The Reality of Algorithm Agility: Studying the DNSSEC Algorithm Life-Cycle

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Introduction

- DNSSEC brings **integrity** to the DNS
- Heavily relies on the security of its signing algorithms
- Signing algorithms are added and removed because of:
  - Security
  - Performance

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- Signing algorithms are added and removed because of:
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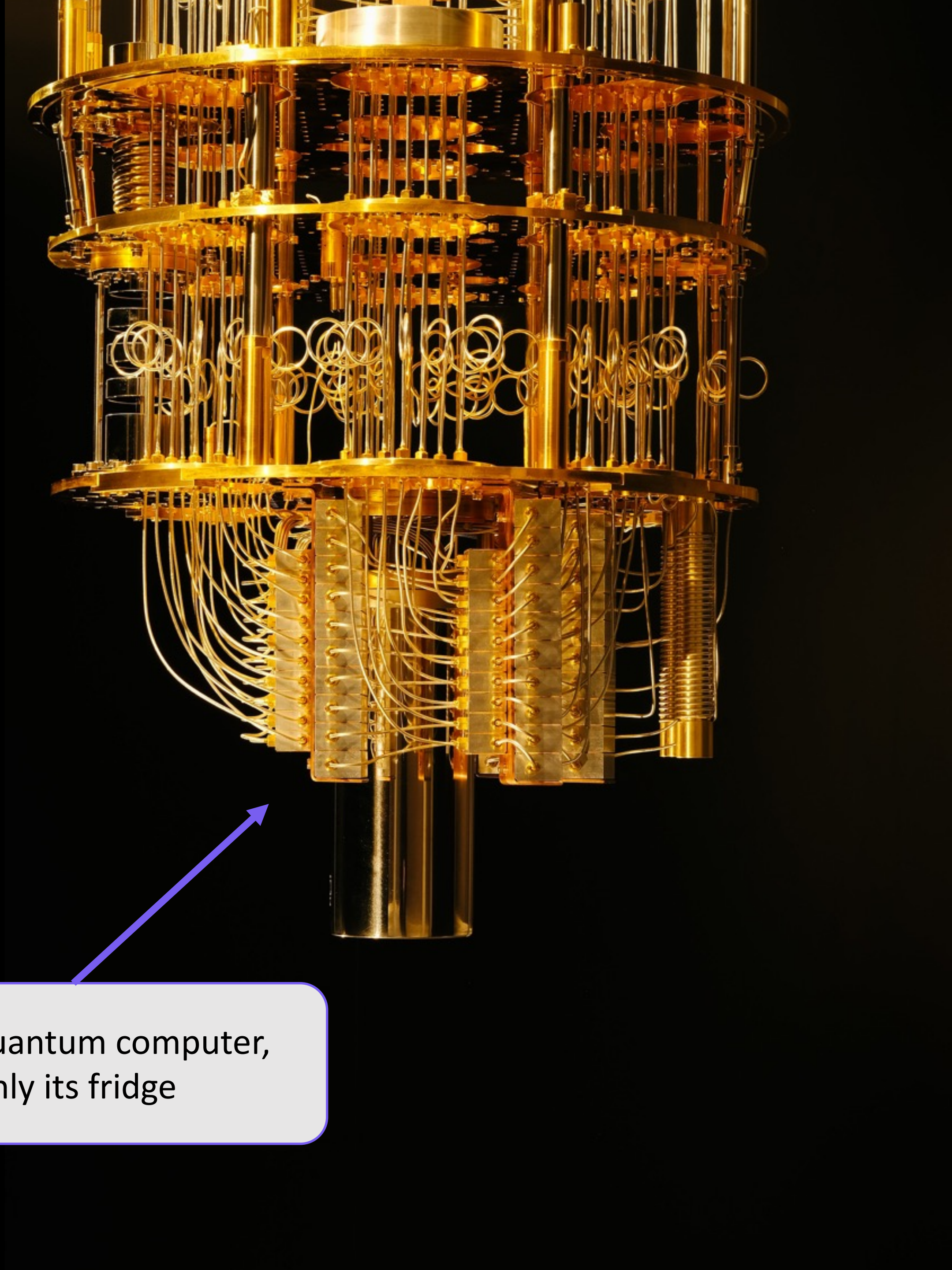
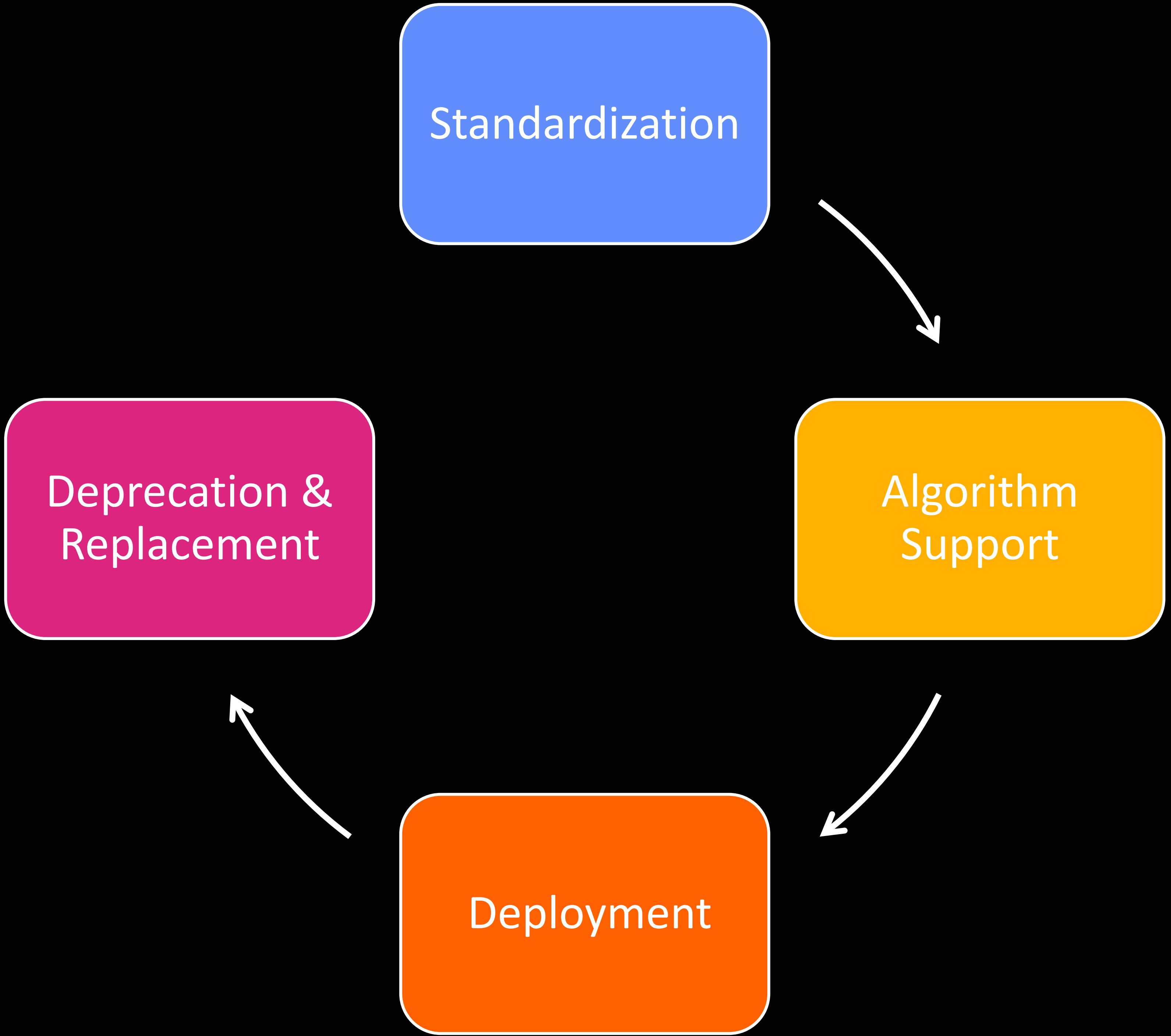
  - Performance
- Quantum computers might **render** all current algorithms **insecure**



Not a quantum computer, only its fridge

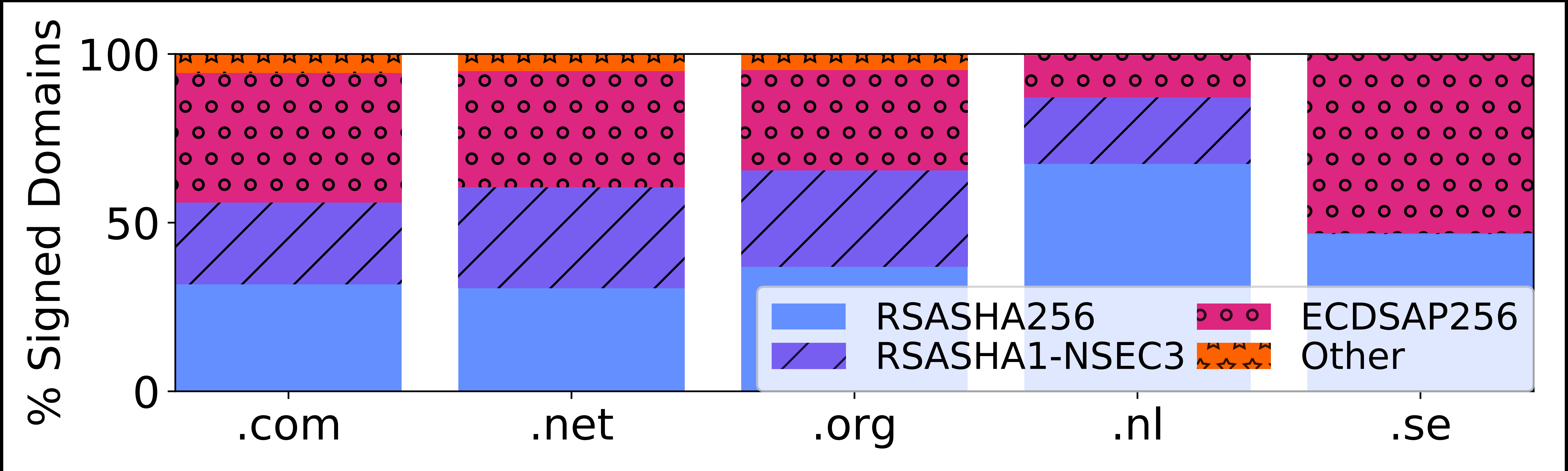
Algorithm Lifecycle

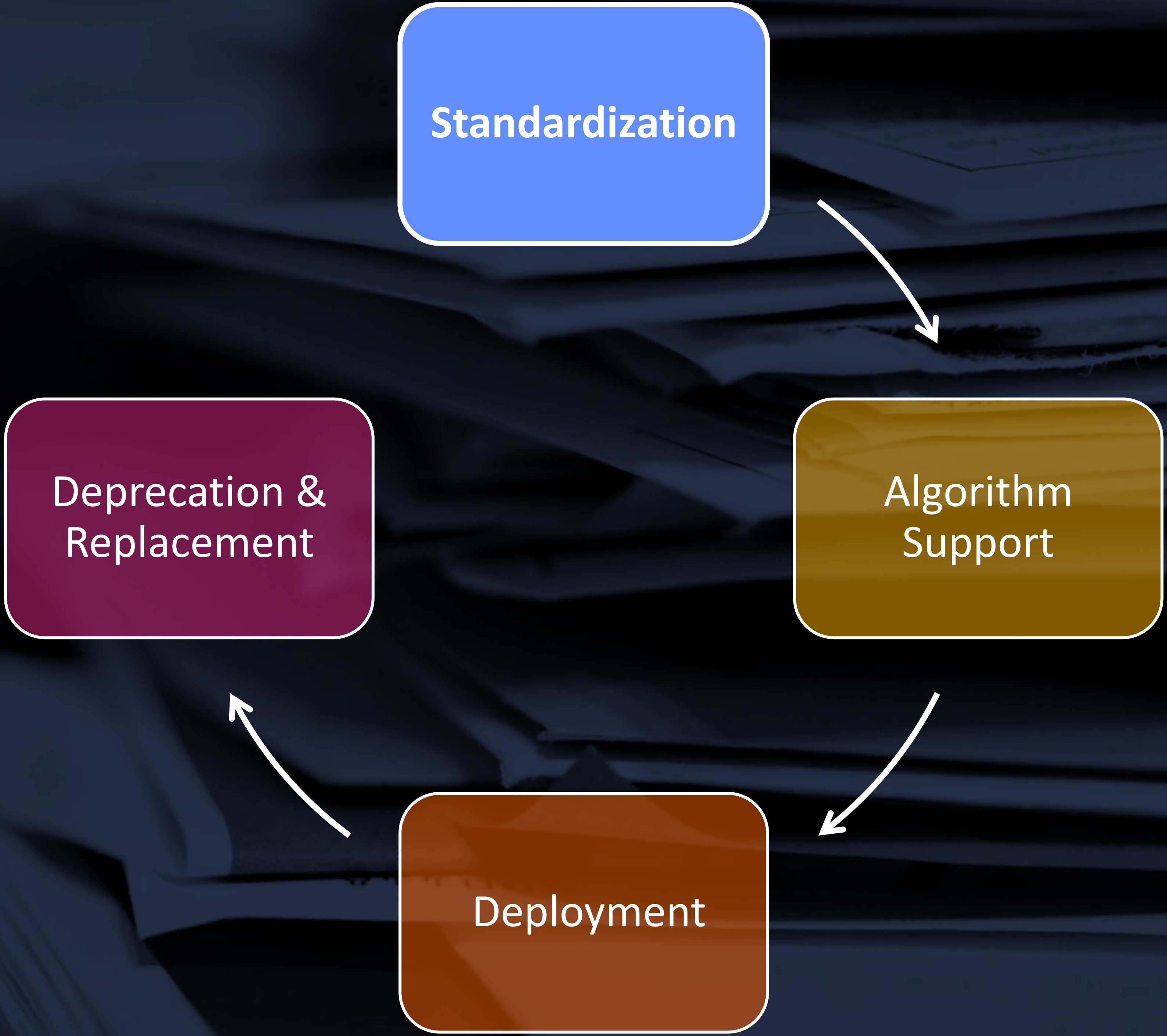


Analyzed Algorithms

- **Standardization:** all algorithms
- **Algorithm Support:** all algorithms
- **Deployment:**
  - ECDSAP256 (signing)
  - ED25519 and ED448 (validation)
- **Deprecation:**
  - RSASHA-1-NSEC3-SHA1 (signing)
  - RSASHA-1-NSEC3-SHA1, DSA, RSASHA1, DSA-NSEC3-SHA1 (validation)

Currently Deployed Algorithms





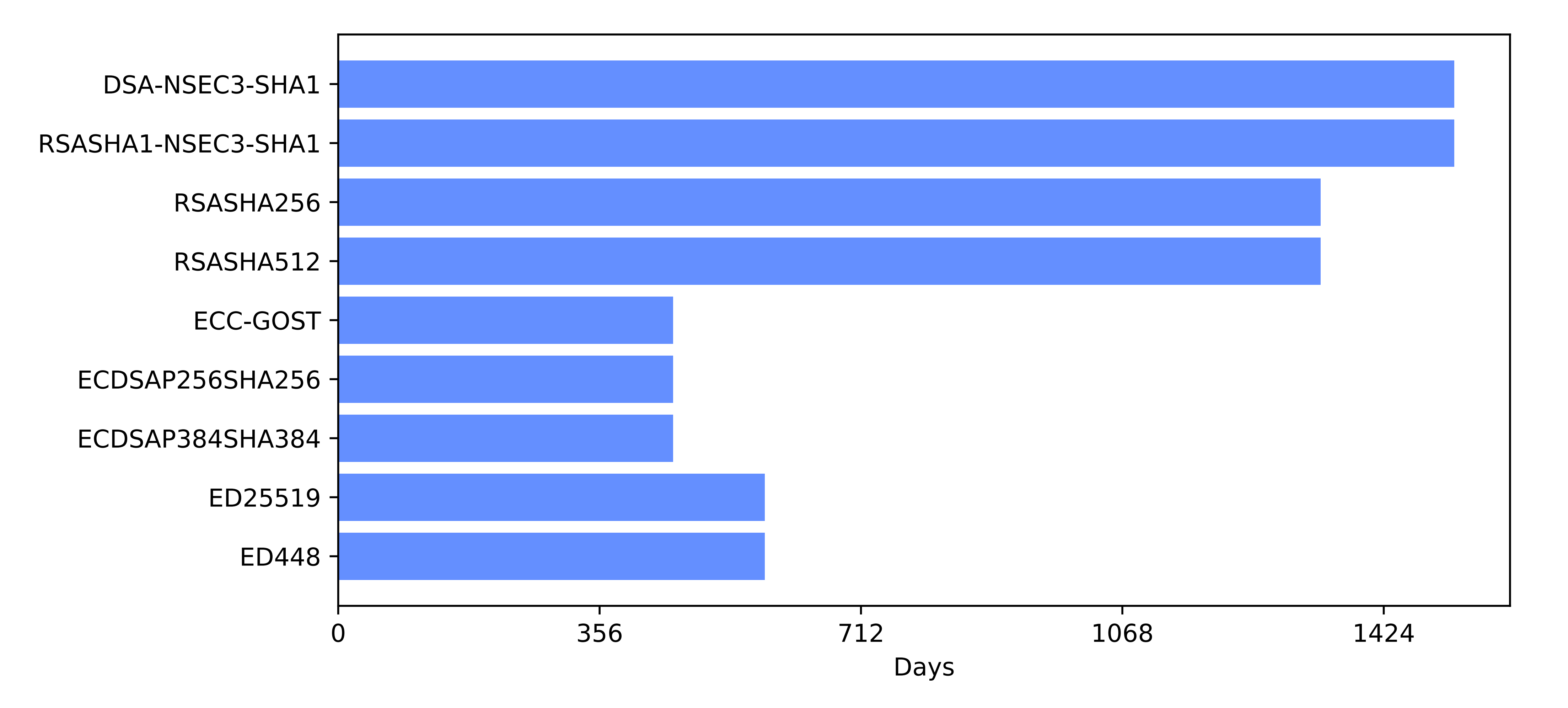
Standardization

Algorithm Support

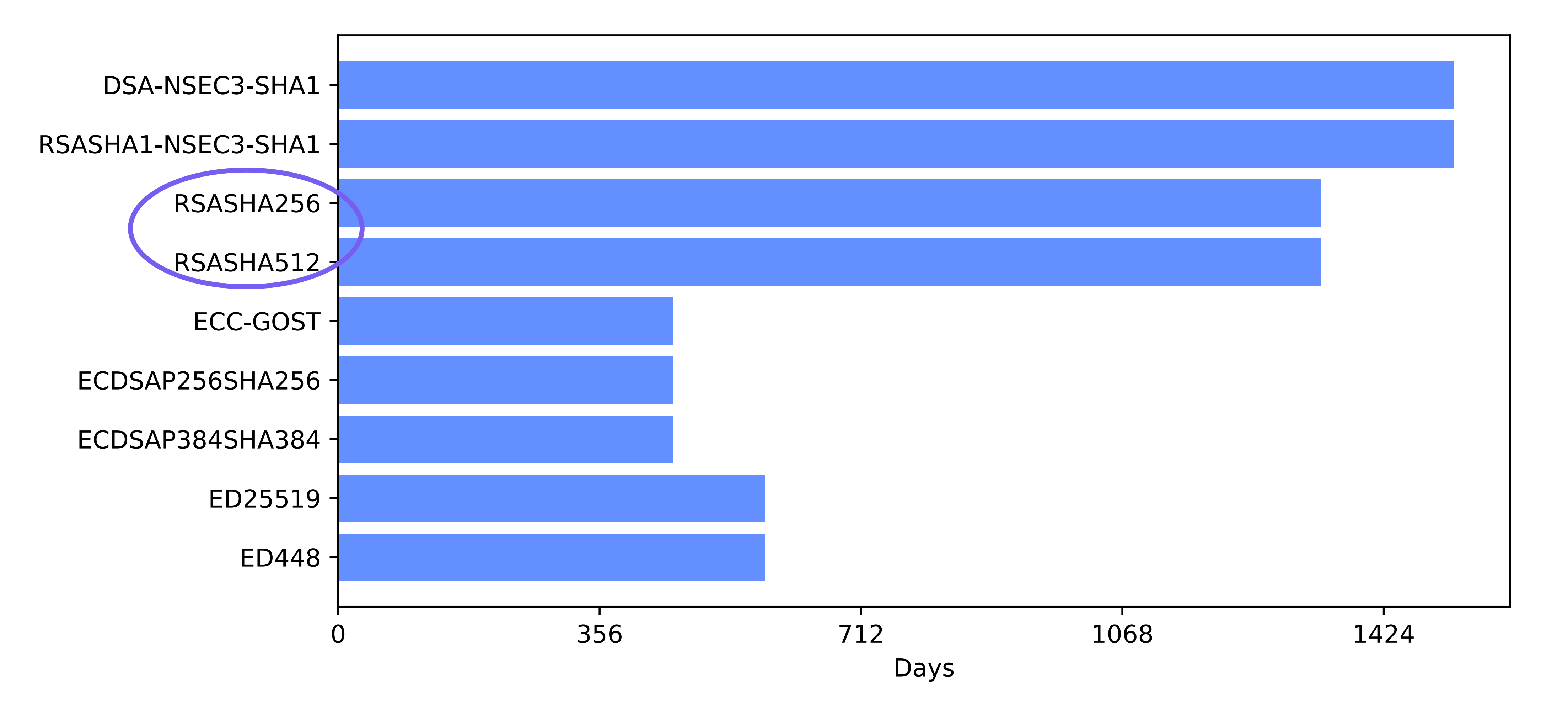
Deployment

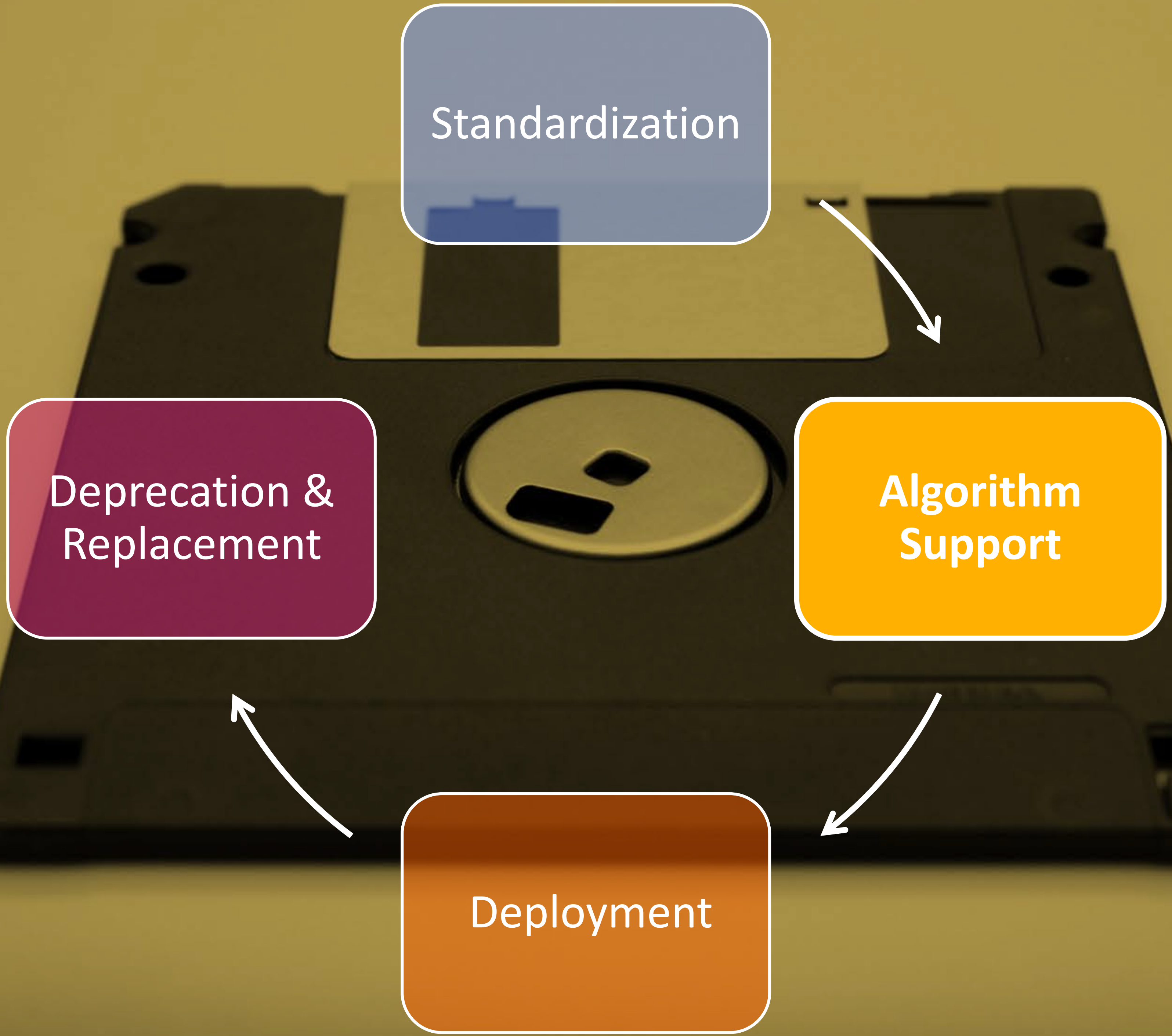
Deprecation & Replacement

Time until Standardization



Time until Standardization





Standardization

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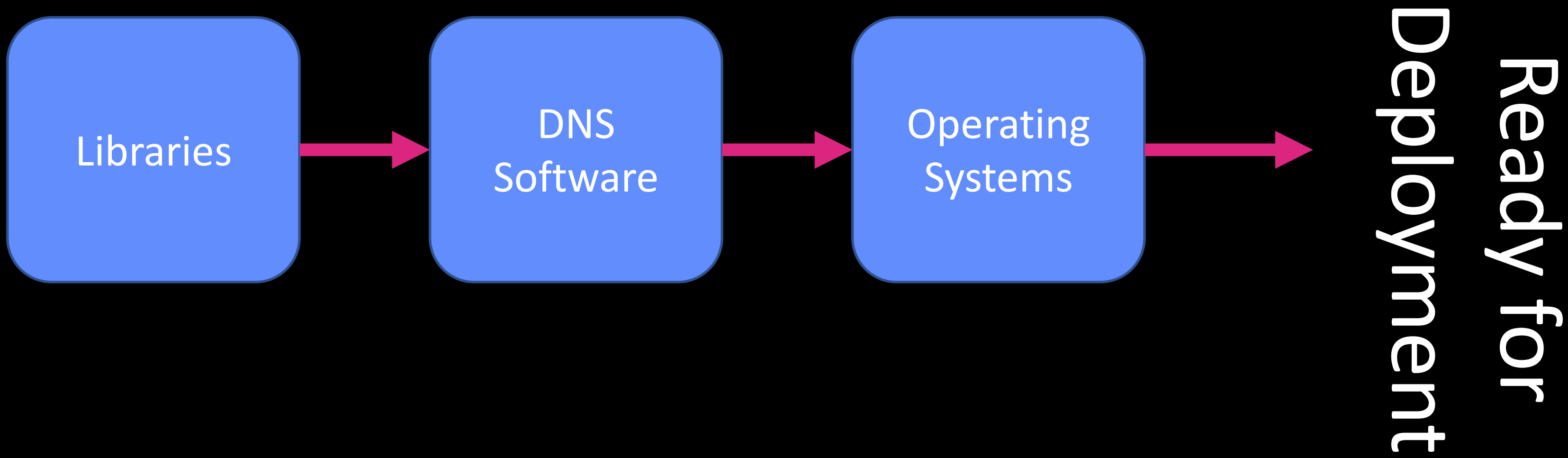
Path to Full Support



Libraries

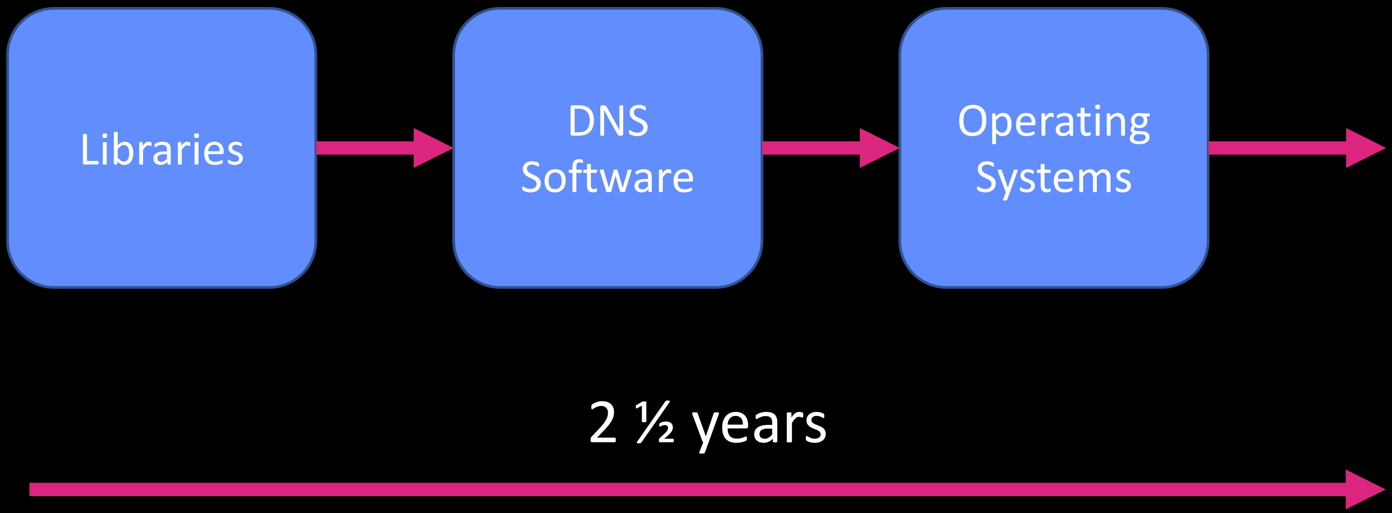
DNS Software

Operating Systems

Ready for Deployment

Photo by Josiah Farrow on Unsplash

Path to Full Support



Libraries

DNS Software

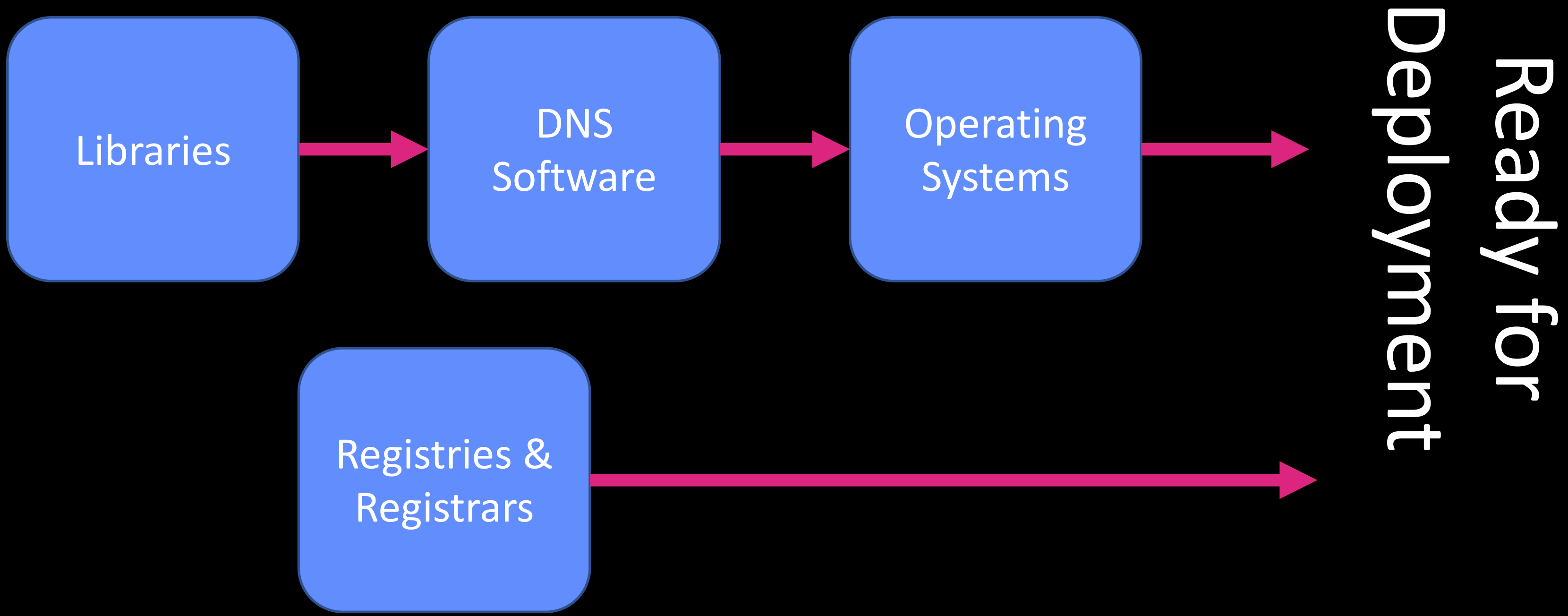
Operating Systems

2 ½ years

Ready for Deployment

ED25519: Ubuntu 18.04 & OpenSSL

Path to Full Support



Libraries

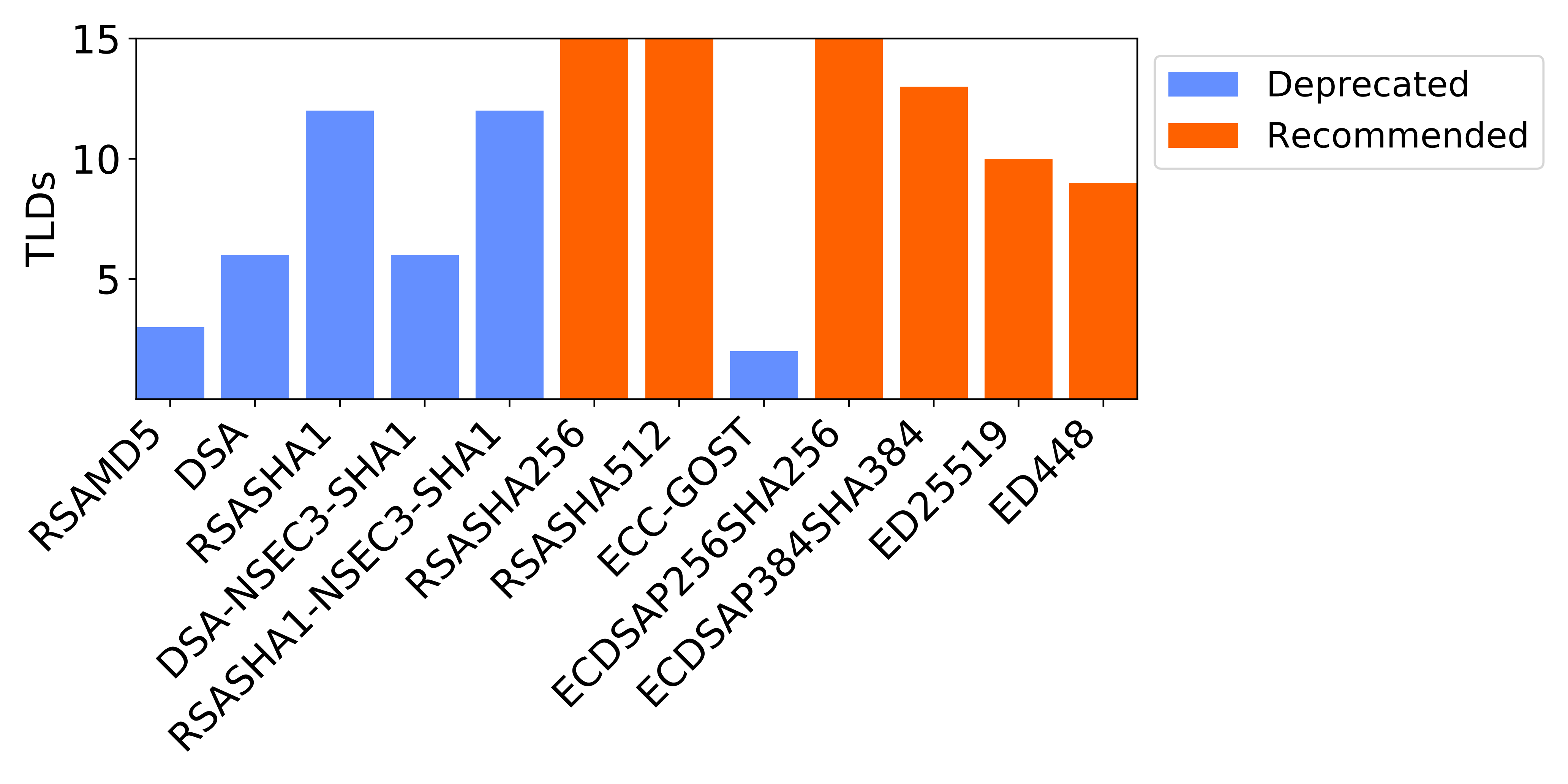
DNS Software

Operating Systems

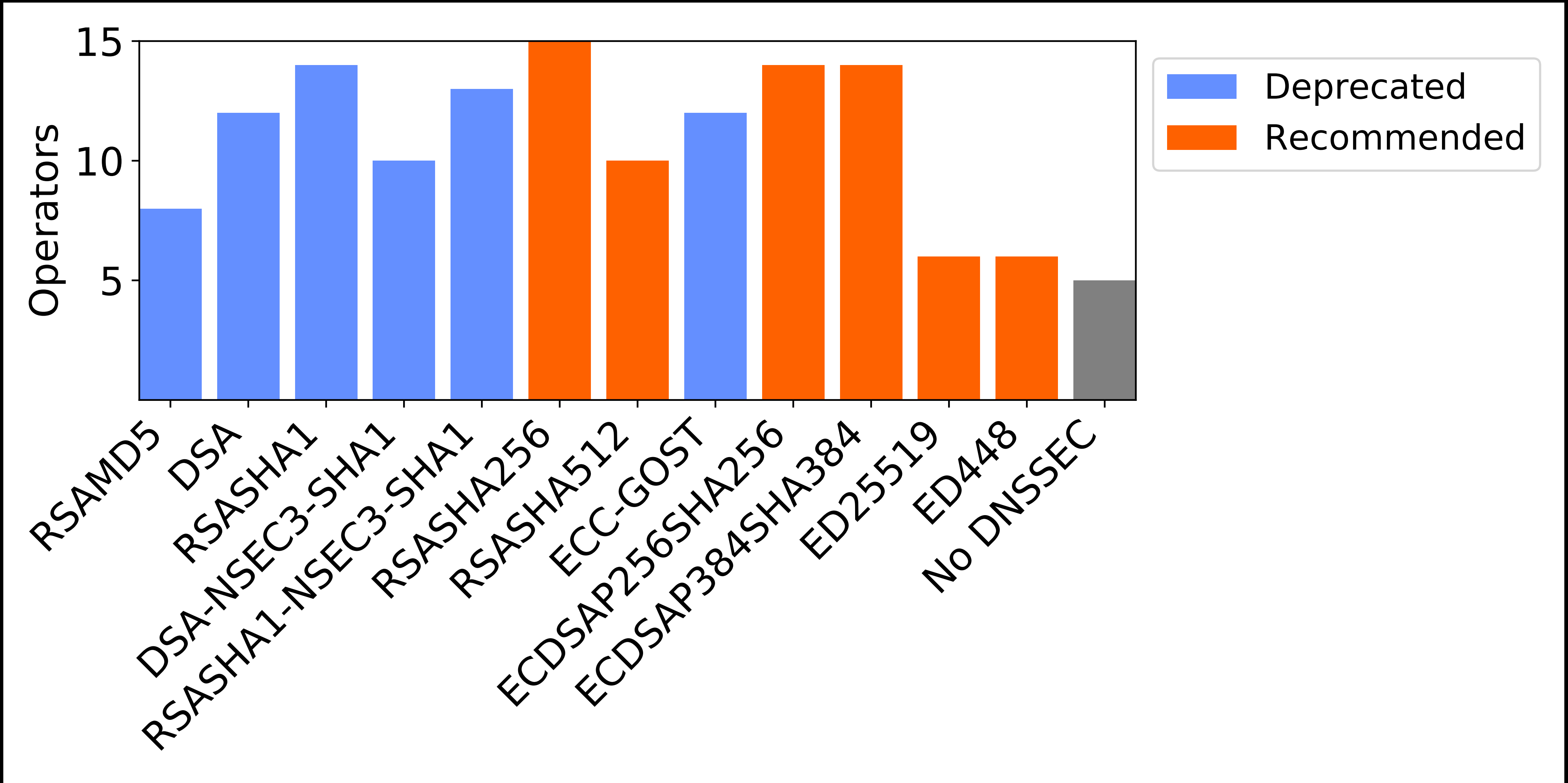
Registries & Registrars

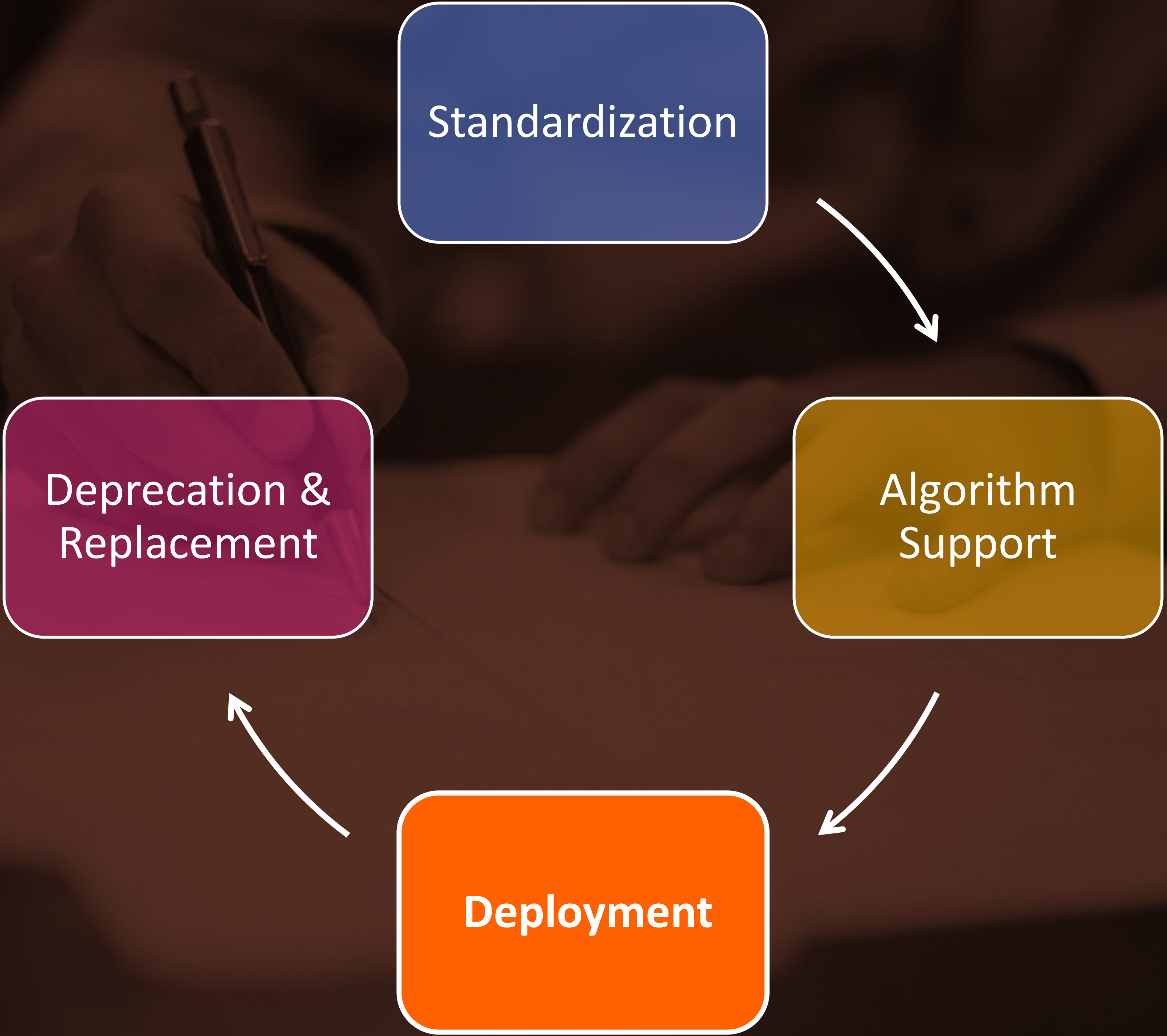
Ready for Deployment

Registry Support



Registrar Support





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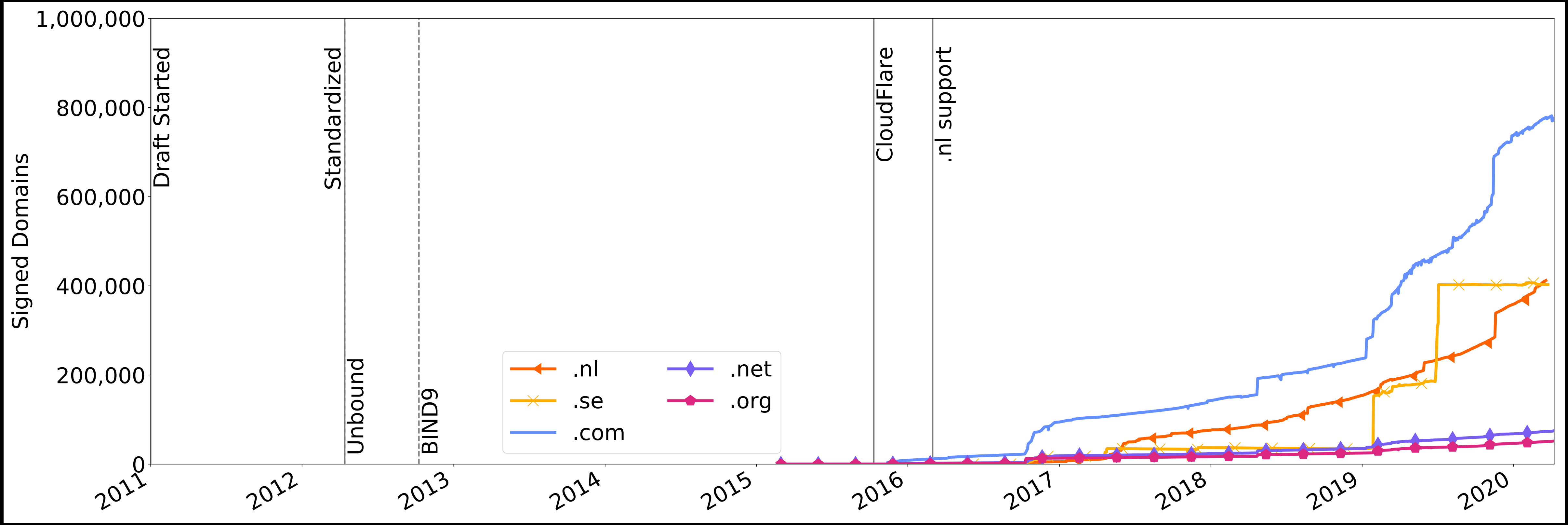
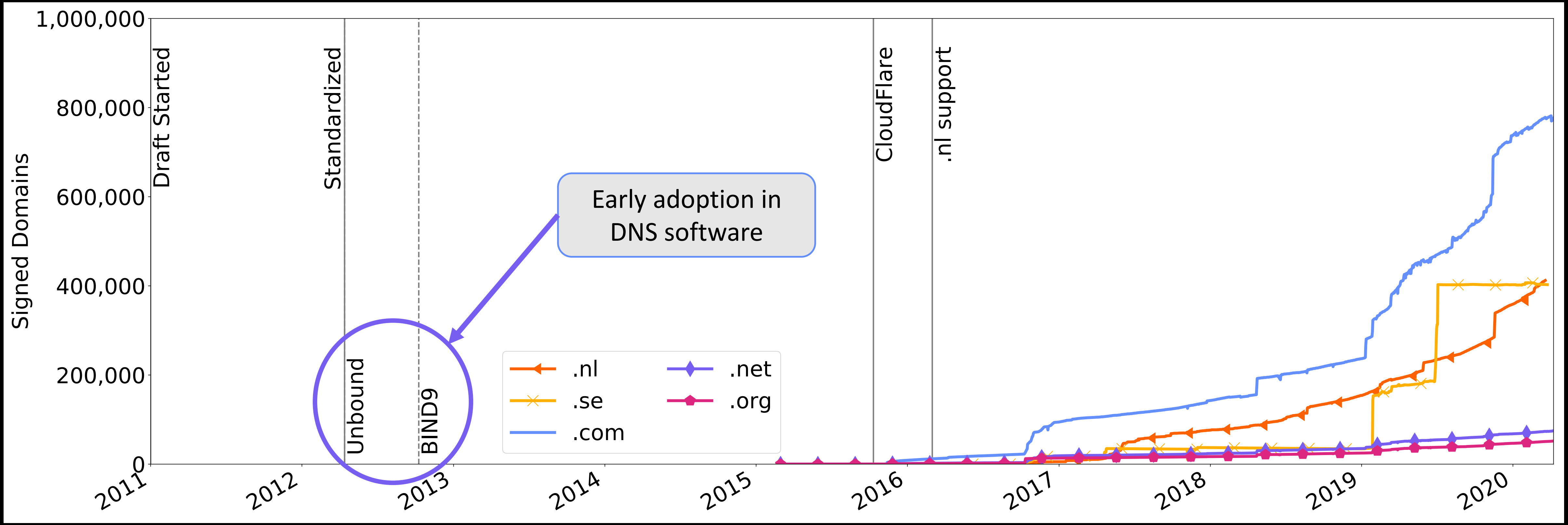
Algorithm Deployment at Domain Names



ECDSA256

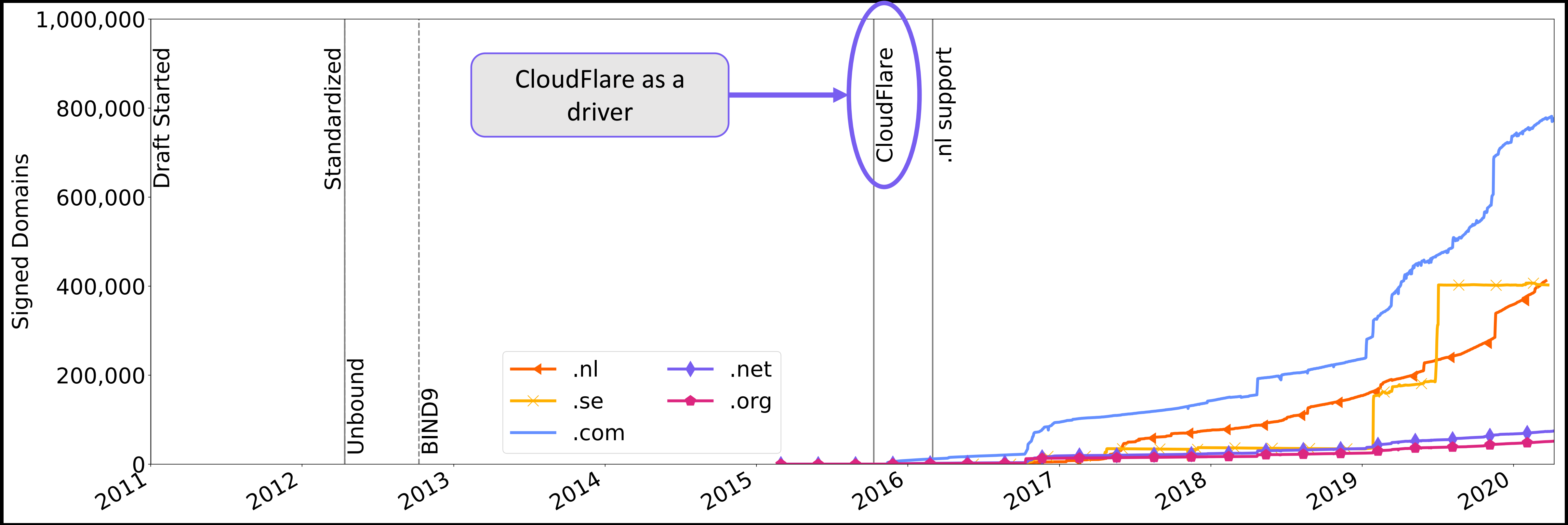
Algorithm Deployment at Domain Names



Early adoption in DNS software

ECDSA256

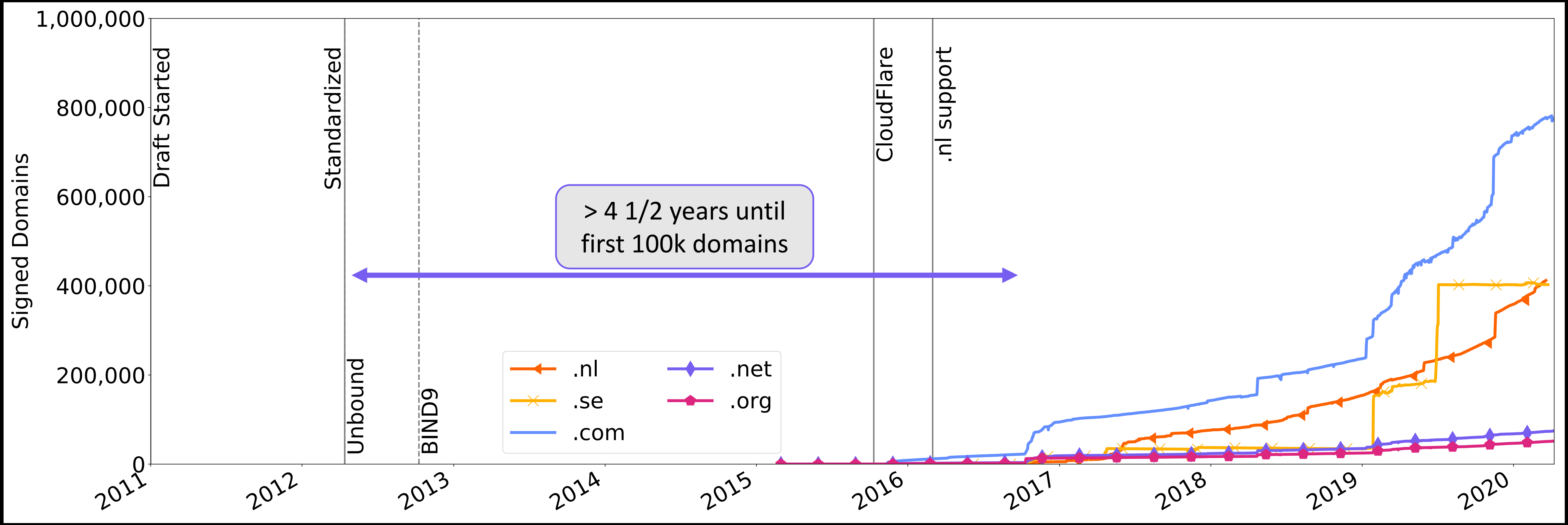
Algorithm Deployment at Domain Names



CloudFlare as a driver

ECDSA256

Algorithm Deployment at Domain Names



ECDSA256

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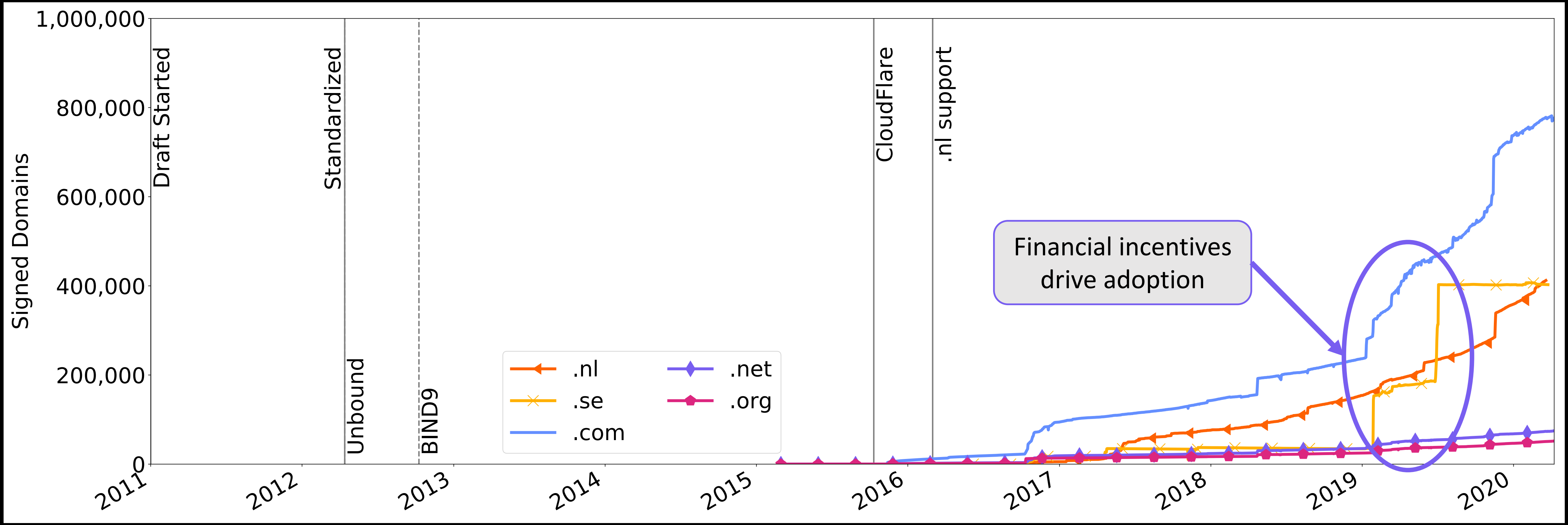
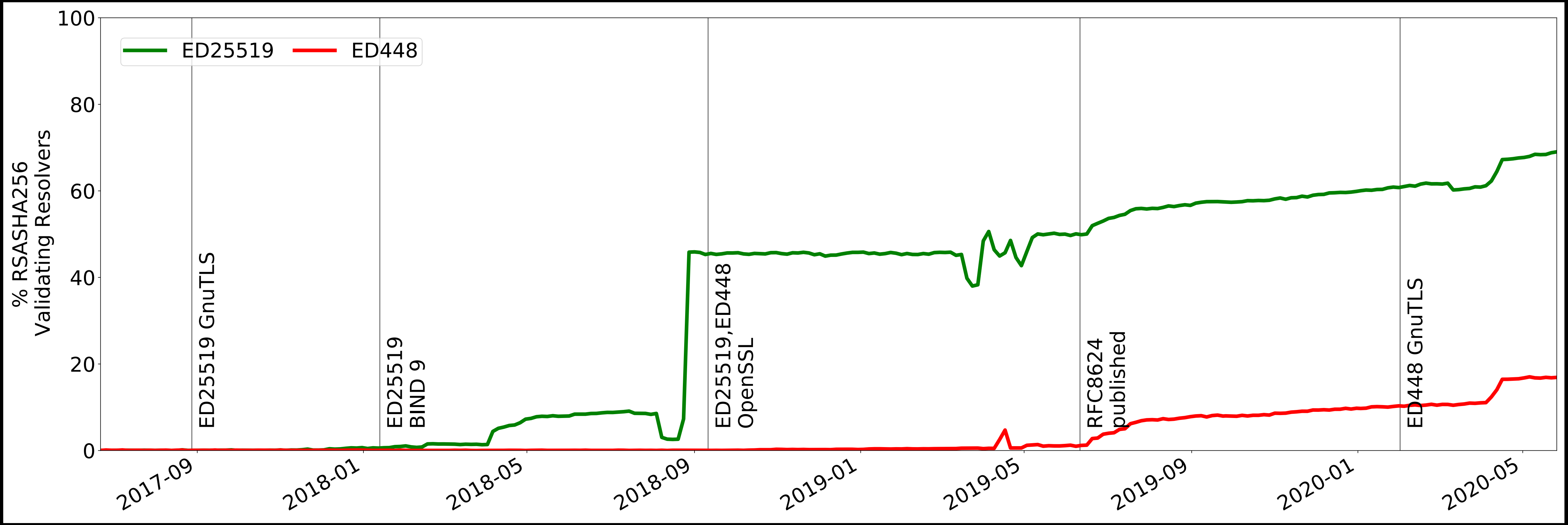


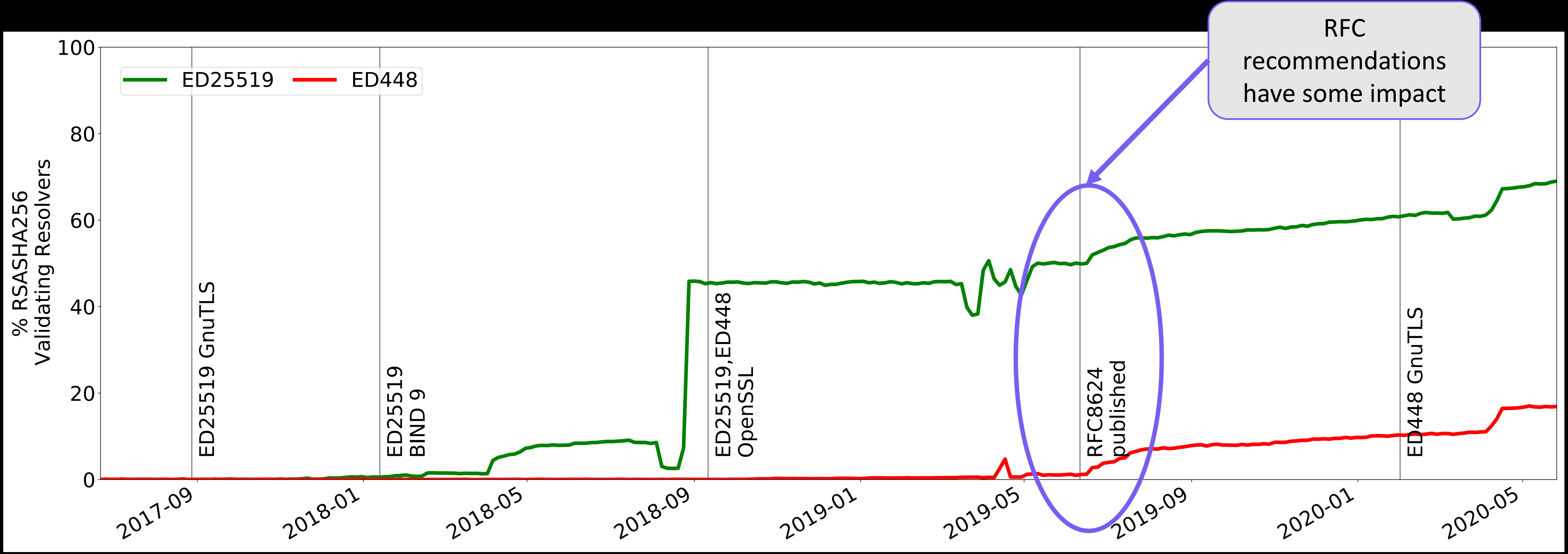
Financial incentives drive adoption

ECDSA256

Algorithm Deployment at Resolvers

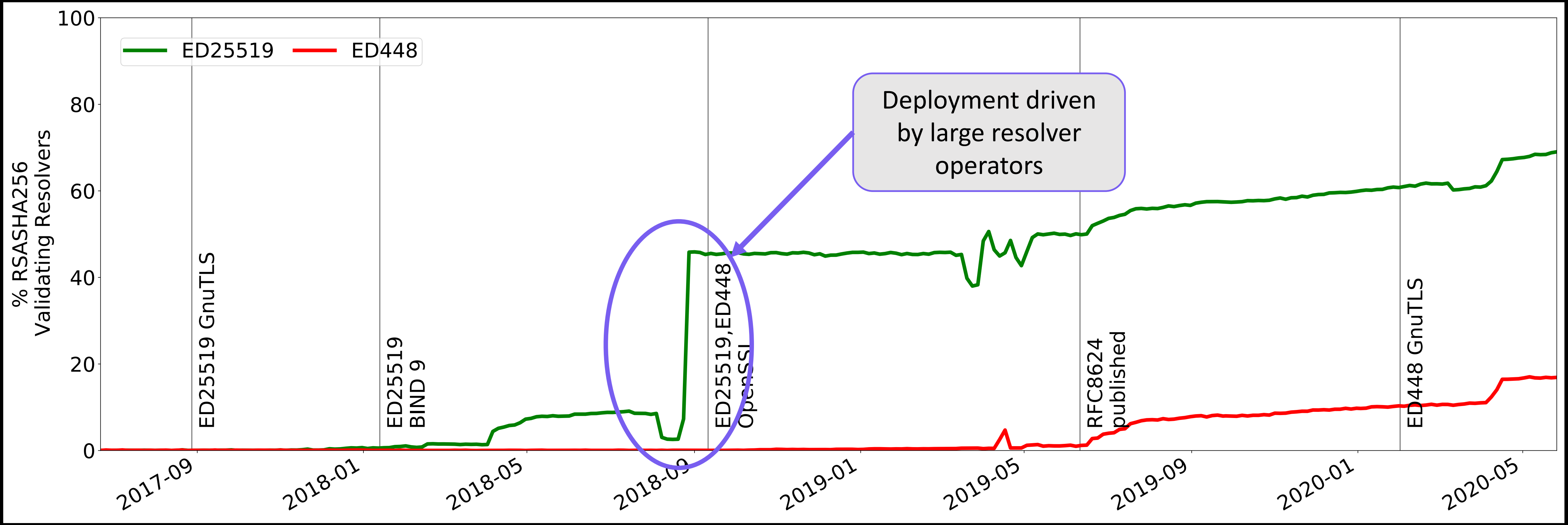


Algorithm Deployment at Resolvers

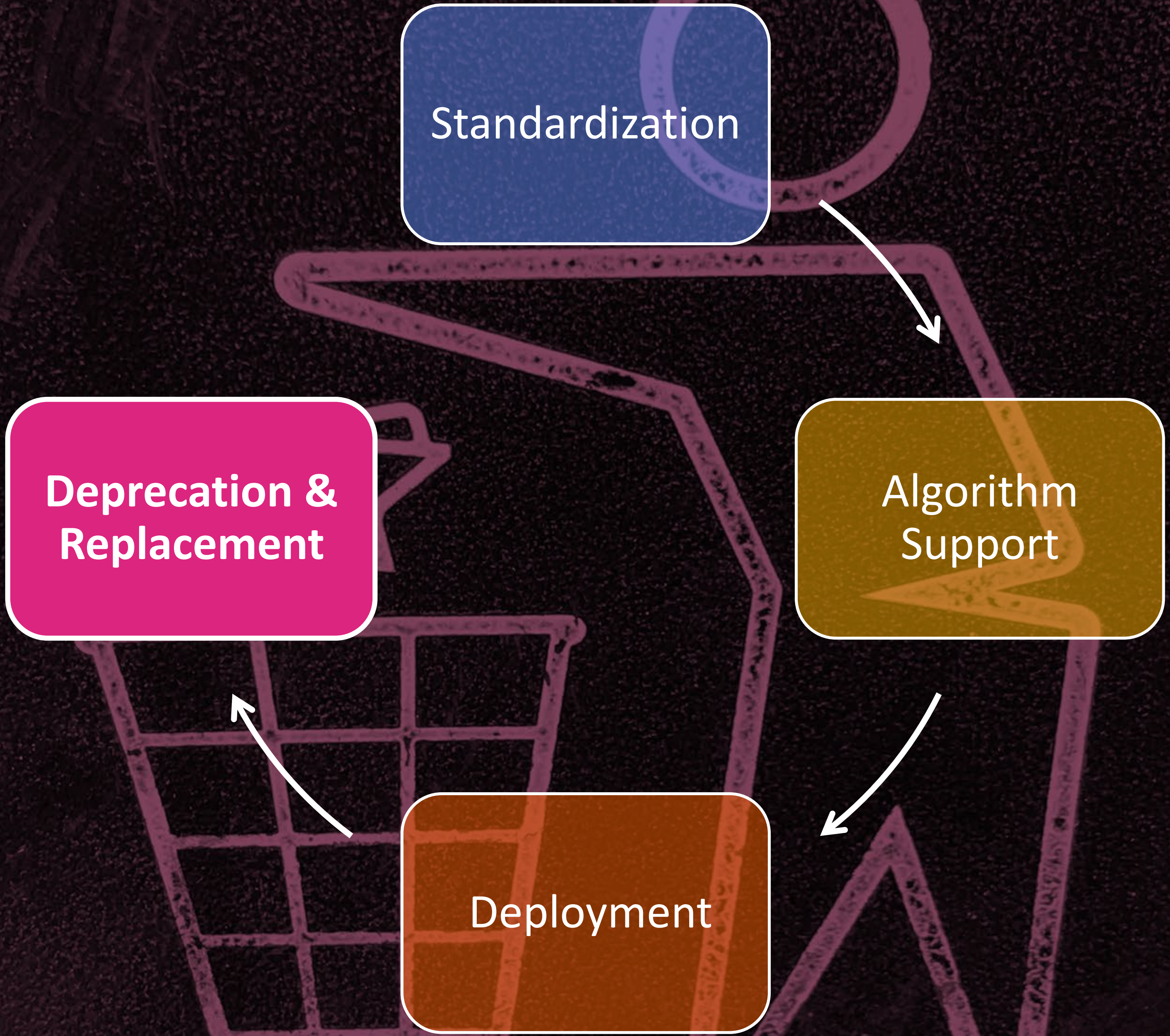


RFC recommendations have some impact

Algorithm Deployment at Resolvers



Deployment driven by large resolver operators



Standardization

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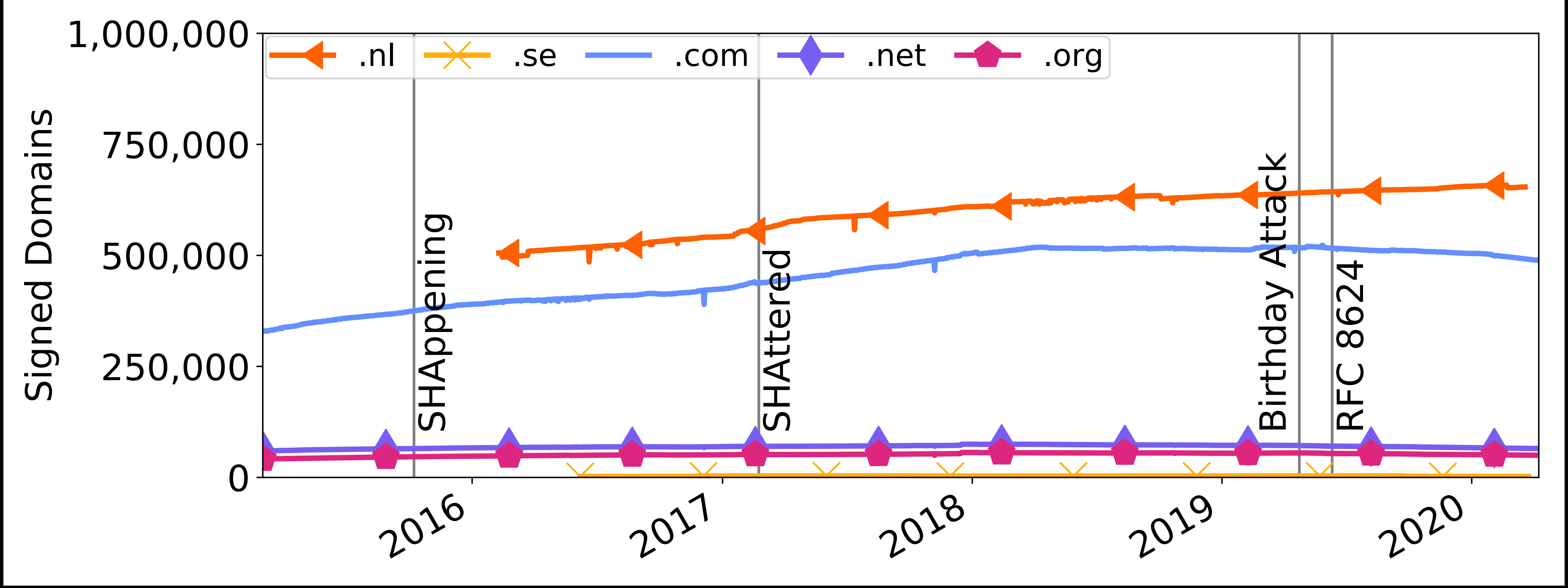
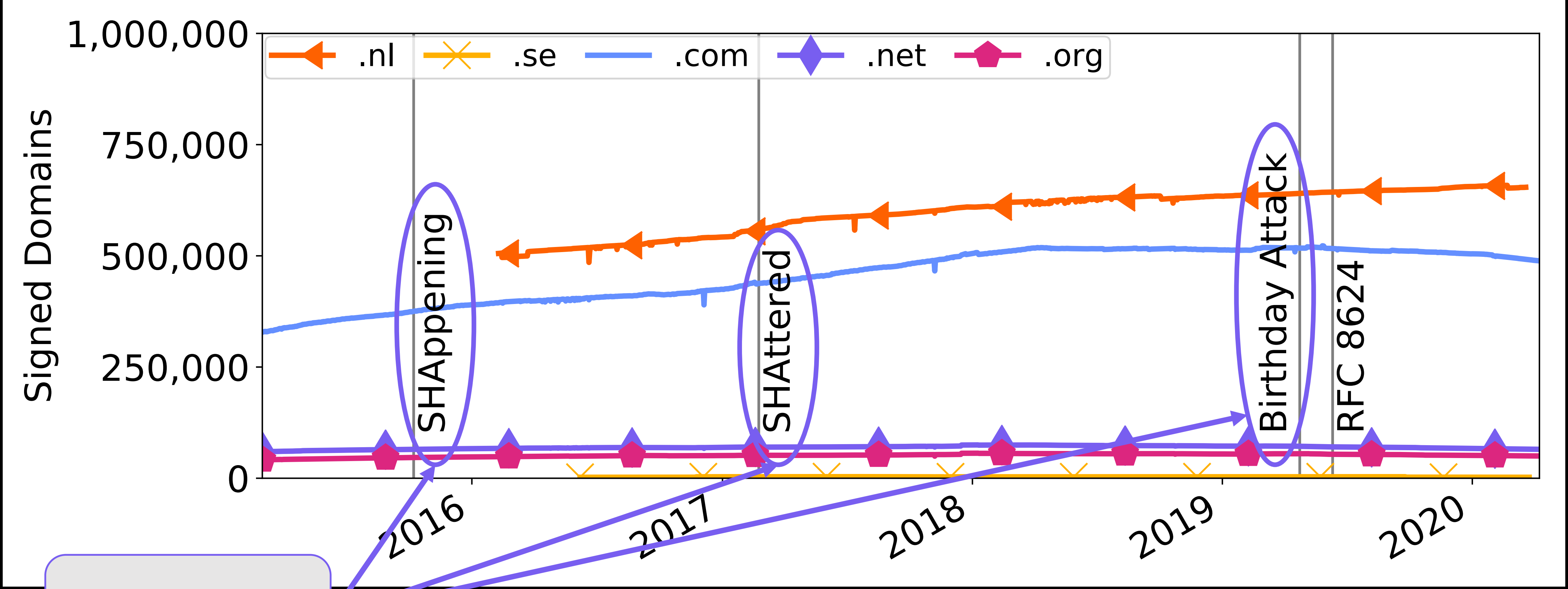
Deprecation & Replacement

Algorithm Deprecation at Domain Names



RSA-SHA1-NSEC3-SHA1

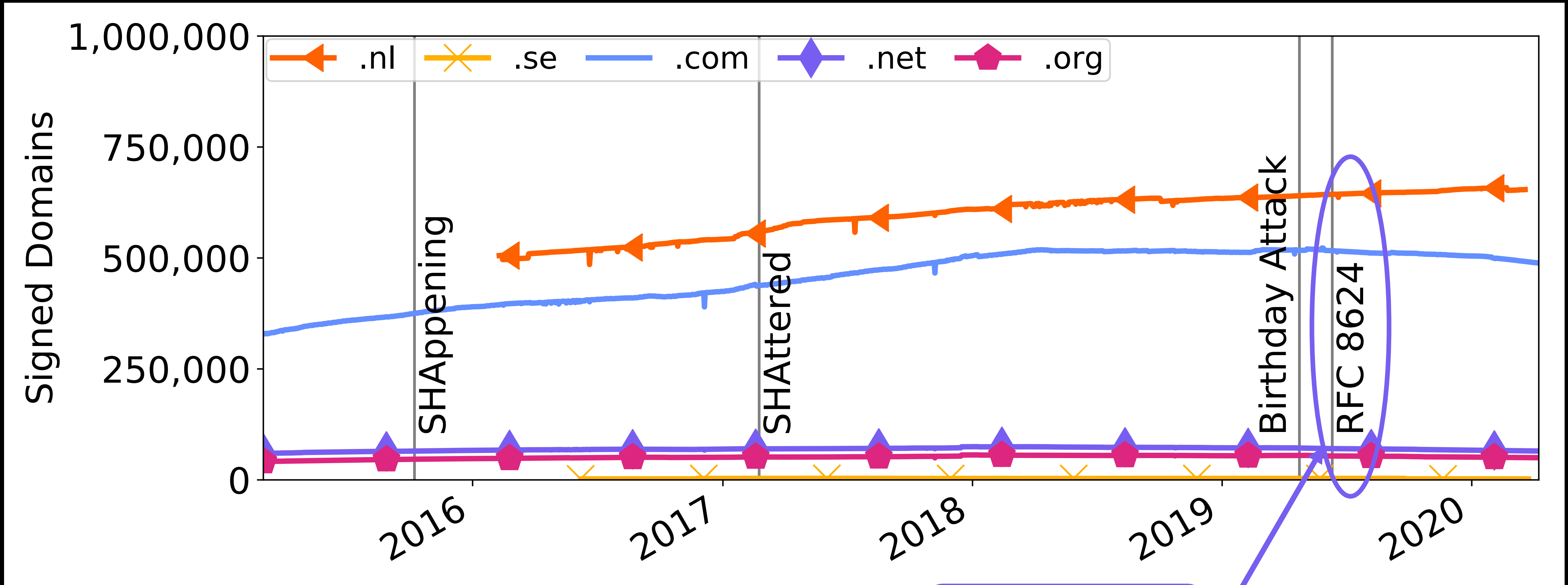
Algorithm Deprecation at Domain Names



Attacks have only minor impact

RSA-SHA1-NSEC3-SHA1

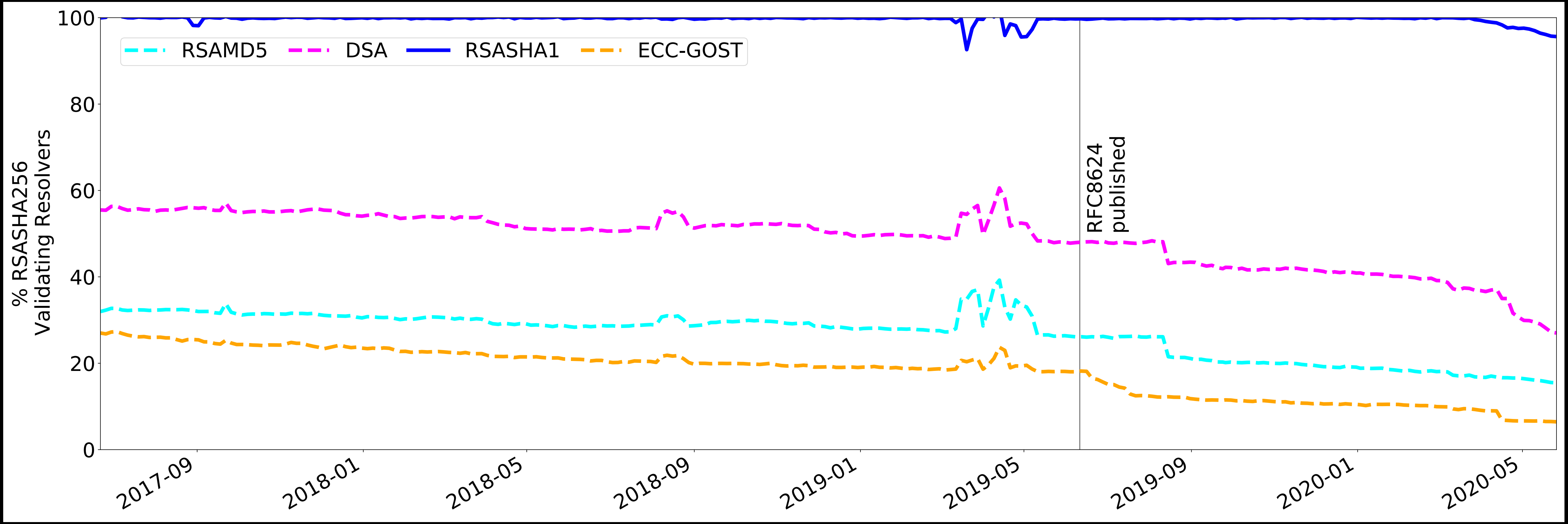
Algorithm Deprecation at Domain Names



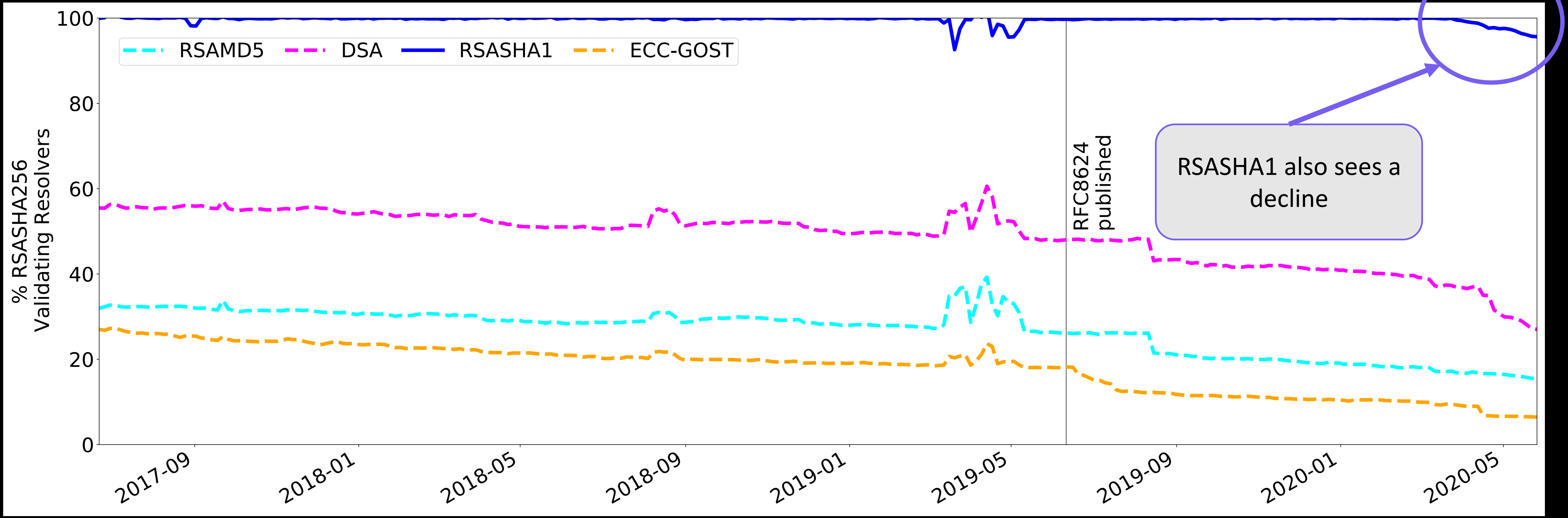
RSA-SHA1-NSEC3-SI

RFC recommendations have some impact

Algorithm Deprecation at Resolvers

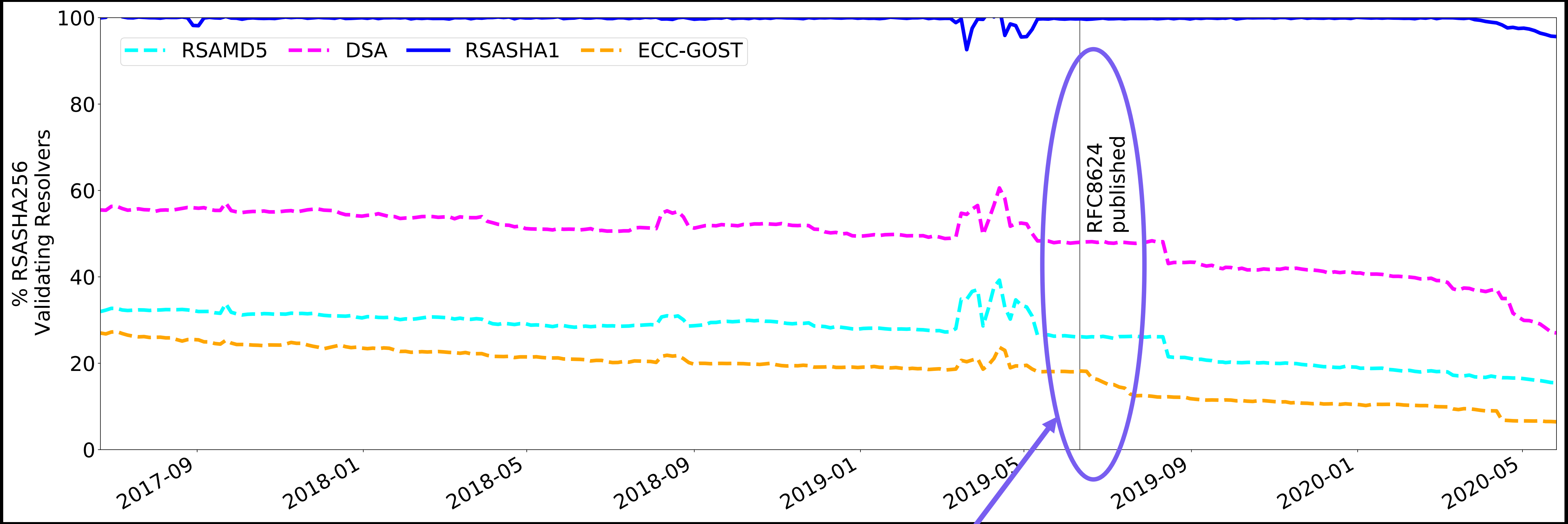


Algorithm Deprecation at Resolvers



RSASHA1 also sees a decline

Algorithm Deprecation at Resolvers



RFC recommendations speed up decline

Has DNSSEC achieved algorithm agility?

- Standardization, support and widespread deployment takes a decade
- DNSSEC is rarely the problem
- But lack of support in software and in the registration channel
- And the complexity of algorithm rollovers

Implications on the Transition to Quantum-Safe Algorithms

- Already transitioning to **current** algorithms takes a lot of time
  - and the Root has not rolled its algorithm yet
- Assessing quantum-safe algorithms as early as possible
- Take barriers into account

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Questions, suggestions, comments?

Contact
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