Sender Authentication Technology Update

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JPAAWG 2nd General Meeting

ベルサール飯田橋ファースト B1F

2019.11.14

Session A7, Hall A

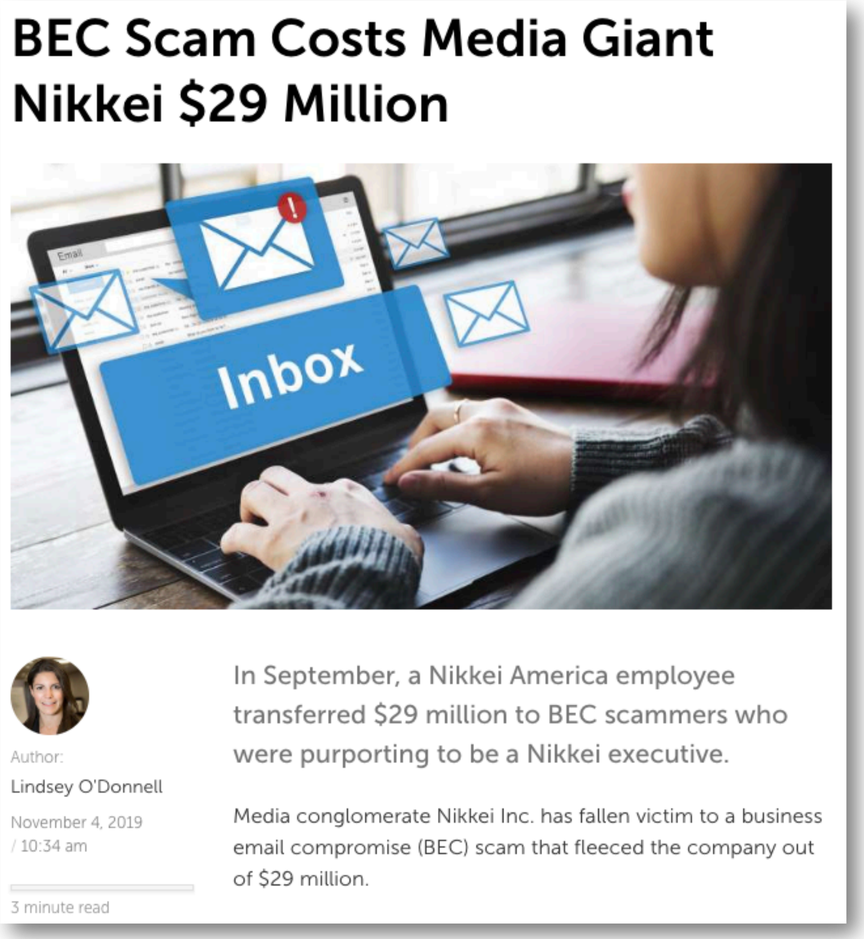
Topics

- Why Do We Focus On Sender Authentication?
- Standards and Protocols
- DMARC Use Update
- Common Problems With DMARC Records

Why Do We Focus On Sender Authentication?

- Easier To Identify Legitimate Email
- Best Practices = Better Delivery
- Undelivered Mail = Wasted ¥

- Criminals Exploit Email Effectively
  - Phishing is #1 Cause - Data Breach
  - Business Email Compromise



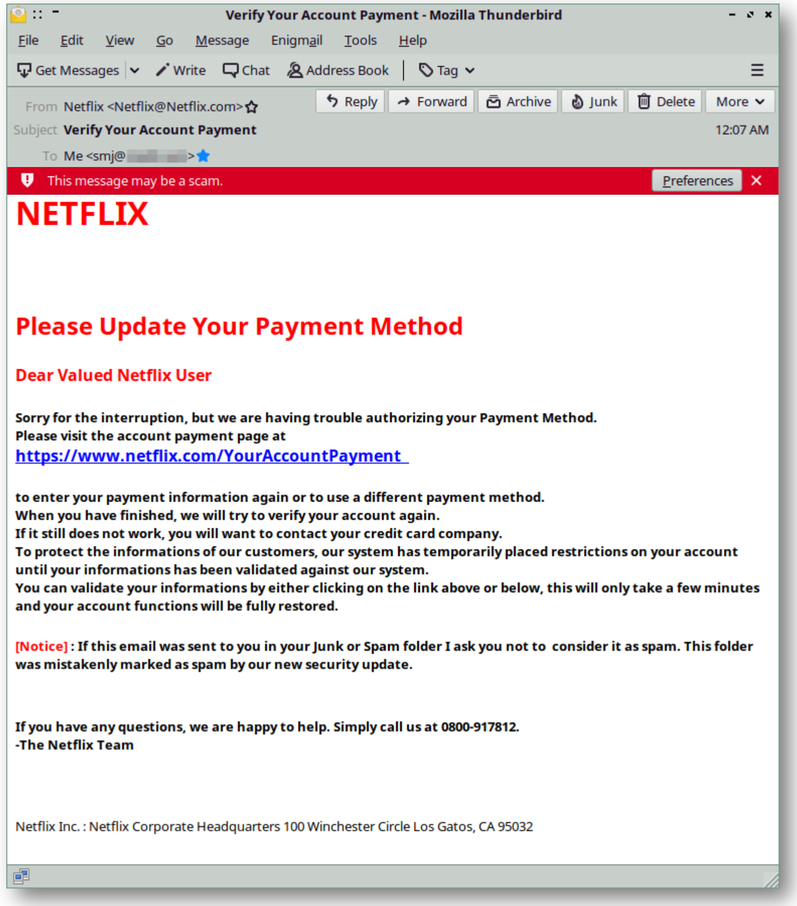
BEC Scam Costs Media Giant Nikkei $29 Million

Author:
Lindsey O'Donnell
November 4, 2019 / 10:34 am
3 minute read

In September, a Nikkei America employee transferred $29 million to BEC scammers who were purporting to be a Nikkei executive.

Media conglomerate Nikkei Inc. has fallen victim to a business email compromise (BEC) scam that fleeced the company out of $29 million.

Easier Detection, Better Protection



From: Netflix <Netflix@**Netflix.com**>

Authentication-Results: *XXX.XXXXX*.com/xACJ8inv058374;

dmarc=fail (p=reject dis=none) header.from=Netflix.com

Authentication-Results: *XXX.XXXXX*.com; **spf=fail** smtp.mailfrom=Netflix@Netflix.com

Authentication-Results: *XXX.XXXXX*.com; **dkim=pass** (2048-bit key; unprotected)

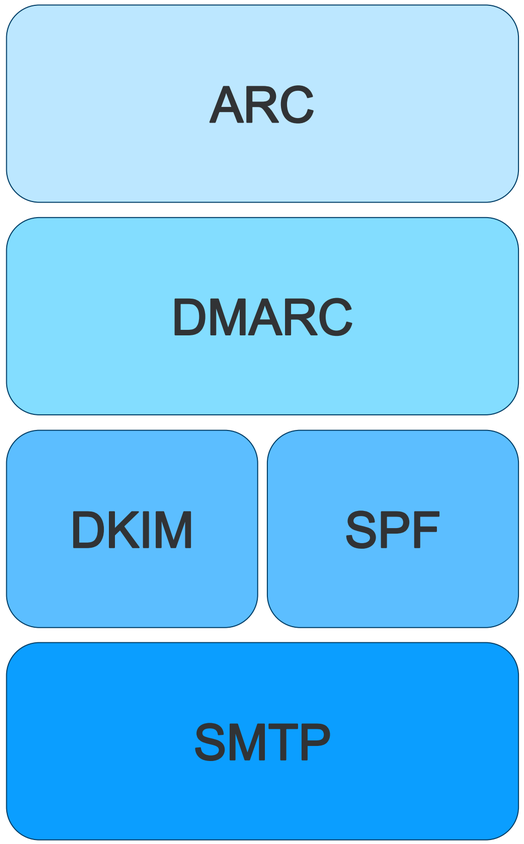
header.d=uttarauniversity.edu.bd header.i=@uttarauniversity.edu.bd

header.b=kU8F/hqO

- Consistent authentication makes your legitimate email stand out, easy to model
- Machine Learning leverages this to detect cousin domains / “display name” attacks

Standards and Protocols

Overview of Common Protocols



- Sender Policy Framework (SPF)
  RFC 7208
- Domain Keys Identified Message (DKIM)
  RFC 6376
- Domain-based Message Authentication, Reporting & Conformance (DMARC)
  RFC 7489
- Authenticated Received Chain (ARC)

Refining Protections Over Time

SPF: Combat “backscatter” from spamming — 2002 – 2004

- Left header From: unprotected
- Easily misconfigured, rarely enforced

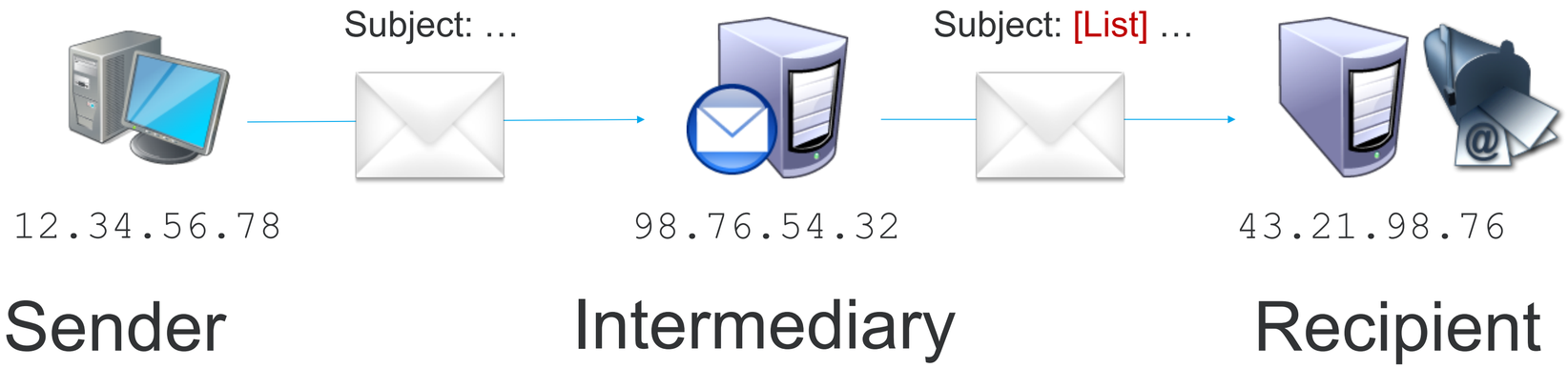
DKIM: Protect header From:, message forgery — 2004 – 2007

- No accepted policy mechanism
- Third-party signatures problematic

DMARC: Has policy mechanism, enforced at ISP — 2009 - 2015

- Cousin domains and “display name” attacks
- Problems with mailing lists, forwarding

Example of an Indirect Mail Flow



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

ARC Protocol

- ARC assists with authentication of “indirect mailflows”
- Under development since 2014
- Part of the IETF DMARC Working Group since 2016
- 8+ Interoperability testing sessions
- Draft of Usage Guide / FAQ available

ARC Published As RFC 8617 on 2019.07.09

ARC Implementations

- FastMail, Google, Microsoft – hosted email services
- Cloudmark ,Halon, MailerQ and MessageSystems (SparkPost) – Mail Transfer Agent (MTA)
- Mailman and Sympa - Mailing List Manager (MLM)
- Free Software – dkimpy, Mail::DKIM, OpenARC
- More at `arc-spec.org` → Resources

Microsoft and ARC

- 2019.10.24 – Announces ARC support on Microsoft 365 Roadmap
- Testing in May 2019
- Began using production key in July
- Messages from many Office 365 tenants sent with ARC headers since July

Looking For Users of ARC

- ARC supports mailing lists – look there
- `arc-discuss@dmarc.org` mailing list
  - First message 2018.01.31 from an OpenARC user
  - 8.6% of posts have included an ARC Seal
- IETF's `ietf@ietf.org` mailing list
  - First message 2019.06.25 from Office 365 customer
  - 4.7% of posts have included an ARC Seal

RFC 8616: Email Authentication for Internationalized Mail

- Use of Unicode characters in domains and email addresses has been evolving
- RFC 8616 updates the core SPF, DKIM and DMARC specifications to clarify which form of Internationalized Domain Name (IDN) each uses
- Published on 2019.06.30

名がドメイン.co.jp

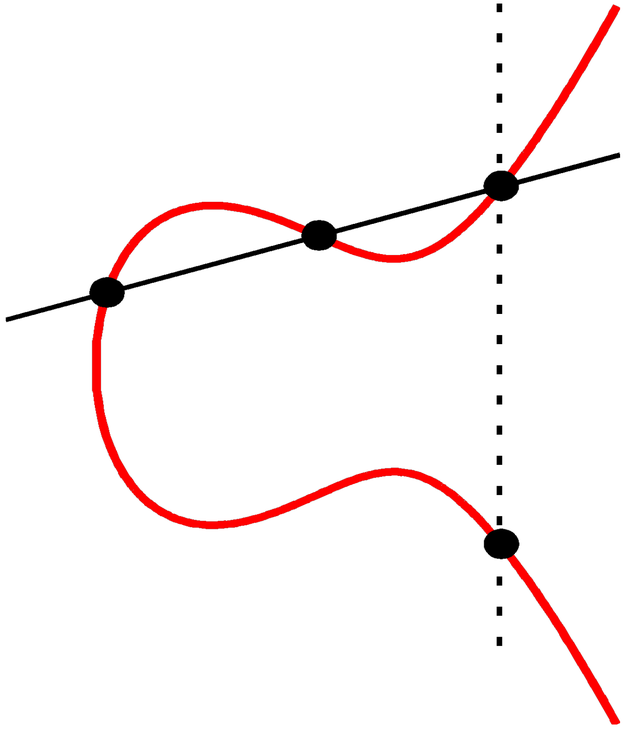
xn--v8jxj3d1dzdz08w.co.jp

DMARC and Public Suffix Domains

- Allow for DMARC to be applied at ccTLD, like `.uk` or `.jp`
- Also cover intermediate domains, ex. `gov.uk`
- Allow TLDs to have a DMARC policy for *non-existent* domains, ex. `nodomain.gov.uk`
- Proposed at M^{3}AAWG 44 (Brooklyn) in 2018.10
- Several revisions in the IETF DMARC Working Group
- Nearing publication (as of November 2019)

Cryptography Changes From 2018

Changes in DKIM Cryptography (RFC 8463)



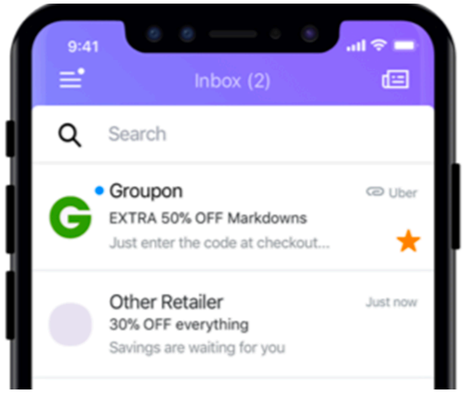
- RSA algorithm was deprecated under RFC 8017
- Elliptic Curve signing algorithm standardized under RFC 8031
- DKIM may now use PureEdDSA variant Ed25519
- Smaller keys for equivalent strength

Quantum Computing and Encryption

- 2019.10.23 – Google claims “Quantum Supremacy”
- What are the implications for traditional cryptography
- M3AAWG 46 (Montreal) had sessions on this topic
- Impacts most online activity, communications
- Directly impacts DKIM and ARC; indirectly DMARC
- How quickly can the IETF address this issue?

BIMI

- Brand Indicators for Message Identification (BIMI)
- Email clients would show sender's logo with messages
- Entrust Datacard issued first Verified Mark Certificate (VMC) in September 2019
- Yahoo US running a trial; Google in 2020
  `https://www.brandindicators.org`



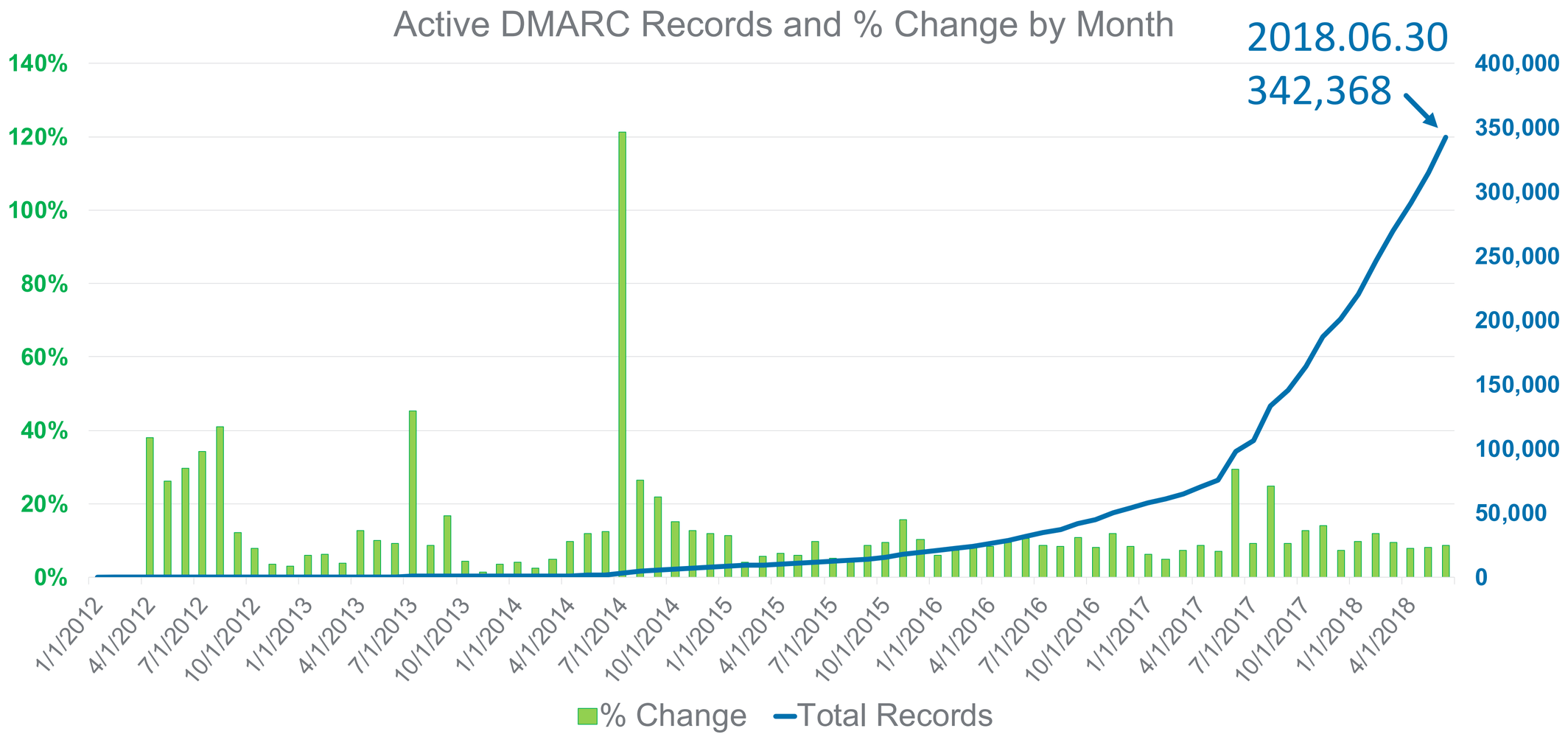
DMARC Use Update

Farsight Security DNS Data

- Sensors located at network providers around the world
- Response data – the answer – is timestamped and stored
- Sensors only see records when somebody looks them up

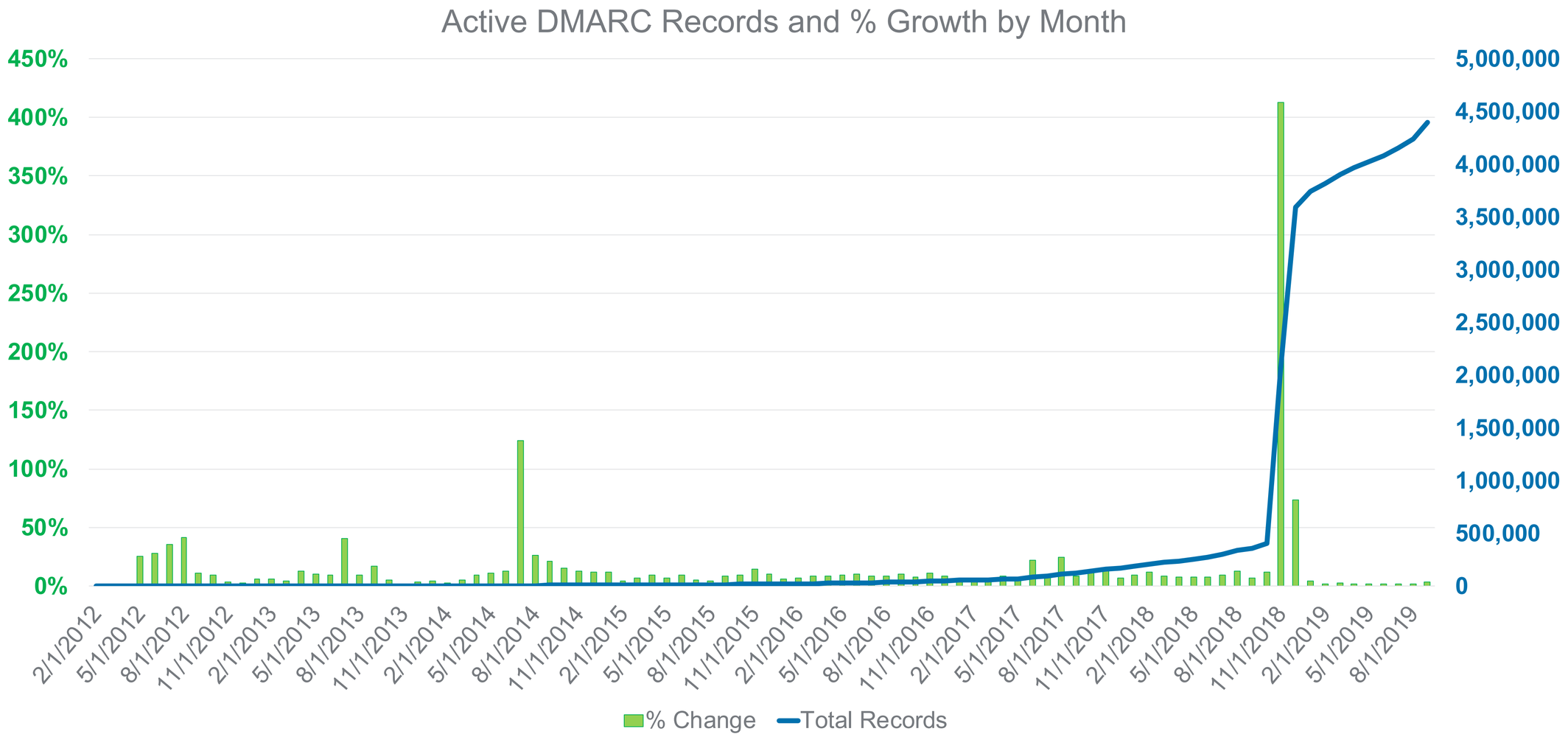
- DMARC.org only includes valid records still published in DNS, and are tracked by when they were first published
  - The set of active records changes over time

Active DMARC Records – 2Q 2018



Data provided by Farsight Security

Active DMARC Records – 3Q 2019

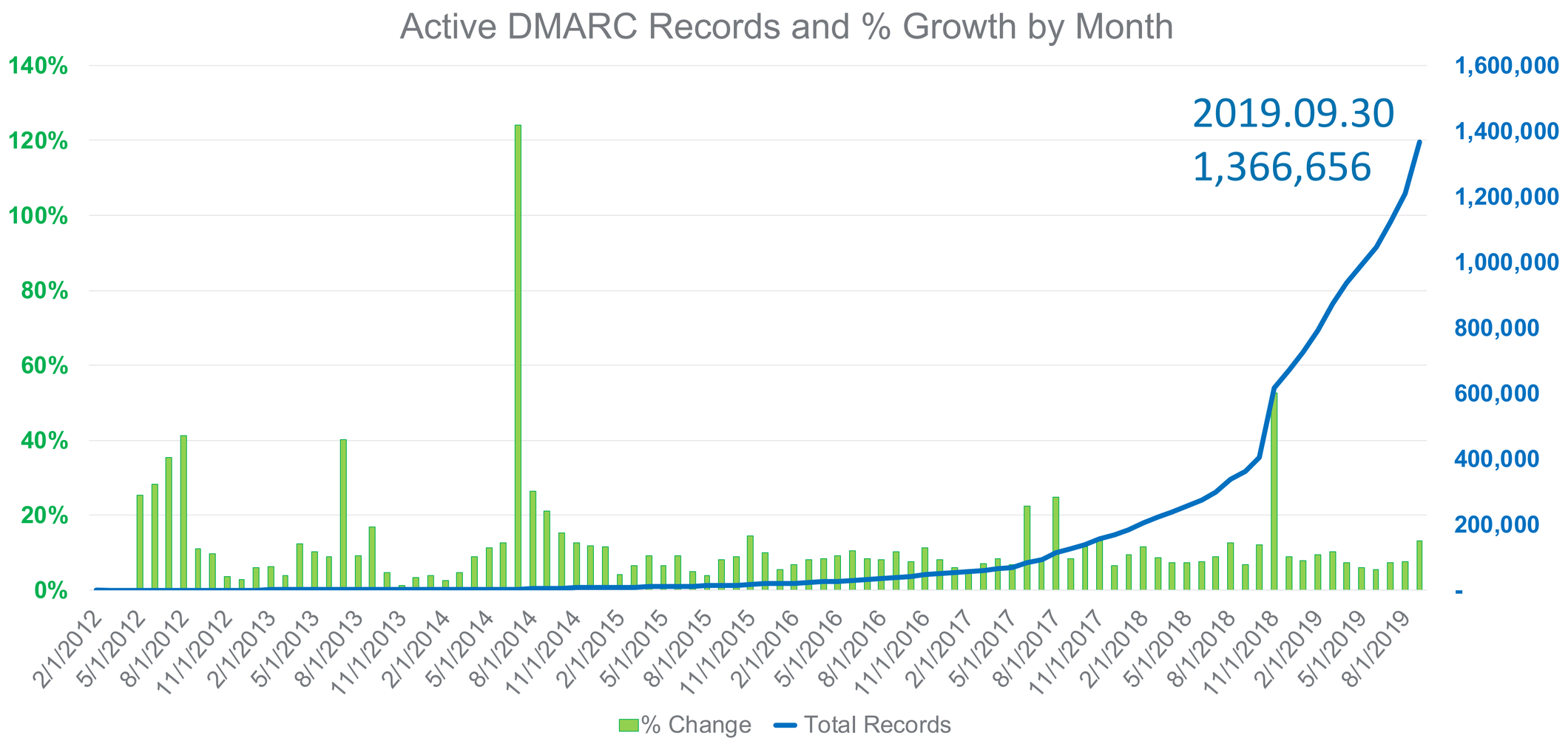


Data provided by Farsight Security

3 Million New DMARC Records?

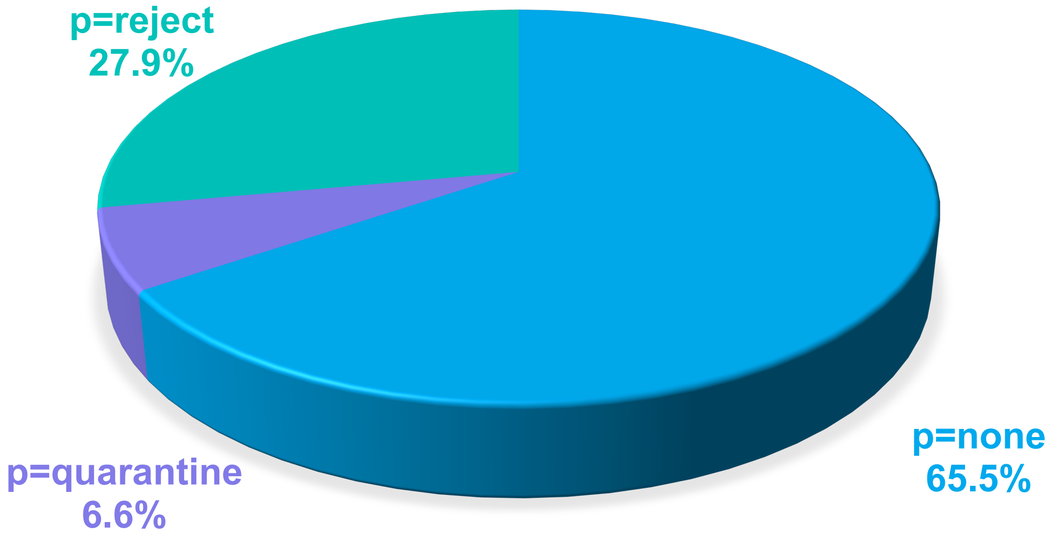
- Millions of DMARC records with strange names
  - `_dmarc.mx.mx.mx.mx.mx.ichiban.example.com`
- Most appear to trace back to “X”
- Nobody was aware of “X” behaving badly
- Exclude these records for now…

Active DMARC Records – 3Q 2019

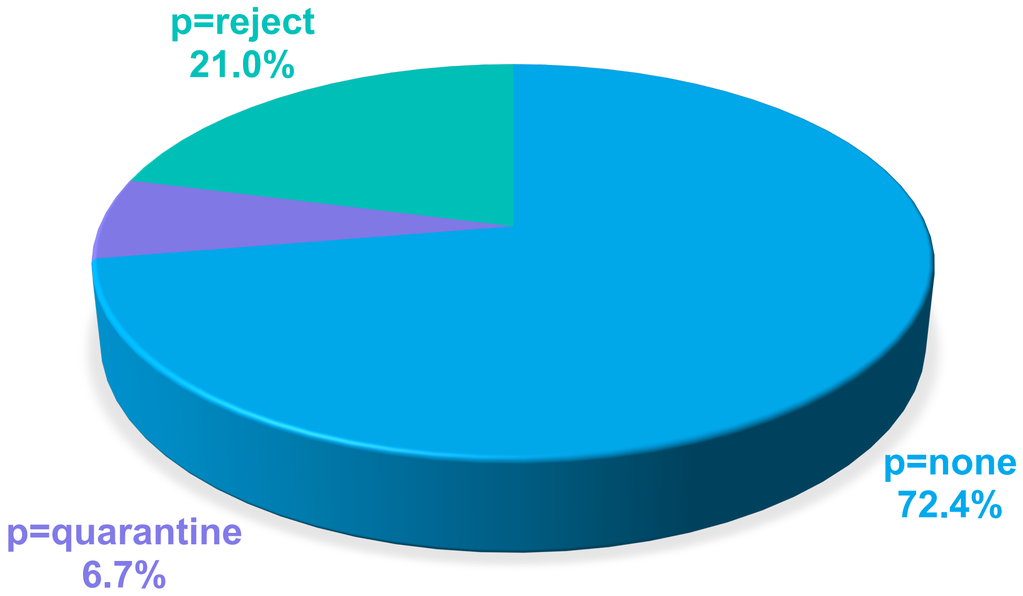


Data provided by Farsight Security

Policy Breakdown of Active DMARC Records

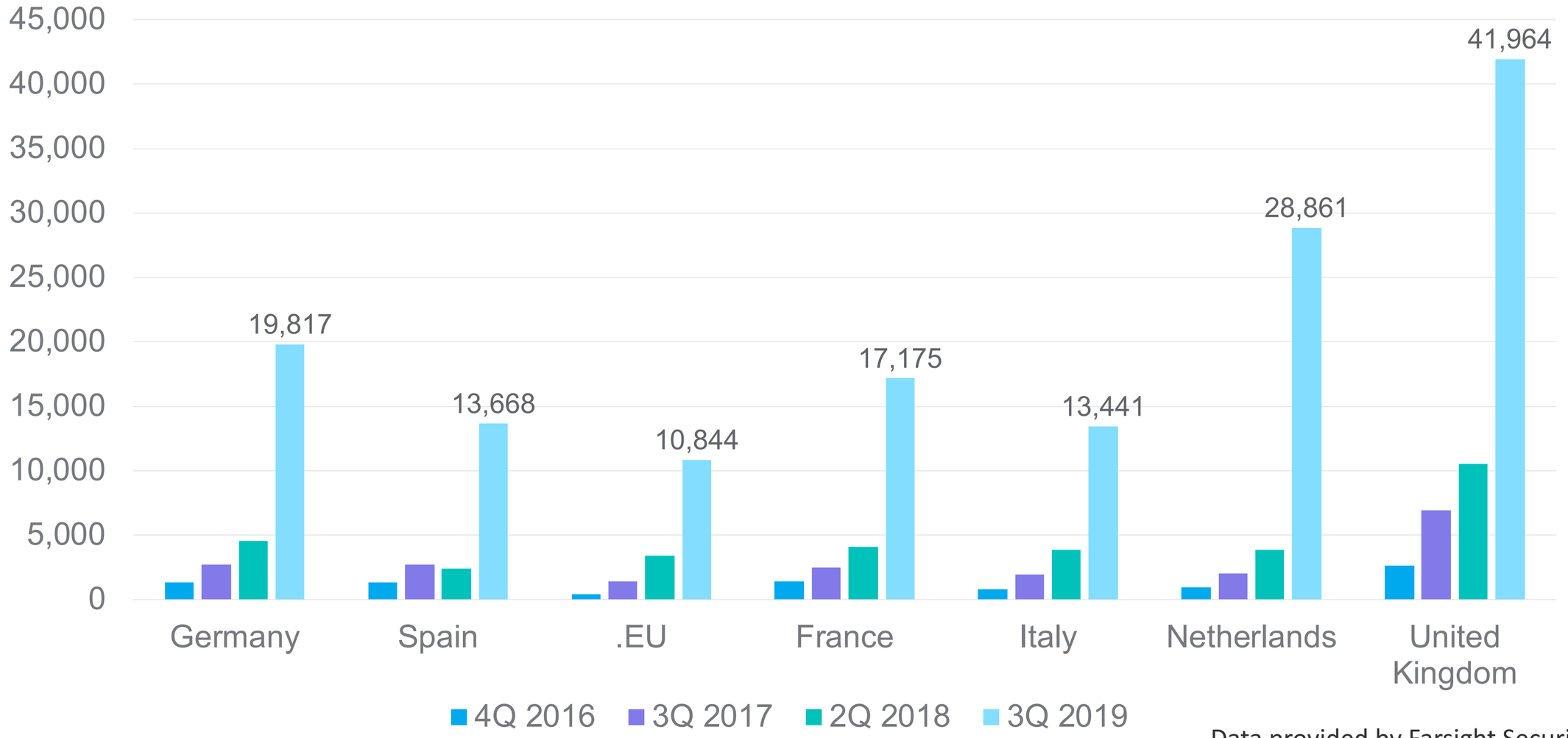


2018.12.31



2019.09.30

Active DMARC Records in Euro ccTLDs



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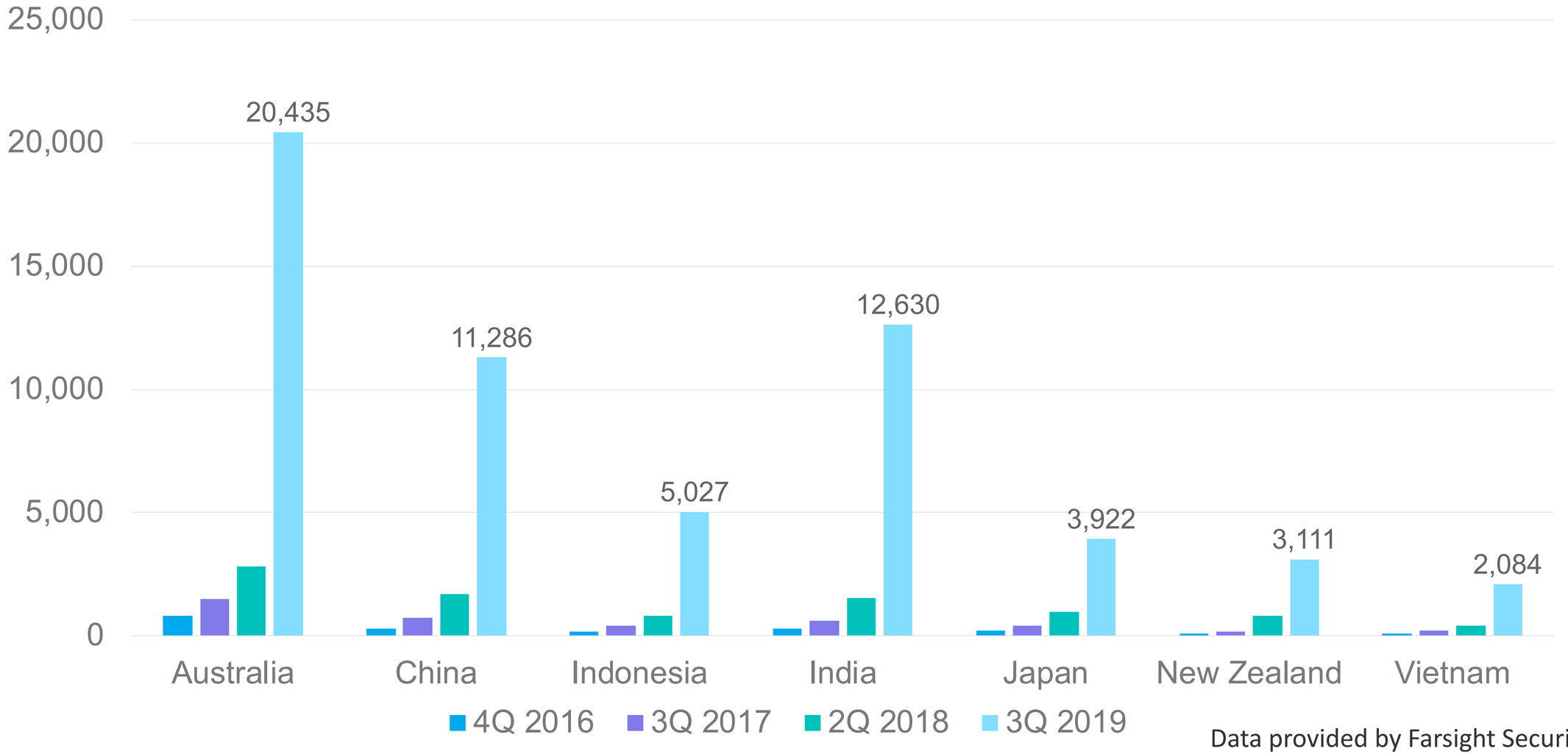
Active DMARC Records in Asia ccTLDs

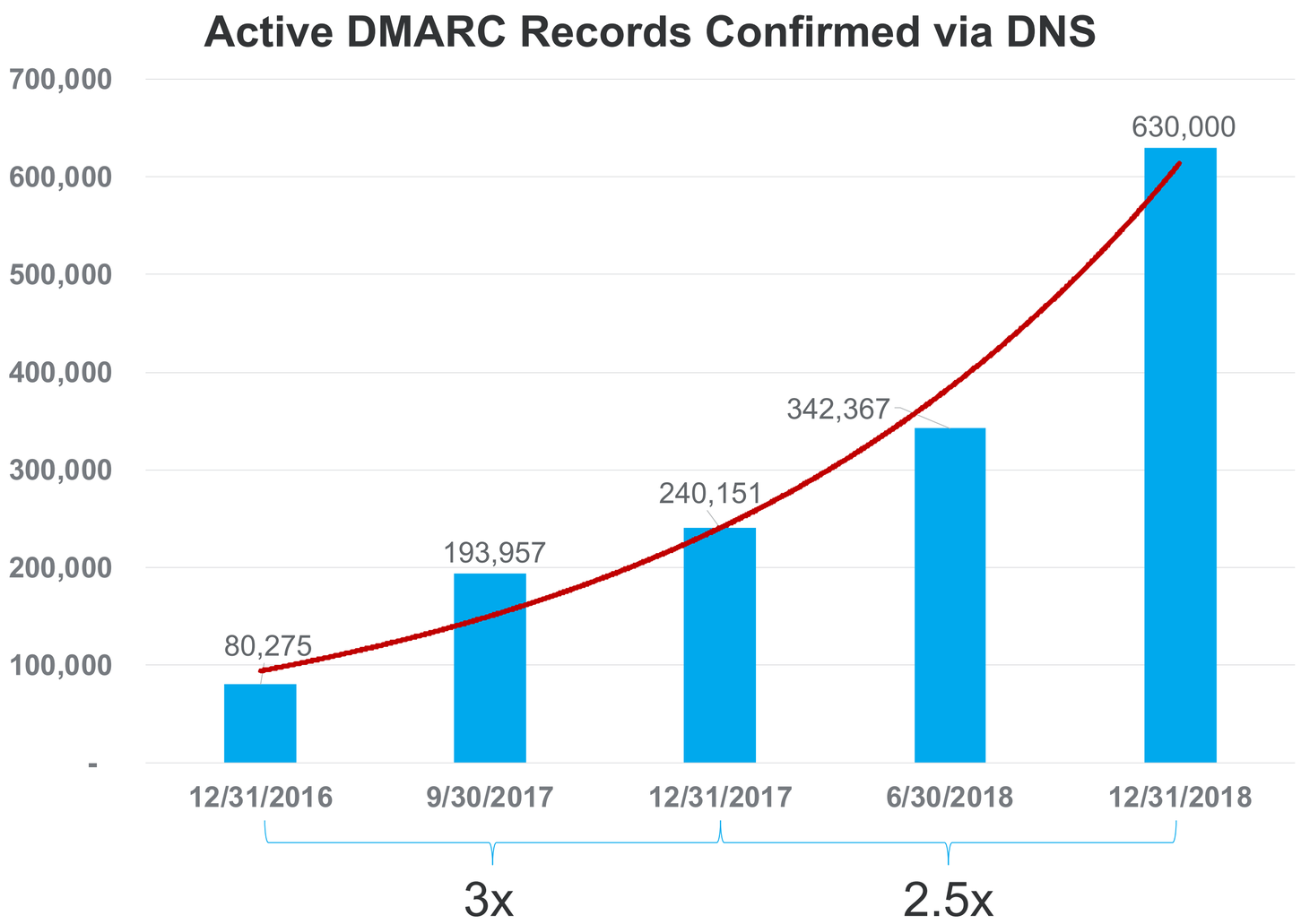


Data provided by Farsight Security

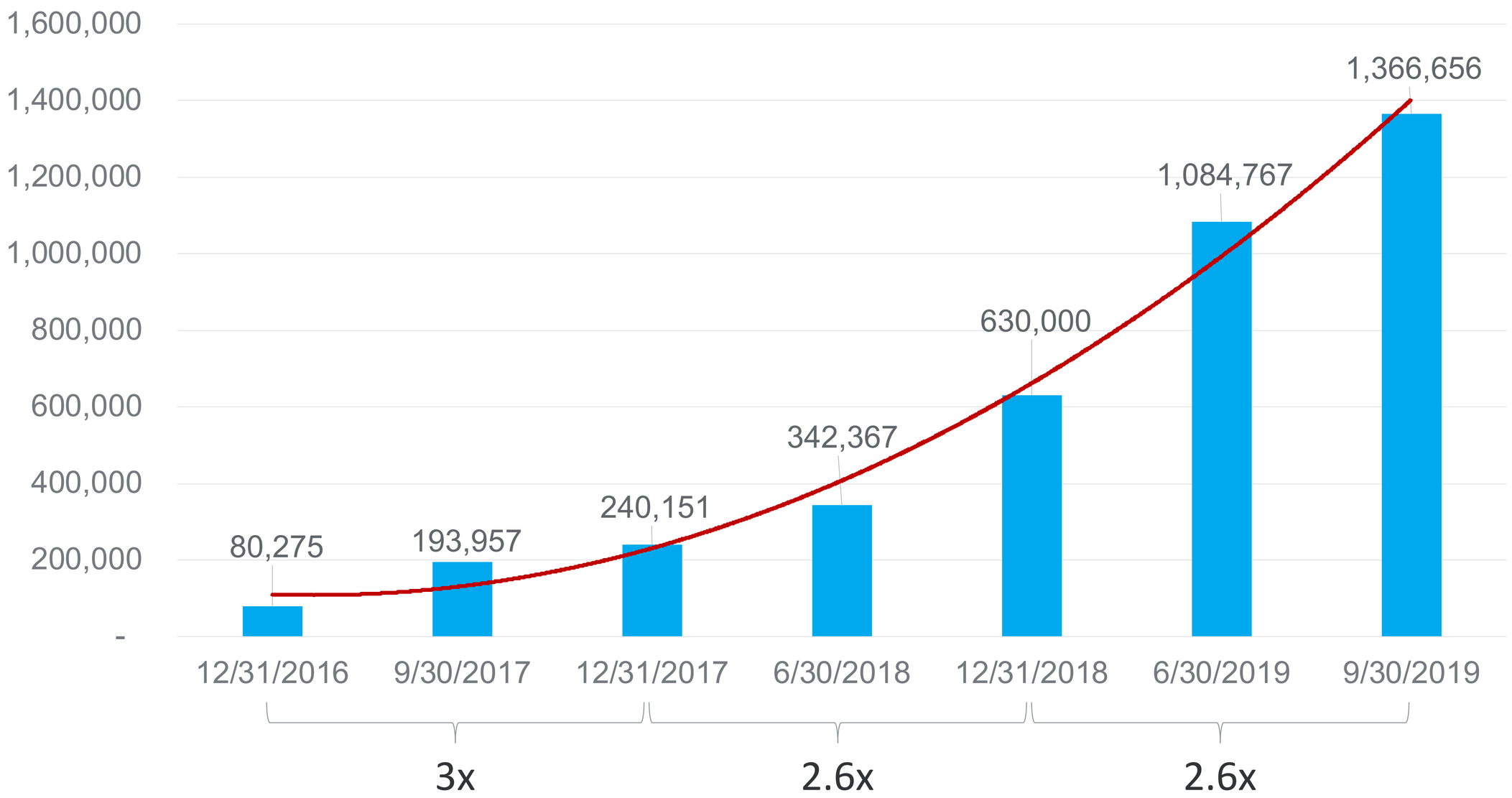
DMARC Records Increase 2.5x Year-over-Year

- Cumulative counts confirmed in DNS for the periods ending
- Robust growth
- Nearly doubled in 2H2018 alone
- Excluding 5MM suspicious records created in 4Q2018

Raw Data: Farsight Security
Analysis: DMARC.org



Active DMARC Record Growth



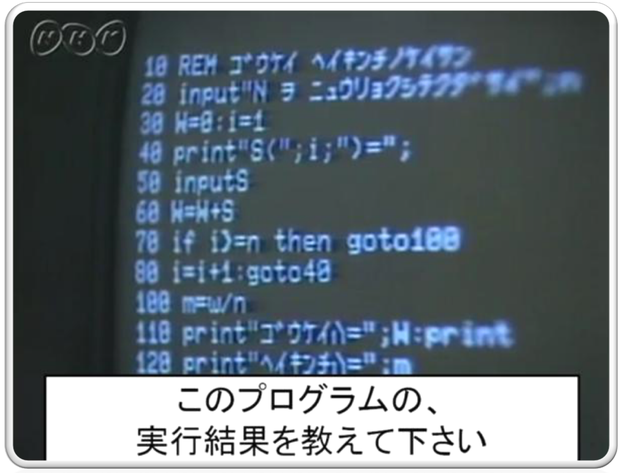
Common Problems with DMARC Records

Problems with DMARC Records

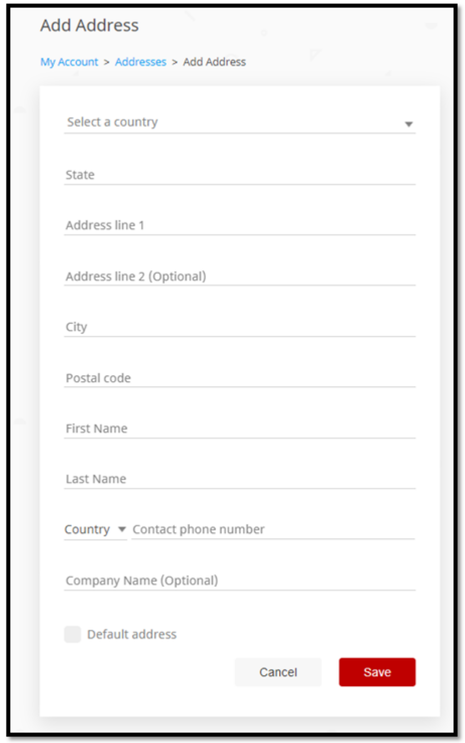
- 2012-2016: 489,000 bad TXT records (`_dmarc...`)
- 2017-2019: 446,000 bad TXT records
- Many are non-DMARC "wildcard" records
  - 76,000 `bio=<base64>`
  - 42,000 `google-site-verification`
  - 25,000 `v=dmarc1` (must be `v=DMARC1`)
  - 11,000 `MS=ms[0-9]*`

Problems with DMARC Records

- Many bad records are formatting issues in `rdata`
  - `\\"v=DMARC1`
  - `v= DMARC1 …`
  - `V-DMARC`
  - `Value: V=DMARC1; …`
  - `_dmarc… IN TXT \"v=DMARC1 …`



Problems (?) with DMARC Records



- Policy records with no reporting address
  - `"v=DMARC1; p=none"`
  - `p=reject` and no reporting, may be intentional
  - `p=none` and no reporting…?
- `p=none` <u>intended</u> to generate reports
- Does this really qualify as deploying DMARC?

Problems with DMARC Records

- Bad mailto: URIs in published policy
  - `rua=mailto:devops`
  - `rua=mailto:rua [] example.com`
  - `rua=user@domain not rua=mailto:…`
- Not just missing reports, may harass reporter
- Potential privacy violations

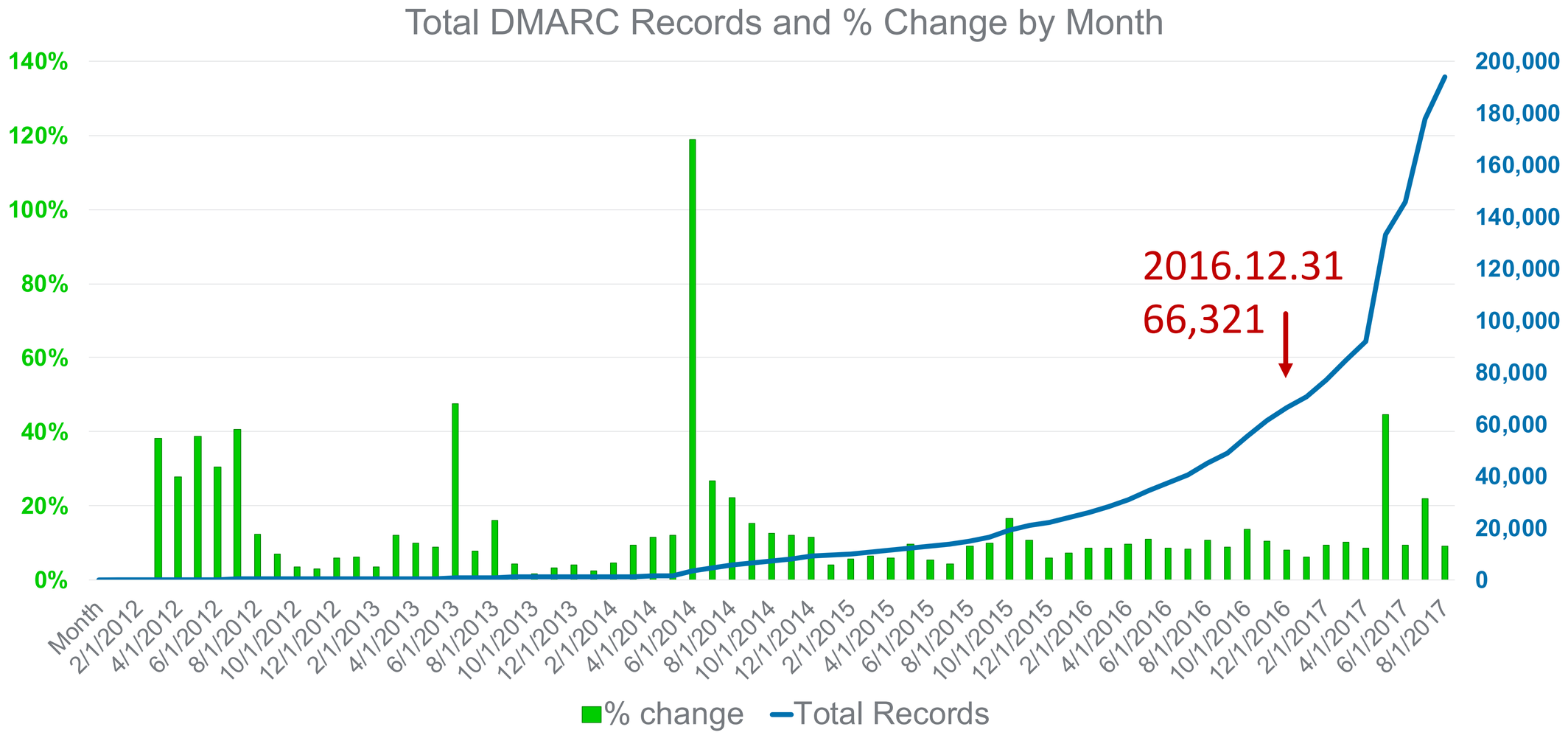
Verifying 3rd Party Report Receivers

- Domain owners publish *authorizing records* under RFC 7489 Section 7.1
  - `foo.com` wants DMARC reports sent to `bar.com`
  - `_dmarc.foo.com = "rua=mailto:foo@bar.com"`
  - **`foo.com`**`._report._dmarc.`**`bar.com`** `= "v=DMARC1"`
- Report generators are not checking
- Big privacy and legal implications

Q & A

“Why Do Your Numbers Change?”

Growth of DMARC Adoption Globally – 3Q 2017



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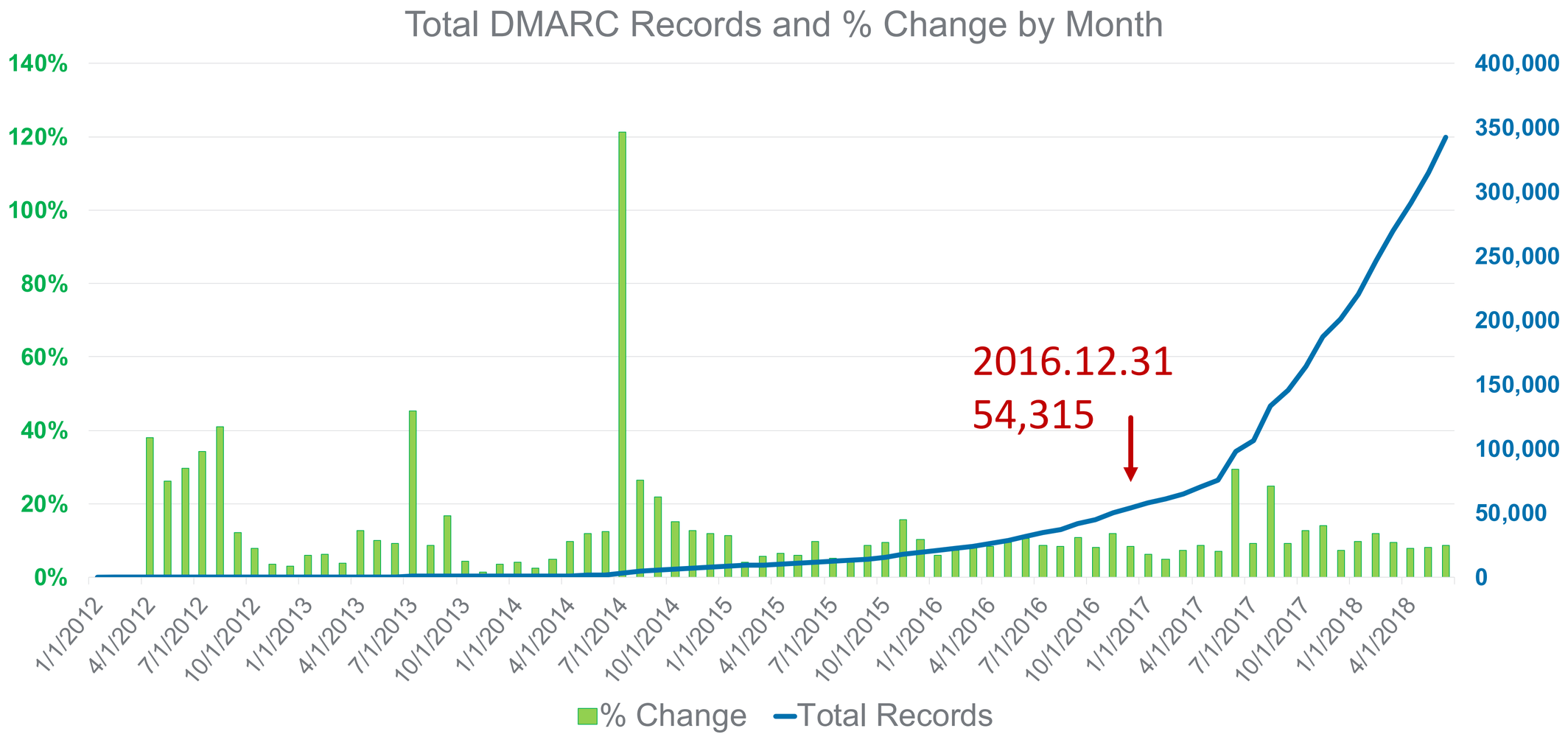

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Why Do The Counts Change Over Years?

- `ichi.com` and `ni.com` publish DMARC records during 2015
- They are both still published as of 2015.12.31, so the total for 2015 as of 2015.12.31 is 2
- During 2016 `ni.com` removes its DMARC record, but `san.com` publishes a DMARC record
- The total for 2015 as of 2016.12.31 is 1, and the count for 2016 as of 2016.12.31 is 1.
- During 2016 `ichi.com` removes its DMARC record
- The count for 2015 as of 2017.12.31 is 0, and the count for 2016 is 1

Concrete Example

- As of 2017.09.30: We reported 66,321 DMARC records for 2016.12.31
- As of 2018.06.30: We reported 54,315 DMARC records for 2016.12.31
- 12,006 records that were active during the 2017.09.30 validation were no longer active during the 2018.06.30 validation
- Since they were no longer in DNS, they are not included in the 2016 total for the 2018 report

ありがとうございました

Thank you