Authenticated Received Chain Overview

DMARC.org

Introduction to DMARC.org

The mission of DMARC.org is to promote the use of DMARC and related email authentication technologies to reduce fraudulent email, in a way that can be sustained at Internet scale. This overall goal is met by educating individuals and organizations through a combination of articles, tutorials, and presentations.

For more information, please visit https://dmarc.org

DMARC.org is an initiative of the non-profit Trusted Domain Project (TDP).
For more about TDP, please visit http://trusteddomain.org

Introduction to DMARC.org

The work of DMARC.org is made possible through the generous support of these companies:

Sponsors

Supporters

Background

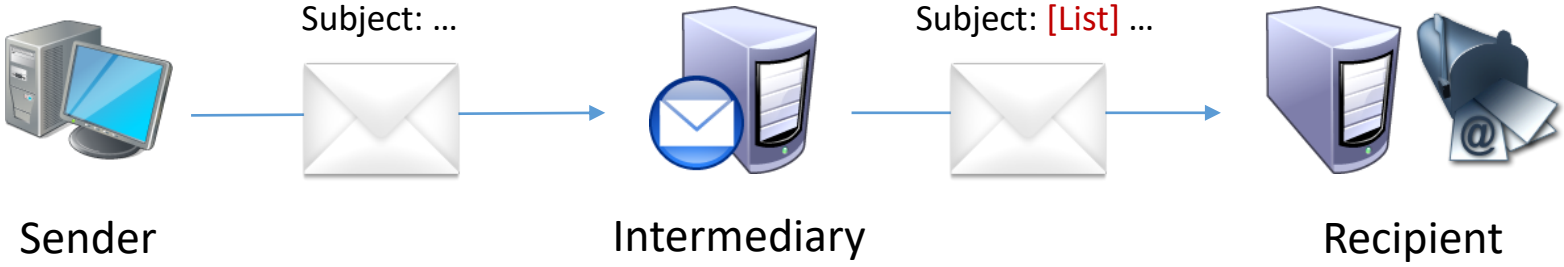
What Was Done Before ARC?

- Previous work had been done on a header to convey authentication results between domains (ADMDs)
- Original Authentication Results (OAR) was published as an Internet Draft in February 2012
- Assumes trust between ADMDs – not widely used
- Some large enterprises used it internally
- Might address issue some domains using DMARC experienced with *indirect mailflows*

Connection Between ARC and DMARC

- Domains with strict DMARC policies (`p=reject`) may see legitimate messages blocked if they go through *indirect mailflows* such as mailing lists, forwarding, or filtering services
- Forwarding causes SPF to fail even if origin was legit
- Forwarders often alter messages, breaking DKIM
  - Disclaimers and footers
  - Virus scan results
  - Removed attachments
  - Mailing list subject tags

Example of an Indirect Mailflow



- Intermediary sends the message from a new IP address, causing SPF to fail to verify for Sender's domain
- Intermediary changes the message contents, causing Sender's DKIM signature to fail to verify

Why Was ARC Created?

- Indirect mailflows always posed this challenge with DMARC – what changed?
- In April 2014, AOL and Yahoo published a `p=reject` DMARC policy for their customer-use domains
- While this affected less than 1% of their customers' email, there was significant disruption for many users of indirect mailflows
- Ad hoc working group formed to adapt OAR to address these disruptions of indirect mailflows
- Significant changes required for a general solution, so a new name was chosen

Design Decisions for ARC

- Originator of message makes no changes
- Convey the `Authentication-Results`: content intact from the first ARC intermediary forward
- Allow for multiple “hops” in the indirect mailflow
- ARC headers can be verified at each hop
- Work at Internet scale
- Define ARC independently of DMARC if possible

Design Decisions for ARC

- Message recipient seeing an authentication failure under DMARC may choose to check ARC headers
- If ARC headers are intact, they can see and validate `Authentication-Results`: content reported by the ARC participants
- Depending on reputation of intermediary/-ies and results, message recipient *may* choose to use ARC information as basis for a “local override” of authentication checks like DMARC

What Does ARC Do?

- Intact ARC chains give you:
  - DKIM, DMARC and SPF results as seen by first “hop”
  - Signatures showing these results were conveyed intact
  - Signatures from participating intermediaries can be reliably linked to their domain name
- Allows intermediaries to alter message with attribution
- ARC can provide data on intermediaries to a reputation system tracking their behavior

What Doesn't ARC Do?

- Does not say anything about "trustworthiness" of the message sender or intermediaries
- Says nothing about the contents of the message
- Intermediaries might still inject bad content
- Intermediaries might remove some or all ARC headers

Implementation

Three New Header Fields

- `ARC-Authentication-Results:` (AAR)
  Archived copy of `Authentication-Results:`
- `ARC-Seal:` (AS)
  Includes some tags and a DKIM-style signature of any preceding ARC headers/sets
- `ARC-Message-Signature:` (AMS)
  A DKIM-style signature of the entire message except `ARC-Seal:` headers

ARC-Authentication-Results: (AAR)

- Copy/consolidation of the contents of the locally generated `Authentication-Results:` header
- One addition – the **i=** tag is prepended, containing a sequence number for the current set of ARC headers

ARC-Message-Signature: (AMS)

- A modified DKIM signature – leverages existing libraries
- **i=** tag is different – under ARC, a sequence number for ARC header sets
- **v=** tag is missing in ARC
- Should not be usable as a DKIM signature in a replay attack

ARC-Seal: (AS)

- Populated with *key=value* pairs
- **b=** is a signature of all ARC headers, no non-ARC hdrs
- **a=/d=/s=** fields match the corresponding DKIM tags
  - Same key format and DNS records as for DKIM
  - Can use your DKIM keys for ARC
  - Can use separate keys per local policy or preference
- **cv=** indicates whether ARC chain validated as received by the reporting intermediary
- **i=** tag is a sequence number for ARC header sets

Order of Insertion

- `Authentication-Results`: content is copied into a new `ARC-Authentication-Results`: header, prefixed to the message
- `ARC-Message-Signature`: is calculated for message, including newest AAR header, and prefixed to the message
  - Must not include any `ARC-Seal`: headers
- `ARC-Seal`: is calculated and prefixed
- ARC headers prefixed per common practice, but order of appearance is not critical for validation

The **i=** Sequence Number

The **i=** sequence tag is used to order the ARC headers for various operations

- Allows multiple ARC header sets to be grouped easily and correctly
- Eliminates reliance on the order of headers being inserted – or not being altered
- Compare with order of insertion of various authentication, content scanning, or `Received:` headers

What Constitutes A Valid ARC Chain

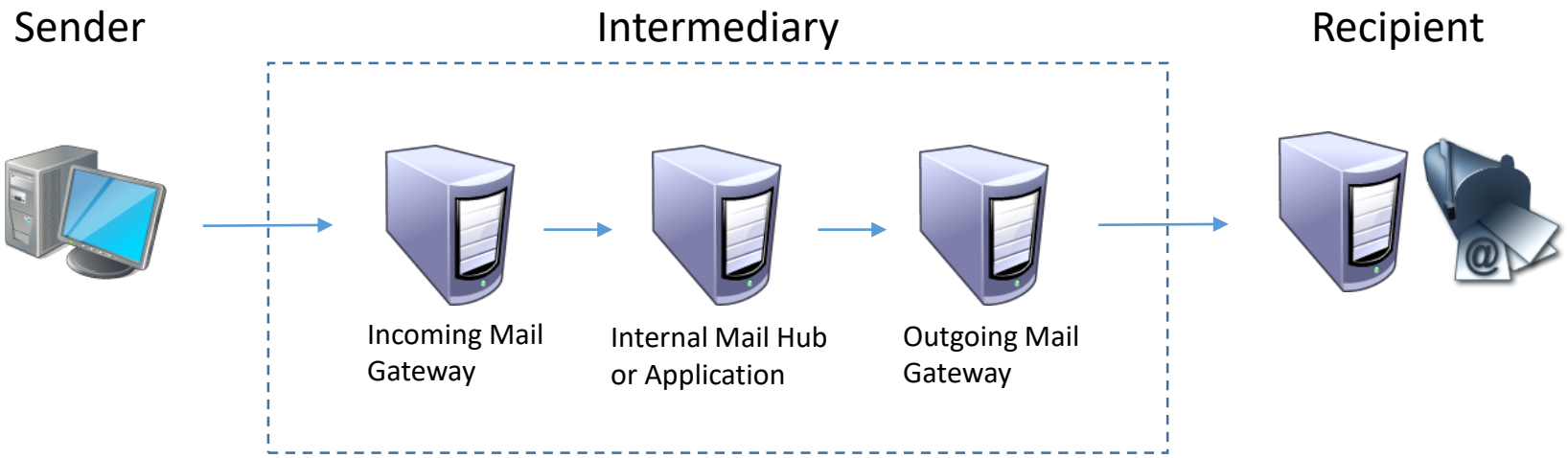
Method used by each participant to determine the **cv=** value in their `ARC-Seal`:

- All `ARC-Seal`: headers must validate
- The **cv=** value for those AS headers must be Pass
- The most recent `ARC-Message-Signature`: (highest **i=** value) must validate

When Would I Insert ARC Headers?

- When a message is subject to handling that will knowingly break existing DKIM signatures
  - Inserting `Subject`: tags
  - Appending disclaimers and footers
  - Stripping attachments
  - Content-encoding changes
- When the message crosses a trust boundary, which might occur exiting an ADMD
  - Sometimes within, e.g. a multi-department or multi-entity enterprise

When Would I Insert ARC Headers?



Incoming Gateway validates ARC, DKIM, DMARC, SPF normally

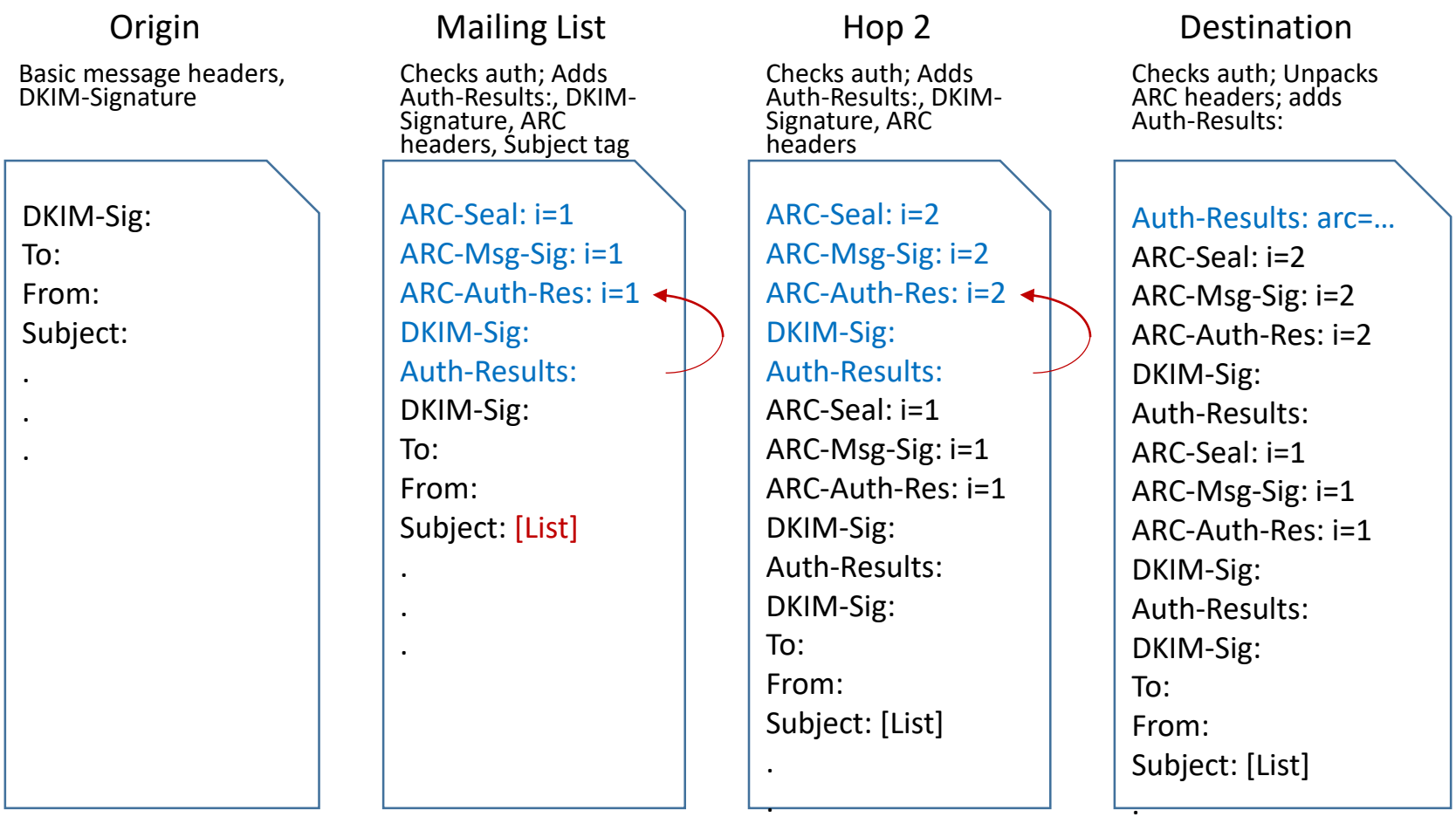
Outgoing Gateway inserts DKIM signature, inserts ARC headers

Different organizations will have different configurations, but still check ARC on inbound messages and insert ARC when messages are outbound

When Wouldn't I Insert ARC Headers?

- When the message will be delivered to a mailbox within the local organization (ADMD)
- ARC builds a verifiable chain of intermediate message handlers – anonymous remailers might not find this desirable…?

What Do ARC Headers Look Like?



What Do They Really Look Like?

```
X-Received: by 20.30.40.11 with SMTP id u204mr8130724ywa.51.1466170851933;
        Fri, 17 Jun 2016 06:40:51 -0700 (PDT)

ARC-Seal: i=1; a=rsa-sha256; t=1466170851; cv=none;
         d=example.com; s=arctest;
         b=xe+jRquPNixNhesh5fostFt7OsrGic+UDHg9ZEnoM/lVyuT+vamXYq+ajRzeoHzkIQ
         qRqpka375Th/wZBCWPYyByFYT17kv/s/0w5TesTSYXxOtO2uGeGoyeg2ekXEdL2z3UxT
         cKIYtAmH7454+a/TVWB7tsm6LlvWSo8bwZMi0vN5YduhSTFOA8bLXq4hEAHkp2xm0xW+
         6fOHAcYIppRKAcF52WRdCKU5rGli+3bVj8mKaHFu+2TChaY9N6bubnR0LqmPkJ64KNhg
         3LvHA4fRSazTblTpdM3n0bEln/mhek1GwUTtsTi03viMbKBu58izA2oN+U2rz9HcAXC3
         Sneg==

ARC-Message-Signature: i=1; a=rsa-sha256; d=example.com; s=arctest;
         h=auto-submitted:subject:from:to:date:message-id:arc-authentication-results;
         bh=5BoDhYVbcbDAJ0VNngnjGAxJHFj24gqA3V1CMwjydl0=;
         b=2iotKbPydBaJ6yyAs3/2gcSJbumGYpN7GRH3lBs9NfU0FTmkikODOrg6KvIkHvUyzU
         7Baf3WoCoCDulCSp1AK/cCOxcyJ5xshuyOhS0e335/Xe8EzwH34w/W1iQsFjdI+CMDbN
         ww7GuCSTRv3SzHLlhVQK3ldLbAldrPsMSs6J8XtwovtJvkreWJWk+lOkQL7UhM8qHhQZ
         AsJ9plKBkzVhl+RCCc1qDXZxNraSVZZ48LYK8m7t9VQhQqJLnXb9OcrxrgMtzl3FQv0x
         qPddkAGzL8PwvFZo/U1Ga3Bw4q6eE6ZmdOIwCNj/9Bpy8ZLa3Ob2ra3YVx0NN3hvoJFg
         uT5Q==

ARC-Authentication-Results: i=1; mx.example.net;
         spf=pass (example.net: domain of kurta+arc@example.org designates 10:20:30:40::1 as
permitted sender) smtp.mailfrom=kurta+arc@example.org;
         dmarc=pass (p=NONE dis=NONE) header.from=example.org;
         arc=none

X-Received: by 10.20.30.100 with SMTP id l4mr2422268wjf.118.1466170851297;
         Fri, 17 Jun 2016 06:40:51 -0700 (PDT)

Return-Path: <kurta+arc@example.org>

Received: from mango.example.org (mango.example.org. [10:20:30:40::1])
         by mx.example.net with ESMTP id f67si23622388wmf.85.2016.06.17.06.40.50
         for <arc-mod-subject@example.com>;
         Fri, 17 Jun 2016 06:40:50 -0700 (PDT)
```

How Are ARC Verdicts Shown?

- `arc=pass` or `arc=fail` may be inserted into `Authentication-Results:` headers
- DMARC-aware receivers who validate ARC results should include ARC information in DMARC aggregate reports, `local_policy` section:

```
<reason>
  <type>local_policy</type>
  <comment>arc=pass ams=d1.example d=d1.example,d1.example</comment>
</reason>
```

- `ams=` is the **d=** domain from the last AMS header
- `d=` is the list of **d=** domains from validated `ARC-Seal:`

Summary

Benefits of ARC

Sender/Intermediary Benefits

- Allow intermediaries to continue and/or resume traditional `From:` semantics, message modifications
- Allow more senders to adopt strict DMARC policies, block more fraudulent messages
- Improves overall deliverability

Receiver Benefits

- Less stress for receivers who enforce DMARC policies
- Allow more mailbox providers to publish strict DMARC policies on their customer-facing domains
- More data for reputation system(s)

ARC Timeline

- October 2015:
  - Announcement at M^{3}AAWG 35 in Atlanta, draft docs published
- Fall 2015 – Spring 2016:
  - AOL, GMail, and OpenARC implementations: initial development
- March-April 2016
  - Updates to the specification
- June 2016
  - ARC specification & usage docs adopted by IETF DMARC WG
- February - October 2016
  - Periodic interoperability tests
- 4Q 2016
  - Initial public releases of open source code anticipated

ARC Resources

- Website for latest ARC news: http://arc-spec.org
- Mailing List for discussion of ARC: http://lists.dmarc.org/mailman/listinfo/arc-discuss
- Specification, current draft: https://tools.ietf.org/wg/dmarc/draft-ietf-dmarc-arc-protocol/
- Usage Guidelines, current draft: https://tools.ietf.org/wg/dmarc/draft-ietf-dmarc-arc-usage/

Questions