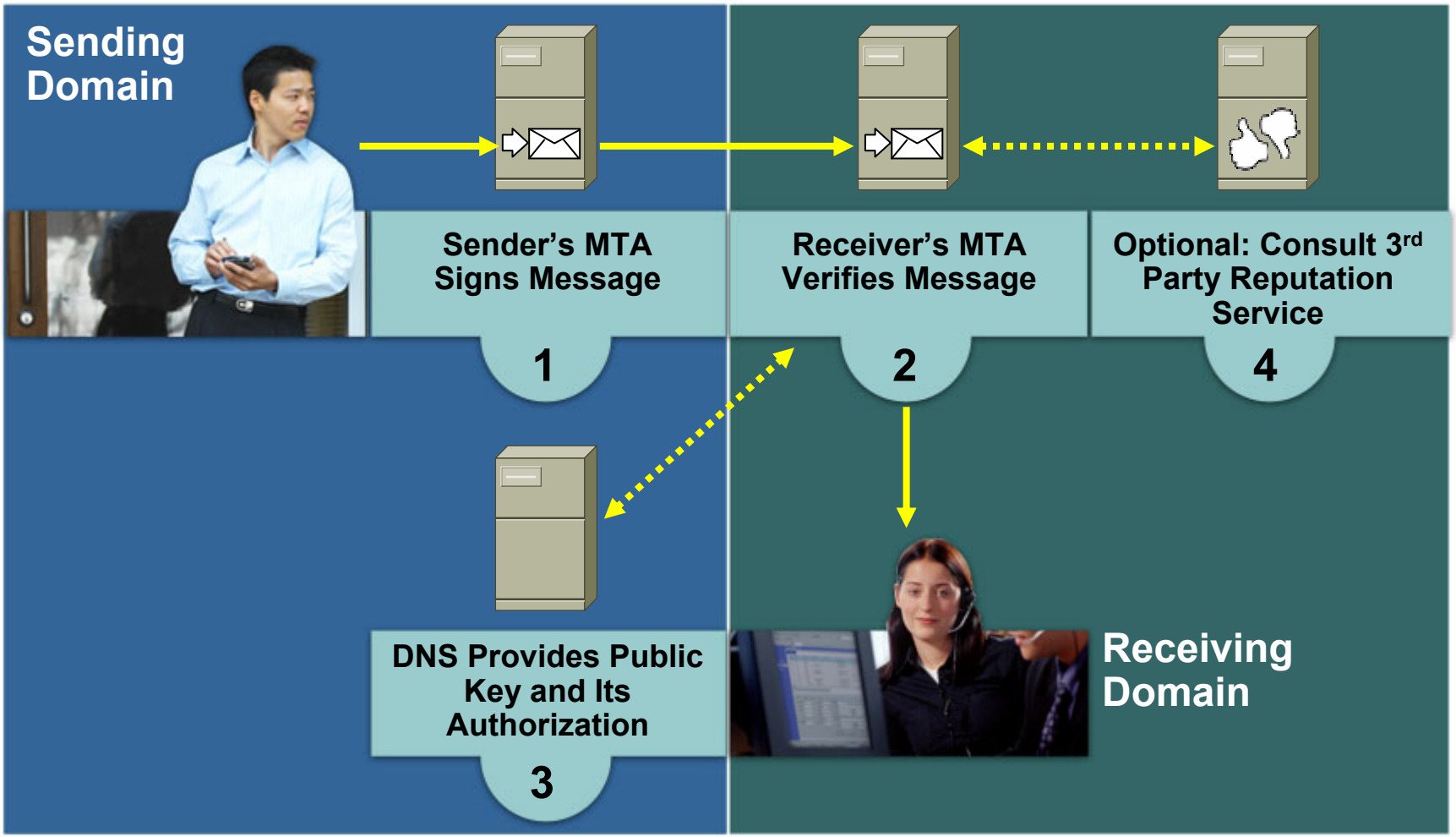


DomainKeys Identified Mail (DKIM)

- DKIM is a hybrid of two prior message signature proposals
  - Identified Internet Mail (Cisco)
  - DomainKeys™ (Yahoo!)
- Header-based signature intended to protect sender from spoofing, cut-and-paste attacks, etc.
- Minimizes changes to transport infrastructure between signer and verifier

DomainKeys is a trademark of Yahoo! Inc.

DomainKeys Identified Mail Explained



DKIM Characteristics

- **Signature appears as an additional message header**
  - **Generally ignored by non-signature-aware elements**
- **Signing and verification typically take place at MTAs, but may occur at MUA**
  - **May occur at any point within the trust domain of originator and recipient**
- **PGP signature over selected headers and body**
  - **Canonicalization may be used to allow “safe” modifications like spacing changes**

Authentication/Authorization Model

Messages Must Pass Two Tests Before They Are Authenticated

AUTHENTICATE THE MESSAGE

Receiving Domain Authenticates the Message—i.e. Verifies that the Message Was Not Altered in any Consequential Manner Prior to Reaching the Receiving Domain

AUTHORIZE THE SENDER

Receiving Domain Asks Sending Domain to Confirm that Whoever Signed the Message Was Authorized to Do So (Without Having to Identify the Sender)

Example of DKIM Signed Message


```
Subject: Sample message
From: John Doe <jdoe@example.com>
To: Mary Smith <msmith@example.net>
Content-Type: text/plain
Message-Id: <1098727240.13184.0.camel@lucid.example.com>
Mime-Version: 1.0
X-Mailer: Ximian Evolution 1.4.6 (1.4.6-2)
Date: Wed, 25 May 2005 11:00:40 -0700
Content-Transfer-Encoding: 7bit
DKIM-Signature: a=rsa-sha1; d=example.com; s=may2005;
  i=jdoe@example.com; c=nowsp; q=dns; t:1098727241; x:10988893641;
  h=Subject:From:Date;
   b=QQgUTUMvDA1BPxxIpSrAiAUXB5rtOt4tJT1BcN3zB01pUARhybDLGF7KLU7ens
  Wie1Zcm7+h5lfOhYvuy3DUTQ==;

Did you receive today's sales orders yet?

-John
```

What's in a DKIM Signature?

Tag	Meaning
v	Version (default = DKIM1.0)
a	Algorithm, e.g., rsa-sha1
b	Signature data
c	Body canonicalization, e.g., nowsp (default = simple)
d	Domain of signer
h	Signed headers
i	Identity associated with signature
q	Key query method(s) (default = dns)
s	Selector specifying key to use
t	Signature timestamp
x	Signature expiration time
z	Copied headers

What's in a DKIM Key Record?

Tag	Meaning
v	Version (default = DKIM1.0)
g	Granularity of key (user or all users)
k	Key type (default = rsa)
n	Human-readable notes
p	Public key data
s	Service type (default = any)
t	Flags, e.g., testing

- Records are stored in DNS TXT RRs at selector._domainkey.example.com
- Alternative RR types being discussed

Third-Party Signatures

- Sometimes a signature on behalf of other than the originator is useful/necessary
- Mailing lists need to sign when they modify messages
  - May also want to sign to indicate that message came through the mailing list
- Some services like Evite want to send messages on behalf of users, but will sign on its own behalf
- Risk: Messages may be signed by attacker "on behalf of" someone else without their authorization
- Mitigation: Attempt to display signer's identity to recipient if different from originator

Message Signing Policy

- **How should unsigned mail from the domain be handled?**
  - **If all messages are signed, unsigned ones are probably bogus**
  - **Otherwise they may be acceptable**
- **May also want to limit re-signing by third parties**
  - **Some senders are more interested in security than, for example, ability to traverse mailing lists**

Deploying Message Signing

- **Deploy a signature-capable MTA**
  - Major MTA appliance vendors are adding signature support
  - "Milter" API software available for sendmail
  - DomainKeys toolkit for other MTAs (e.g., qmail)
- **Generate and publish message signing keys**
  - Published in DNS records in a separate subdomain
  - May delegate key subdomain to mail administrators
  - Optional: publish a message signing policy
- **Tell users how to handle message verification results**

CERTIFIED SERVER VALIDATION (CSV)

Introduction to CSV

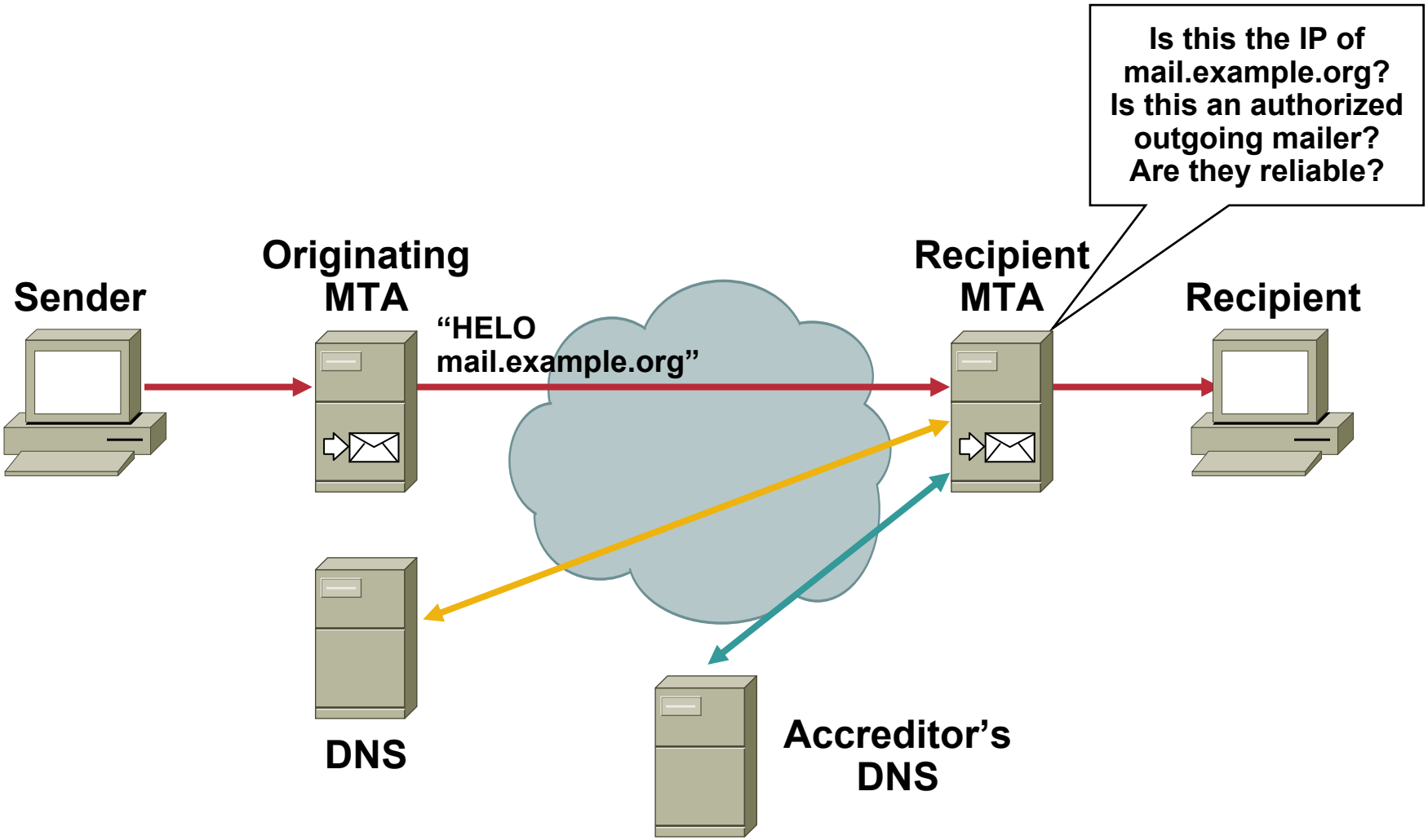
- **Philosophy: The reliability of the mail server correlates well with the desirability of the messages it sends**
- **Mail server identity is expressed in HELO/EHLO string**
- **CSV includes:**

  DNS authentication of HELO string (does HELO string translate to the address in use)

  DNS-based authorization mechanism (CSA)

  Accreditation mechanism (DNA)

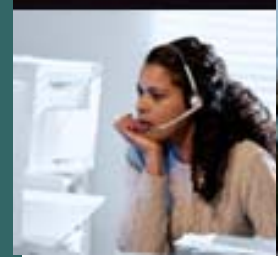
CSV Usage Example



CSV Issues

- **Many commercial MTAs mis-populate the HELO string because it doesn't currently matter**
  - **Receivers can't interpret a bogus HELO string as fraud**
- **Relatively large dependence on accreditation or reputation systems**

COMPARING MESSAGE AUTHENTICATION APPROACHES



Common Characteristics

- **All depend on DNS integrity**
  - **Theoretically insecure, but good in practice (so far)**
  - **DNSSEC is coming…someday**
- **None are 100% reliable**
  - **No single approach always works**
  - **Goal of rejecting messages is difficult to achieve**
  - **Much easier to make a positive than a negative assertion about a message**

Comparison Matrix

	SPF	Sender ID	DKIM	CSV
Classifies message before acceptance	✓			✓
Survives transparent forwarding			✓	✓
Minimal deployment requirements for sender	✓	✓		✓
User-level granularity			✓	
Mitigates message replays	✓	✓		✓
Deployable within recipient network			✓	
Some effectiveness before reputation deployed	✓	✓	✓	

Comparison Comments

- There is no clear winner or loser
- Authentication methods are complementary
  - Strengths of some are weaknesses of others

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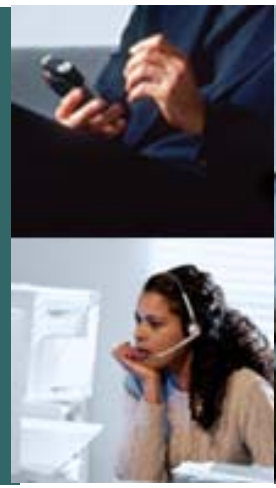
DEPLOYING MESSAGE AUTHENTICATION



What's Required to Deploy?

- All approaches require sender to publish some data in DNS
- Signature-based approaches (DKIM) additionally require signer to compute and attach signature
- All require software at the verifier to evaluate the message
- Typically a verification header is added to indicate the results downstream

  All approaches but DKIM need to be evaluated at the edge of the recipient domain

Software Availability

- Typically implemented by a plug-in to popular MTAs (e.g., sendmail's milter API)
- Open-source code available for several popular schemes
  - Sender ID milter available on Sourceforge
  - DKIM code under development, soon to be released
  - Exim patch for CSV

Resources: Technologies

- **Sender Policy Framework**

  http://spf.pobox.com/

- **Sender ID**

  http://www.microsoft.com/mscorp/safety/technologies/senderid/default.mspx

- **DomainKeys**

  http://antispam.yahoo.com/domainkeys

- **Identified Internet Mail**

  http://www.identifiedmail.com/

- **Certified Server Validation**

  http://www.mipassoc.org/csv/

Resources: Mailing Lists

- **IETF message authentication signature standards**

  http://www.imc.org/ietf-mailsig/index.html

- **SPF discussion**

  http://archives.listbox.com/spf-discuss@v2.listbox.com/

- **SPAM-L mailing list**

  http://peach.ease.lsoft.com/archives/spam-l.html

- **IETF-Clear mailing list (CSV, etc.)**

  http://mipassoc.org/mailman/listinfo/ietf-clear

Resources: Organizations

- **Messaging Anti-Abuse Working Group (MAAWG)**

  http://www.maawg.org/

- **APWG**

  http://www.antiphishing.org/

- **ASRG**

  http://asrg.sp.am/

- **IETF**

  http://www.ietf.org

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