Authenticated
Received
Chain

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Tuesday, May 10th, 2016
Palo Alto, California

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

DMARC

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Background

Why Was ARC Created?

- Previous work had been done on a header to convey authentication results between 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

Why Was ARC Created?

- Domains with strict DMARC policies (`p=reject`) may see legitimate messages blocked if they go through *indirect mailflows* such as mailing lists or forwarded mailboxes
- In 2014 AOL and Yahoo published `p=reject` for customer-use domains
- Working group formed to adapt OAR to address these *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
- 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 may choose to check ARC headers
- If ARC headers are intact, they can see and validate `Authentication-Results`: content from first participant
- Depending on reputation of intermediary/-ies and results, they *may* use ARC information as basis for a "local override" of authentication checks

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 some attribution
- ARC can provide input to a reputation system that includes intermediaries

What Doesn’t ARC Do?

- Does not say anything about “trustworthiness”
- Says nothing about the content 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 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
- **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
  - *SMJ*: I recommend a separate key per best practices
- **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
- `ARC-Message-Signature`: is calculated for message, including newest AAR header, and prefixed
  - 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 headers to be grouped 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 A Valid ARC Chain Looks Like

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

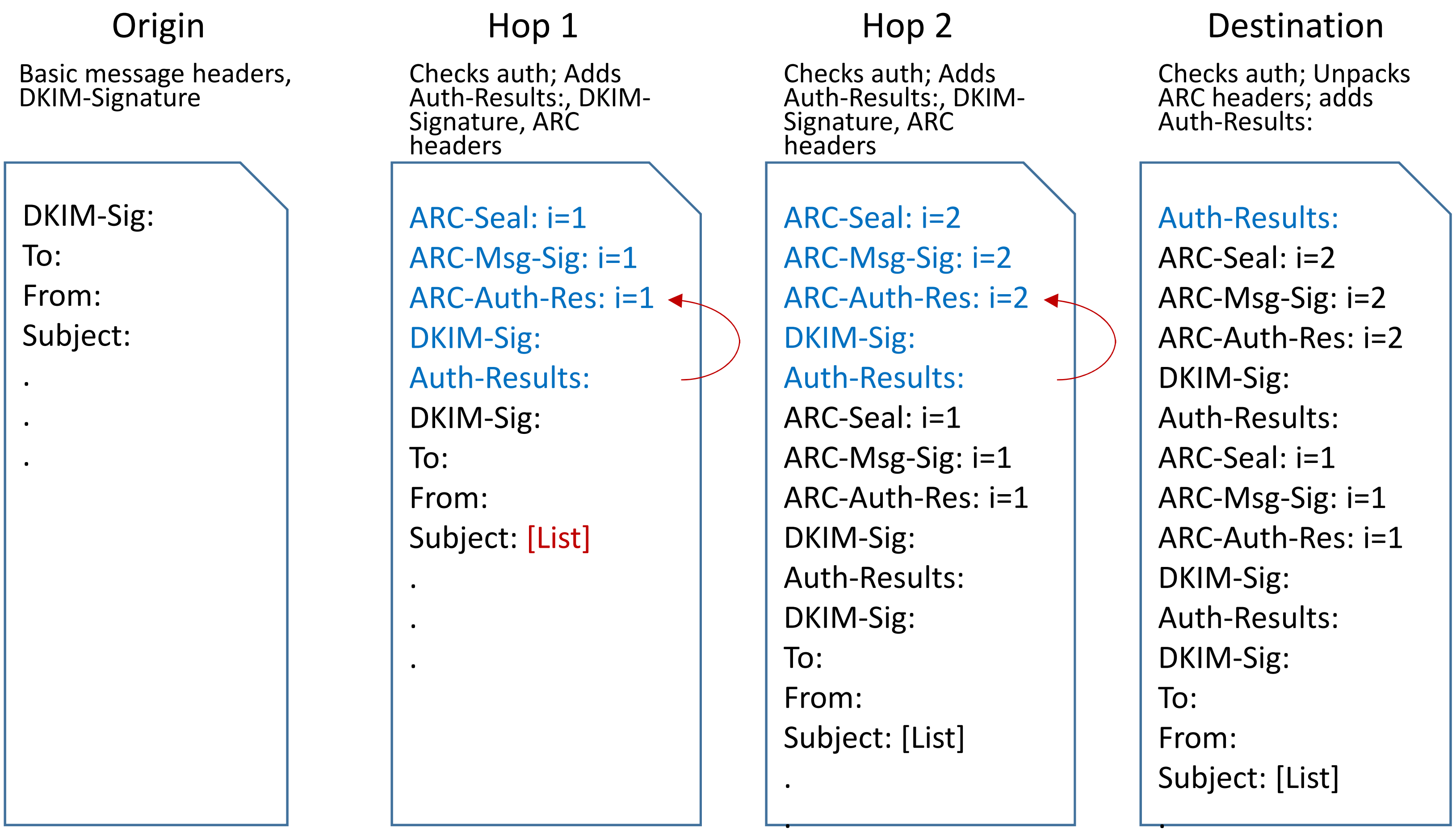
When Would I Insert ARC Headers?

- 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 within a given ADMD
  - Multi-department or multi-entity enterprise

When Wouldn’t I Insert ARC Headers?

- ARC builds a verifiable chain of intermediate message handlers
- Anonymous remailers would not find this helpful
- *Other examples?*

What Does ARC Look Like?



Origin

Basic message headers, DKIM-Signature

DKIM-Sig:
To:
From:
Subject:
.
.
.

Hop 1

Checks auth; Adds Auth-Results:, DKIM-Signature, ARC headers

ARC-Seal: i=1
ARC-Msg-Sig: i=1
ARC-Auth-Res: i=1
DKIM-Sig:
Auth-Results:
DKIM-Sig:
To:
From:
Subject: [List]
.
.
.

Hop 2

Checks auth; Adds Auth-Results:, DKIM-Signature, ARC headers

ARC-Seal: i=2
ARC-Msg-Sig: i=2
ARC-Auth-Res: i=2
DKIM-Sig:
Auth-Results:
ARC-Seal: i=1
ARC-Msg-Sig: i=1
ARC-Auth-Res: i=1
DKIM-Sig:
Auth-Results:
DKIM-Sig:
To:
From:
Subject: [List]
.
.

Destination

Checks auth; Unpacks ARC headers; adds Auth-Results:

Auth-Results:
ARC-Seal: i=2
ARC-Msg-Sig: i=2
ARC-Auth-Res: i=2
DKIM-Sig:
Auth-Results:
ARC-Seal: i=1
ARC-Msg-Sig: i=1
ARC-Auth-Res: i=1
DKIM-Sig:
Auth-Results:
DKIM-Sig:
To:
From:
Subject: [List]
.

How Are ARC Verdicts Shown?

- `arc=pass` or `arc=fail` may be inserted into `Authentication-Results`: headers

- DMARC-aware receivers who incorporate ARC results should include ARC information in 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

- d= is the list of **d=** domains from validated `ARC-Seal`:

Summary

Benefits of ARC

Sender/Intermediary Benefits

- Allow more senders to adopt `p=reject` DMARC policies, block fraudulent messages
- Allow intermediaries to continue or resume traditional `From:` semantics, message modifications
- May improve deliverability

Receiver Benefits

- Allow more receivers to enforce DMARC policies
- Allow more mailbox providers to publish `p=reject` policies on their customer-facing domains
- More data for reputation systems

ARC Timeline

- October 2015:
  - Announcement at M^{3}AAWG 35 in Atlanta
  - Draft specification and usage doc published as IETF Internet-Drafts
- Fall 2015 – Winter 2016:
  - AOL, GMail, and OpenARC implementations developed
- February 2016
  - Interoperability event #1
- March-April 2016
  - Updates to the specification
- May 2016
  - Interoperability event #2
- June-July 2016
  - Interoperability event #3

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/html/draft-andersen-arc-04
- Usage Guidelines, current draft: https://tools.ietf.org/html/draft-jones-arc-usage-01

Questions