Living on the Edge: (Re)focus DNS Efforts on the End-Points

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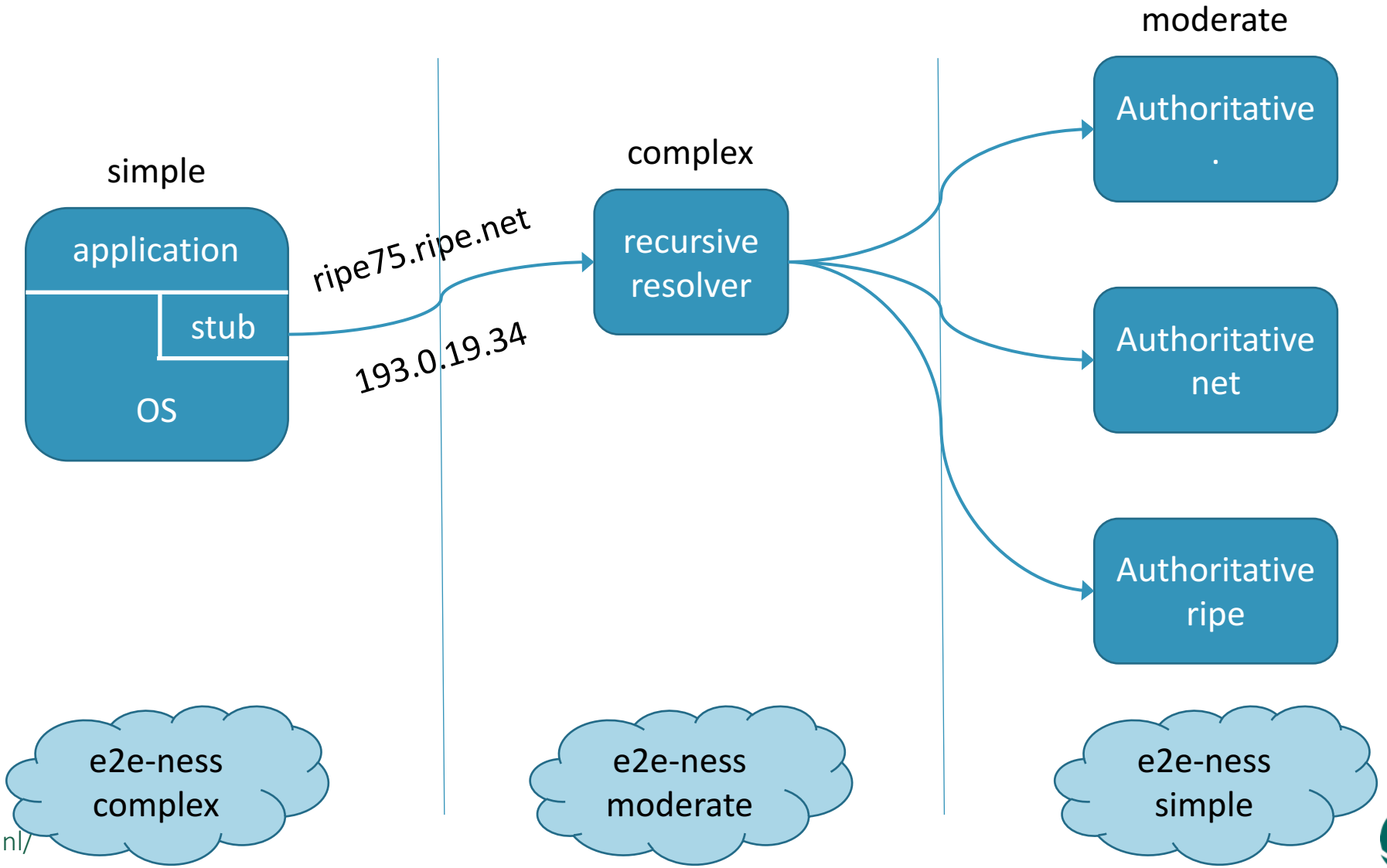
Complexity at Core-Middle-Edge



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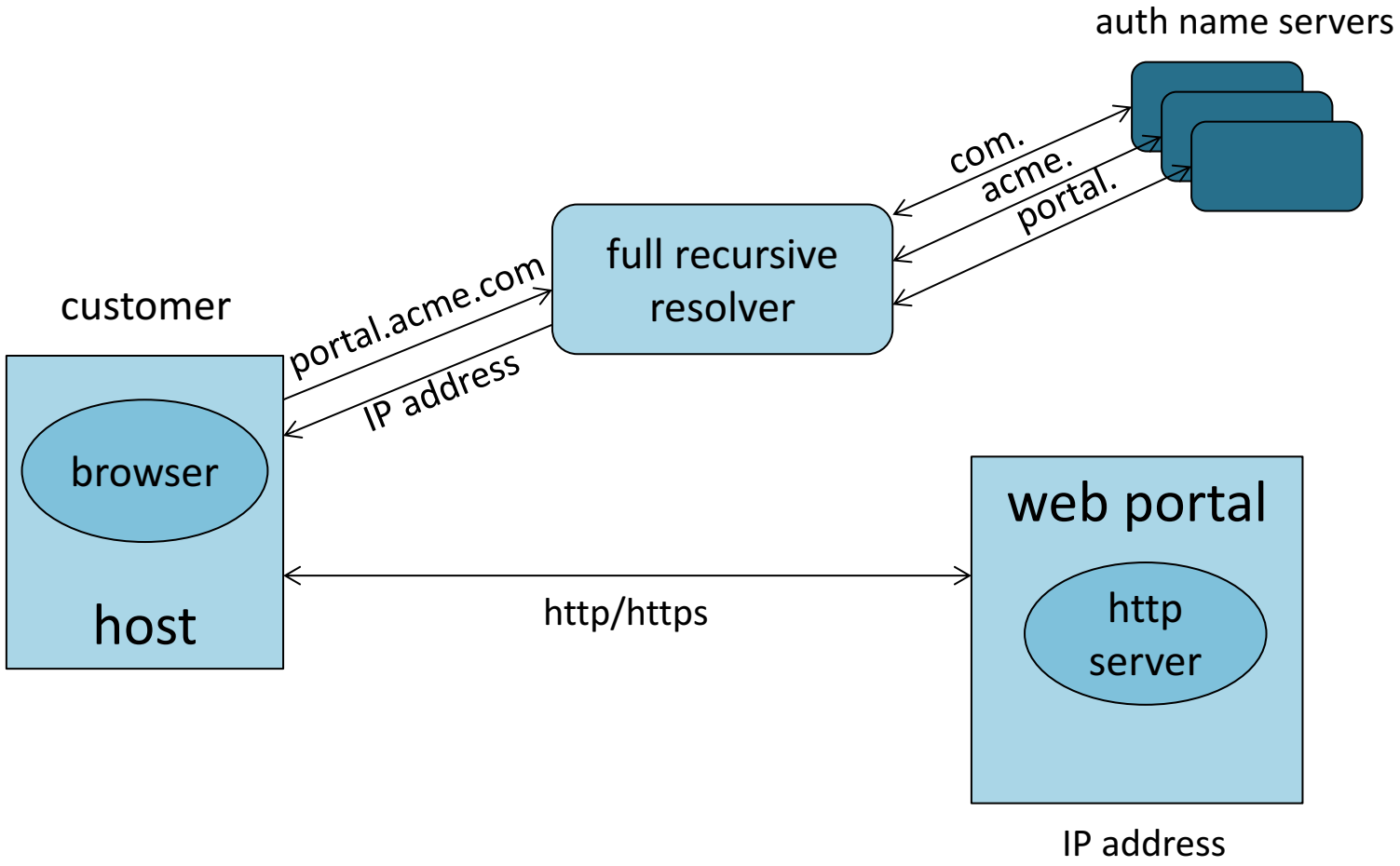
From the ground-up security

… and now for something completely different

Customer–Web Portal Interaction



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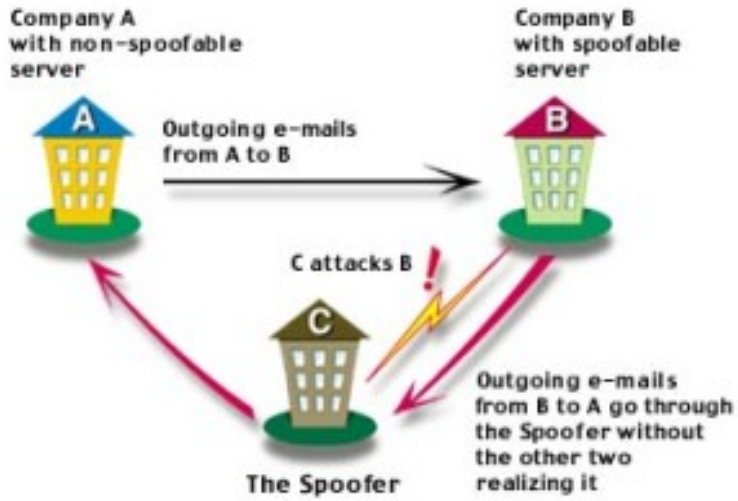
DNS Spoofing

- DNS Spoofing by cache poisoning
  - attacker flood a DNS resolver with phony information with bogus DNS results
  - by the law of large numbers, these attacks get a match and plant a bogus result into the cache

- Man-in-the-middle attacks
  - redirect to wrong Internet sites
  - email to non-authorized email server



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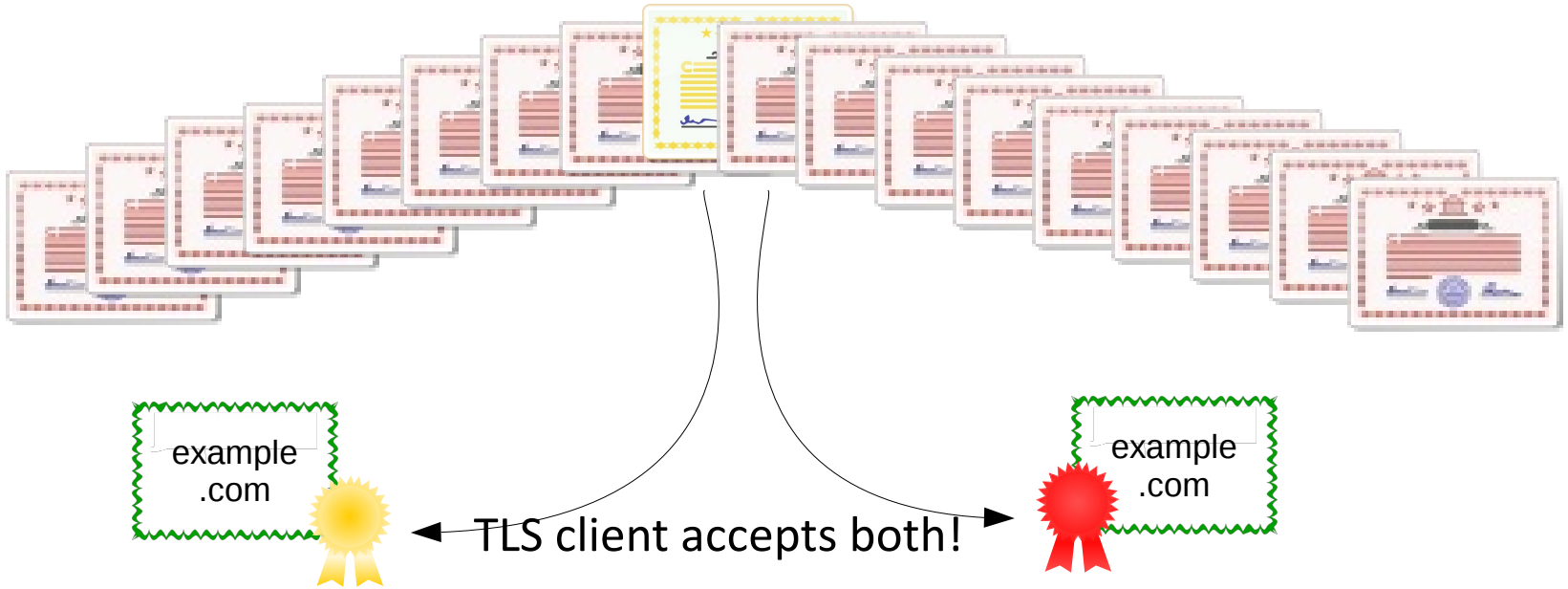
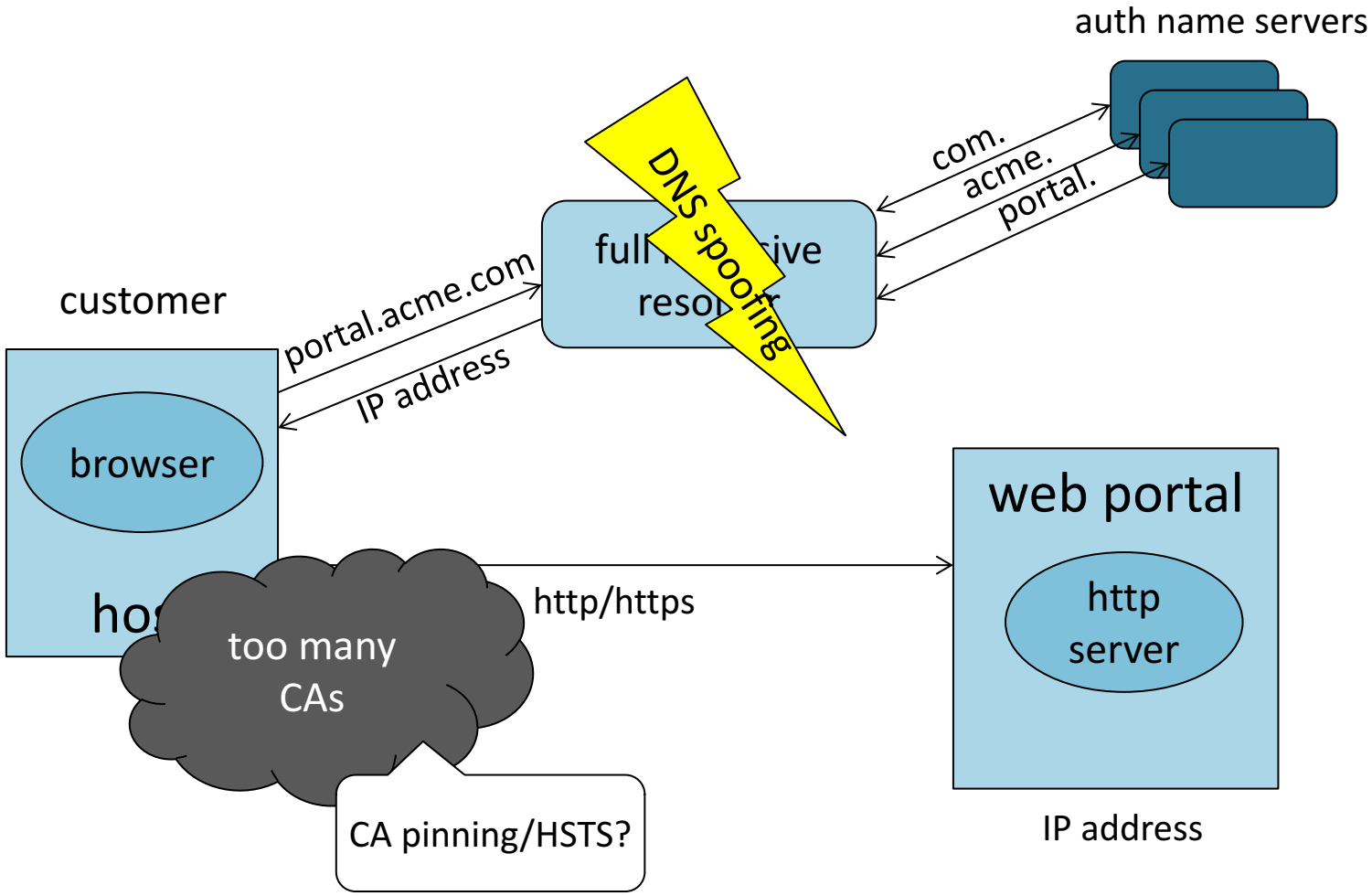
The “Too Many CAs” Problem

- TLS clients have abundance of TAs
  - modern web browsers have 1300+ TAs
  - any of them can issue certificate for example.com

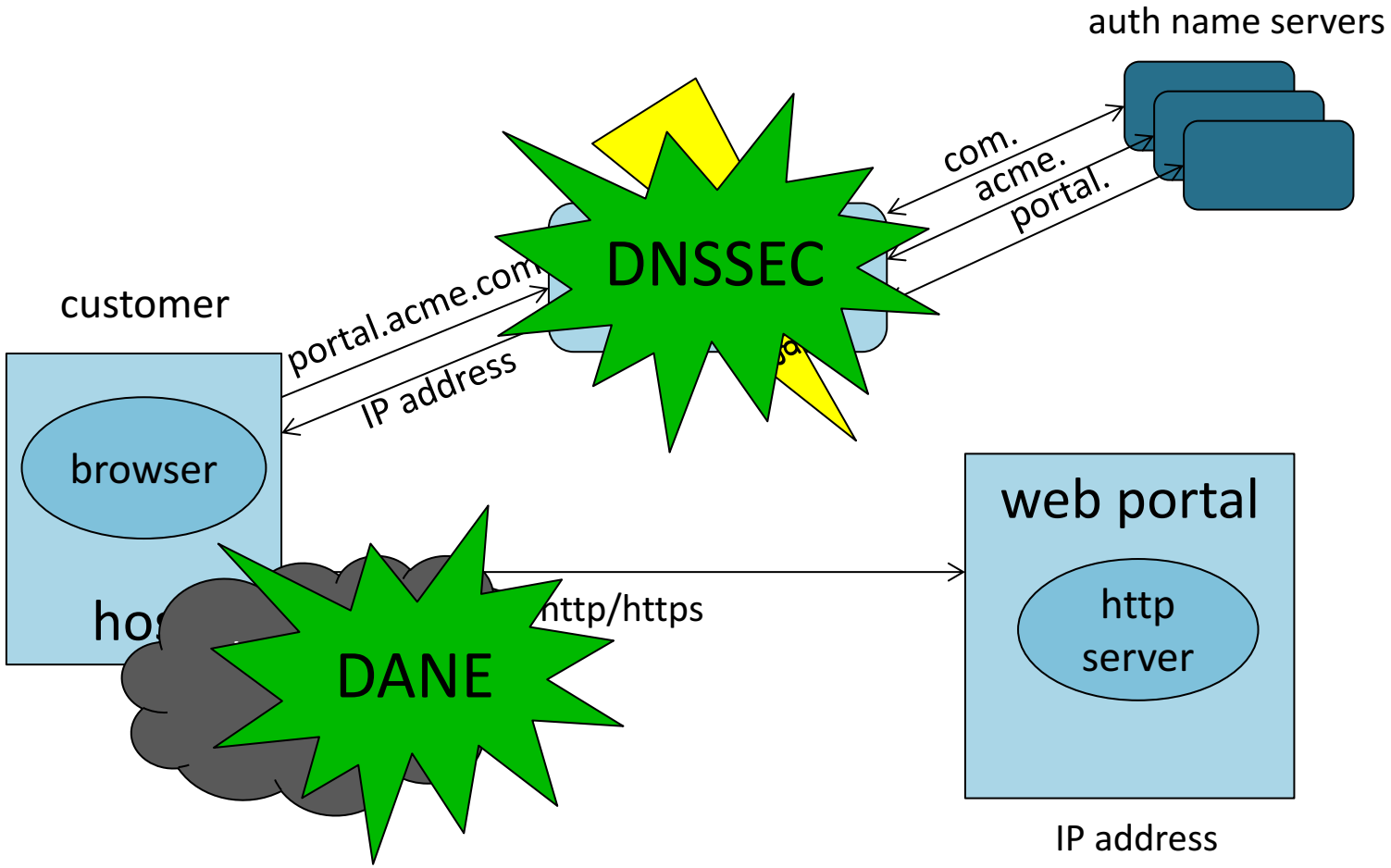


credits wes.hardaker@parsons.com

Customer–Web Portal Interaction



DNSSEC-Based Secure Customer–Web Portal Interaction



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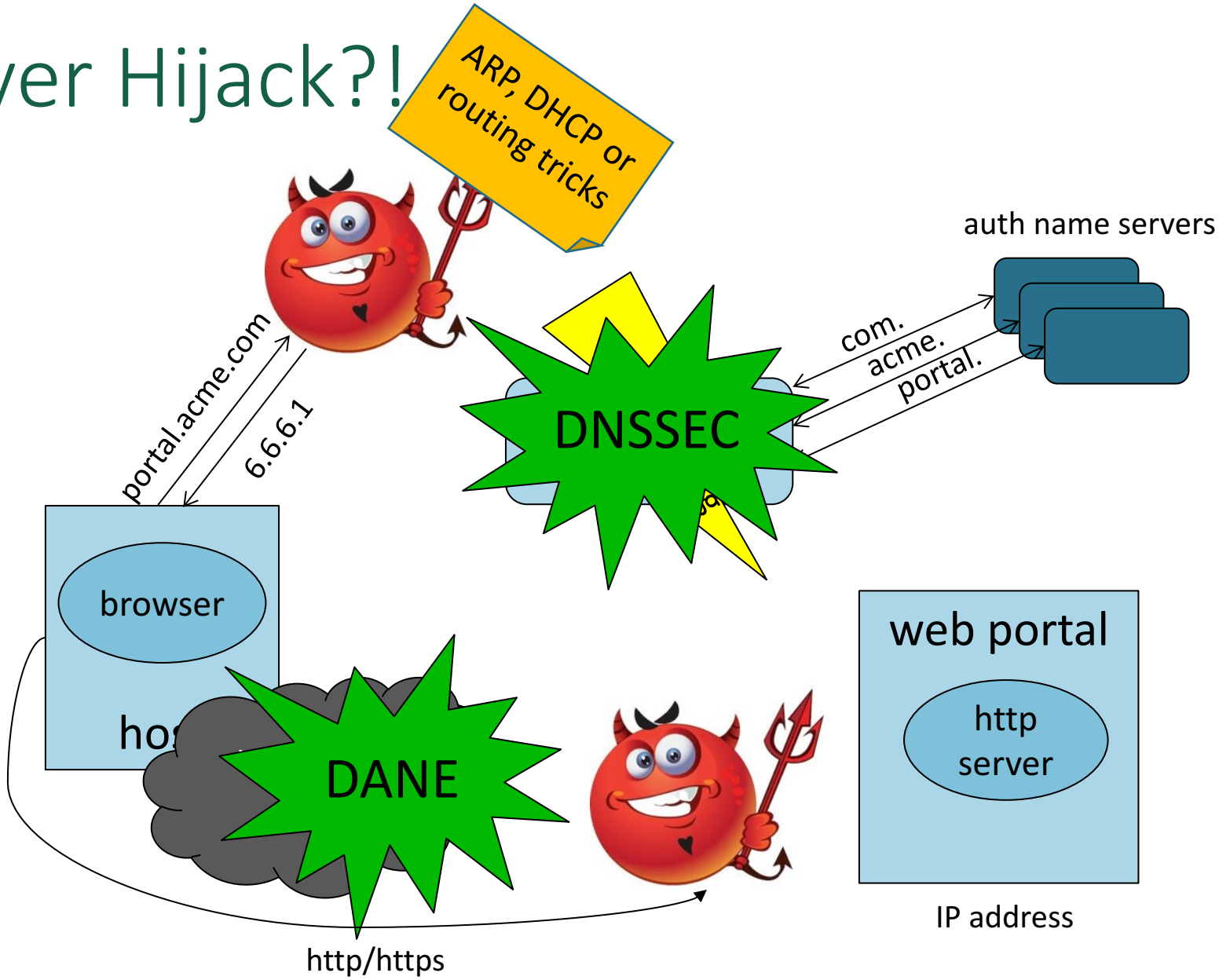
Resolver Hijack?!



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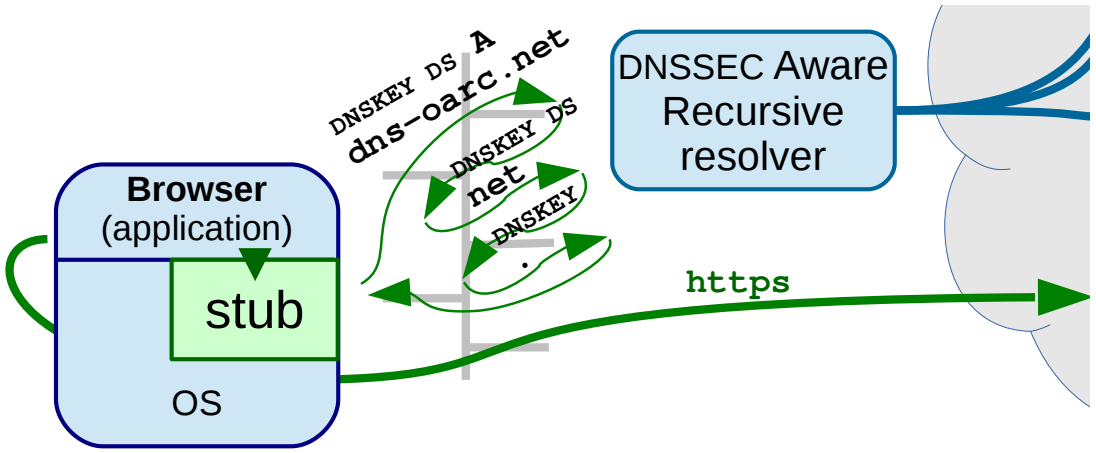
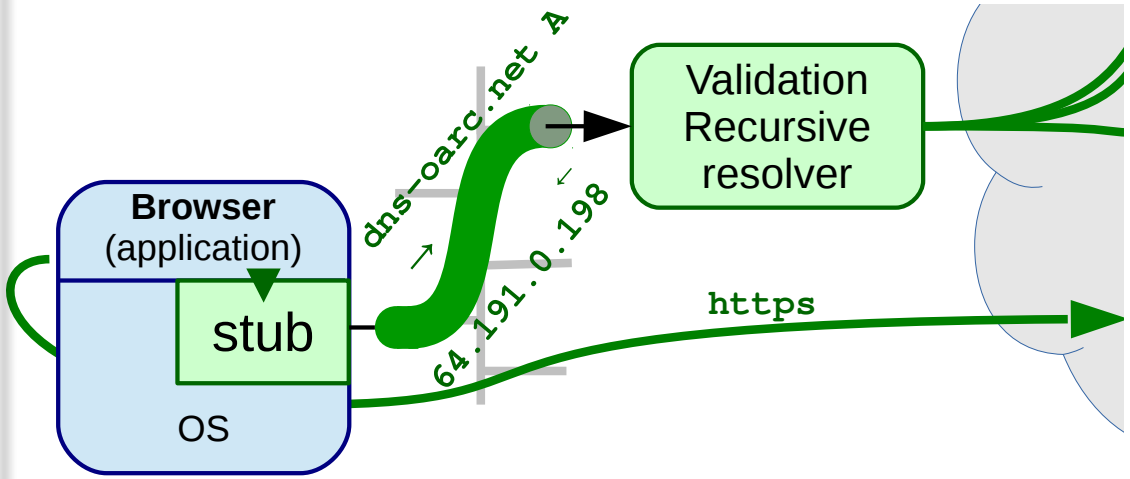
Countering Resolver Hijack

- DNSSEC on the stub



- DNS-over-TLS



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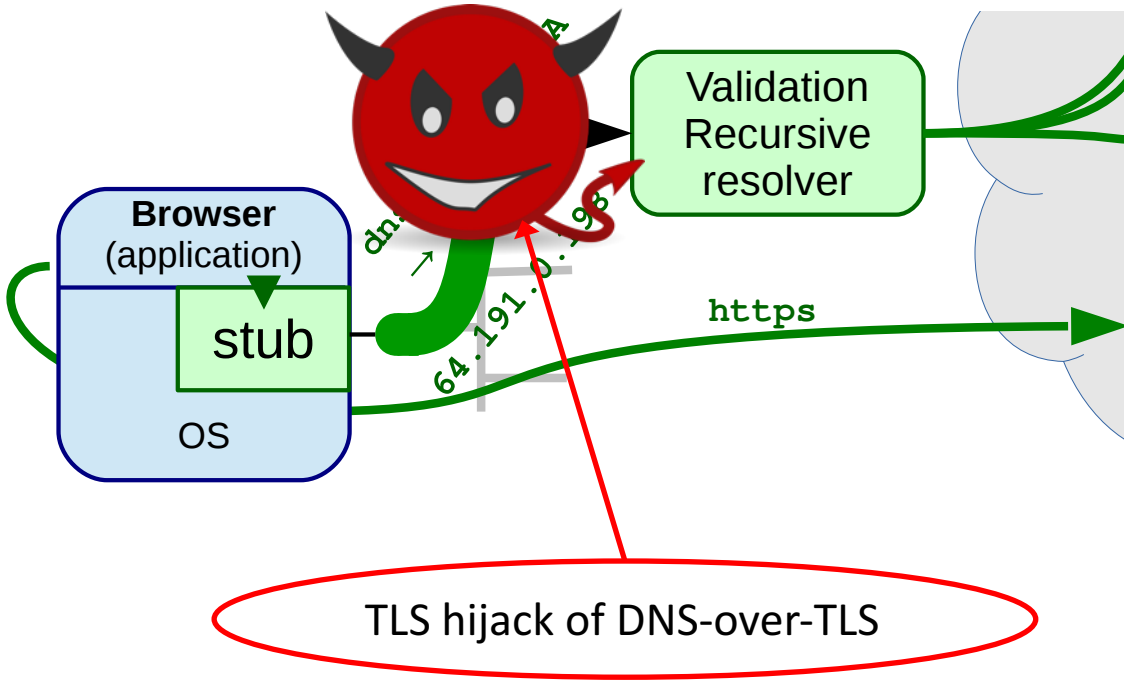
Countering Resolver Hijack (cont'd)

- DNS-over-TLS



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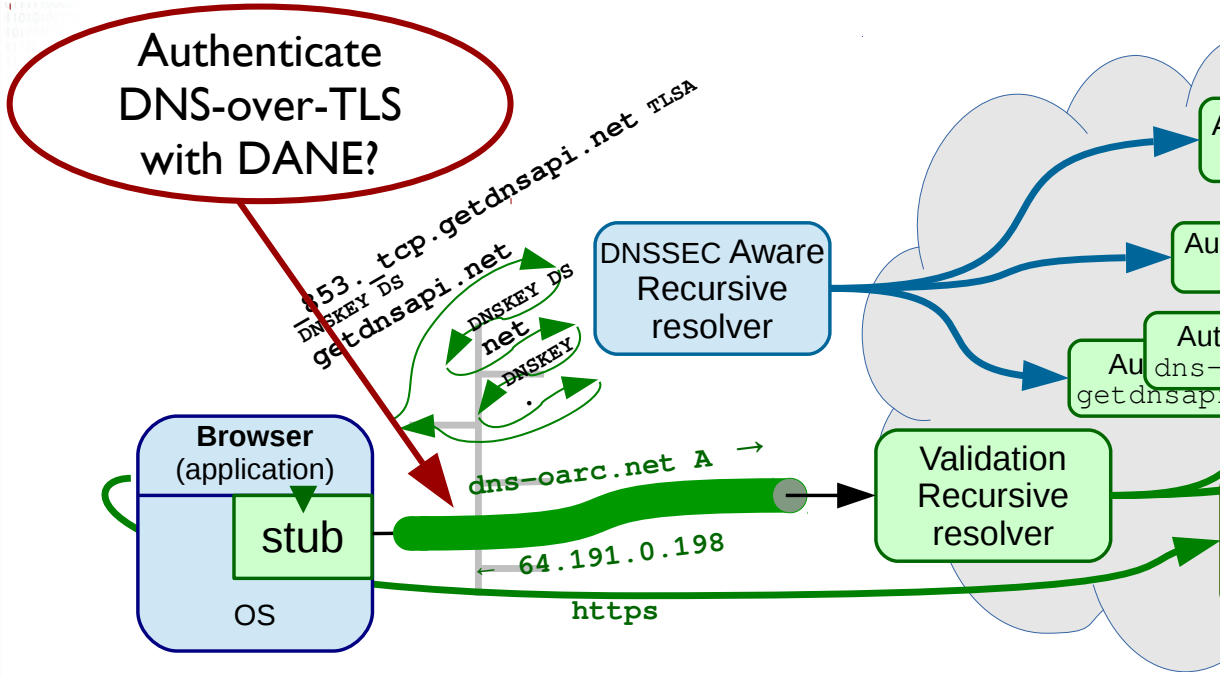

Bootstrap the TLSA lookup with regular DNS?

Chicken and egg problem.

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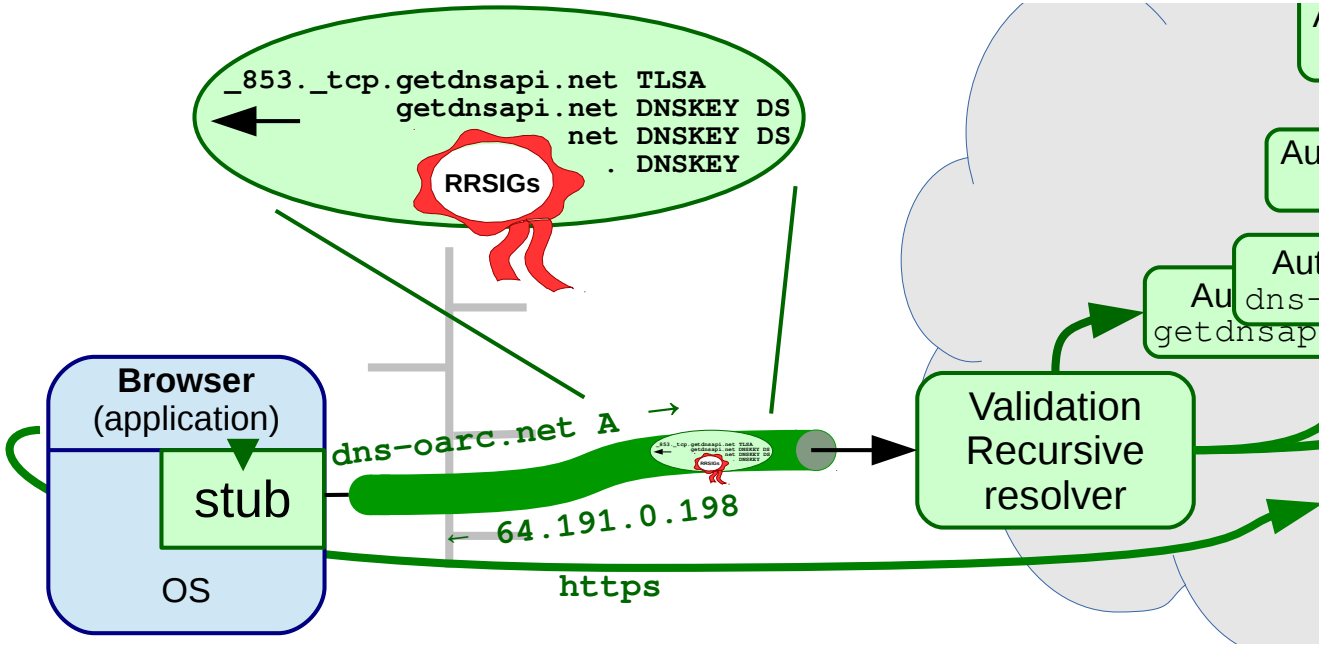
DNSSEC Data Blob-over-TLS

- TLSA record + the complete DNSSEC authentication chain embedded in a TLS extension
  - TLS DNSSEC authentication to prevent “Too many CA’s” problem
  - https://tools.ietf.org/html/draft-ietf-tls-dnssec-chain-extension



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DNS Privacy and Standards

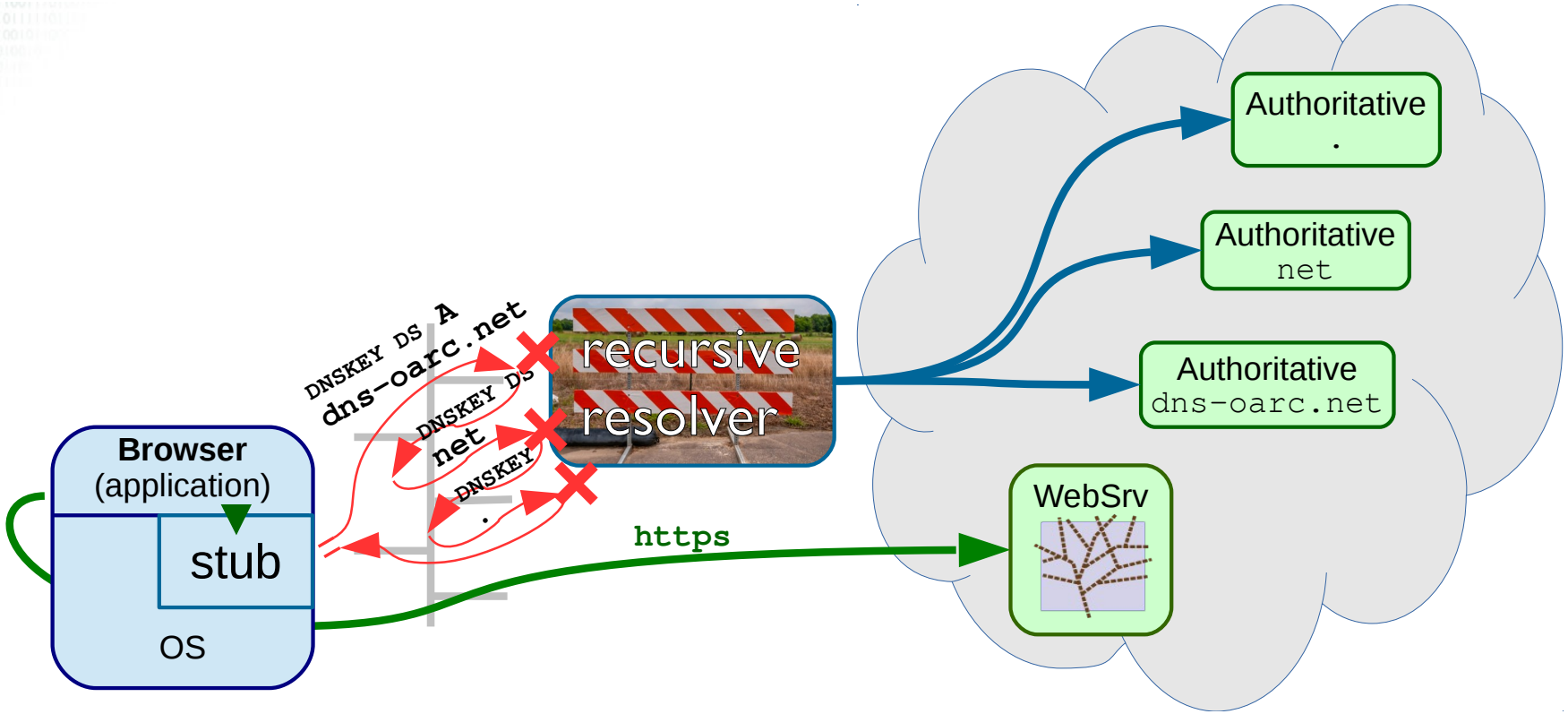
- DNS privacy requirements

Capability	Standard
DNS-over-TLS	RFC7858
Reuse/pipelining/OOOP	RFC7766
TCP fast open	RFC7413
ENDS0 keep alive	RFC7828
ENDS0 padding	RFC7830
PKIX support for authentication	*(various)*
DNSSEC support *(for address lookup and authentication)*	*(various)*

DNSSEC Roadblocks

Consequences of living on the edge

DNSSEC Roadblocks



- Resolving DNSSEC (to cross the first mile) needs DNSSEC aware recursive resolver

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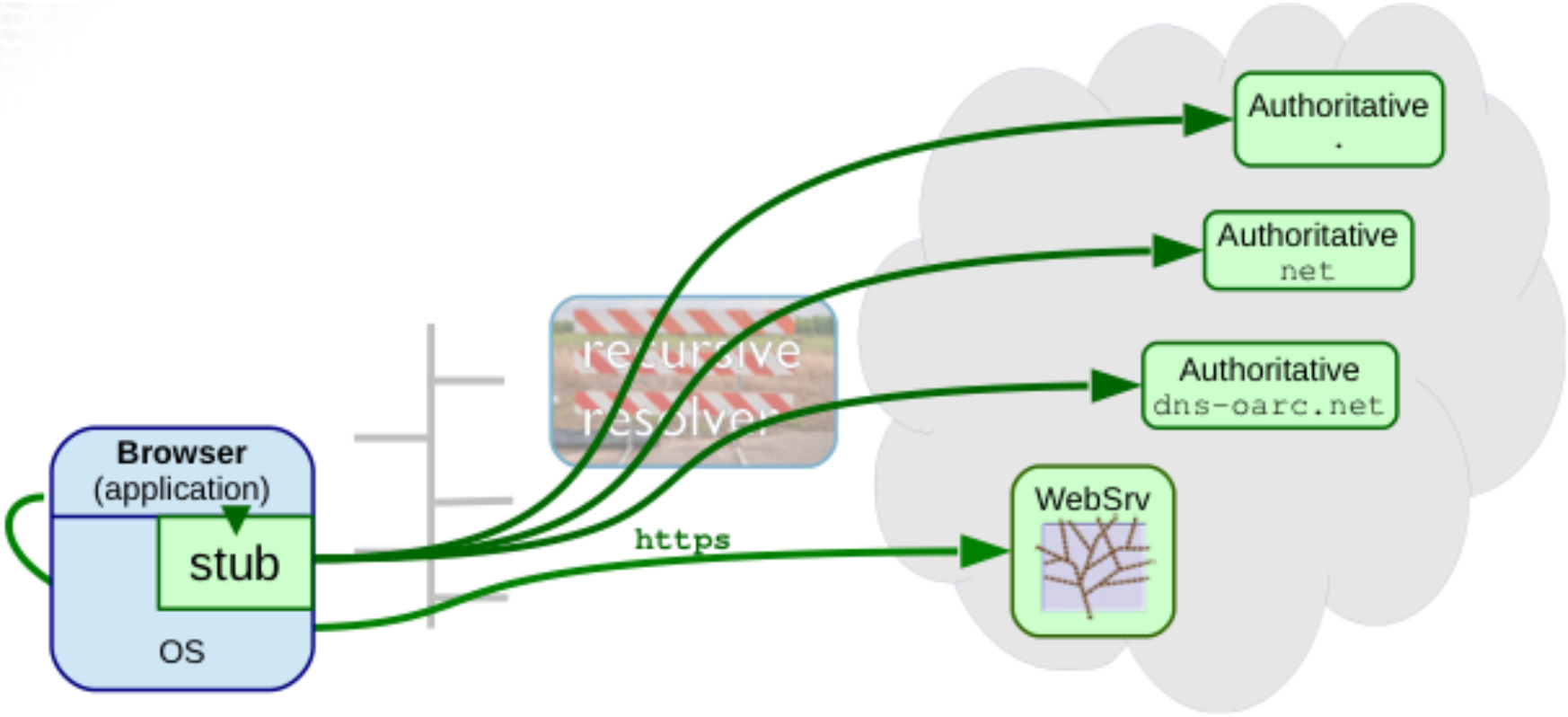
DNSSEC Roadblock Avoidance



- DNSSEC roadblock avoidance + full recursion capability
  - https://tools.ietf.org/html/rfc8027

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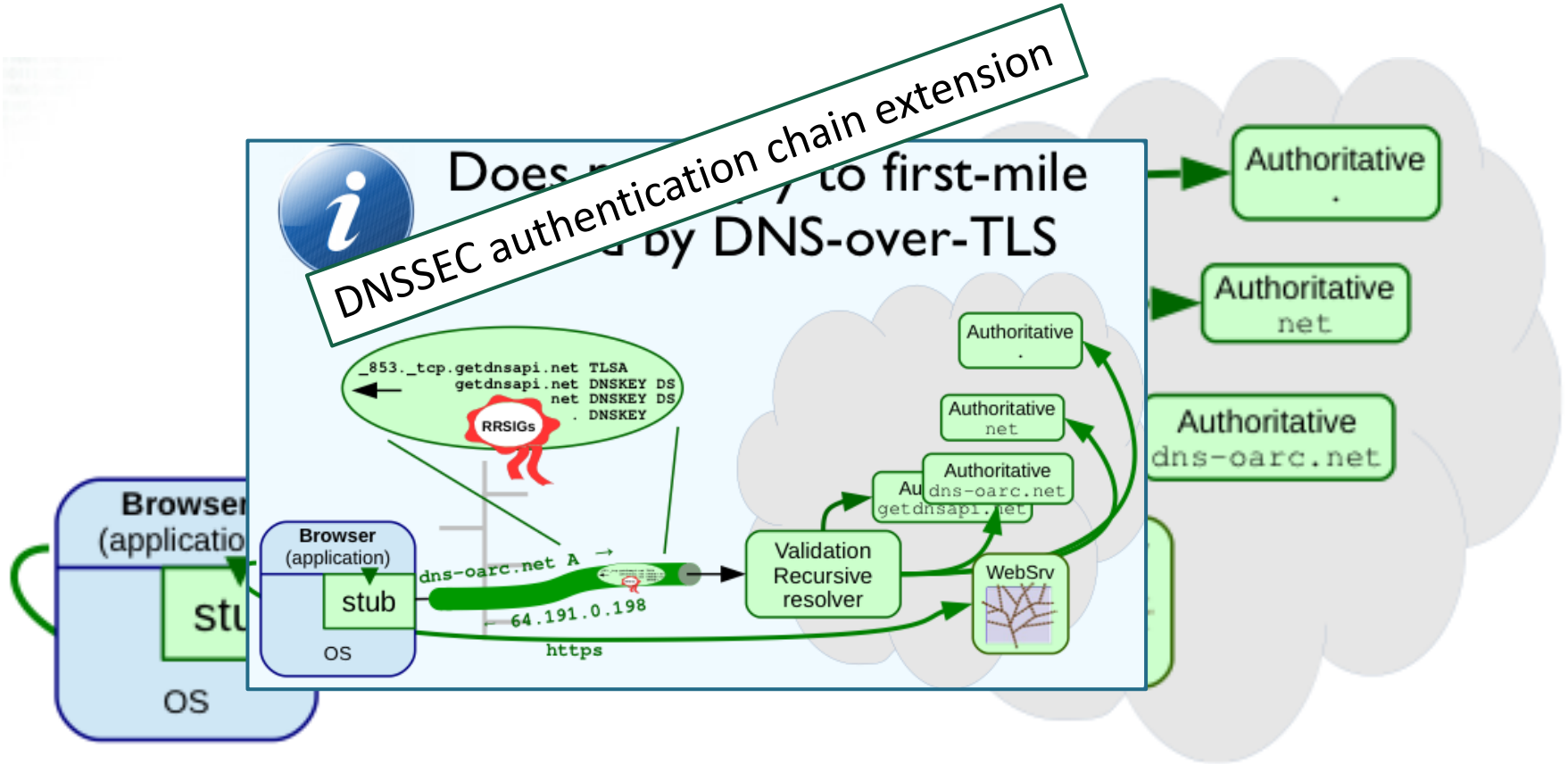
DNSSEC Roadblock Avoidance



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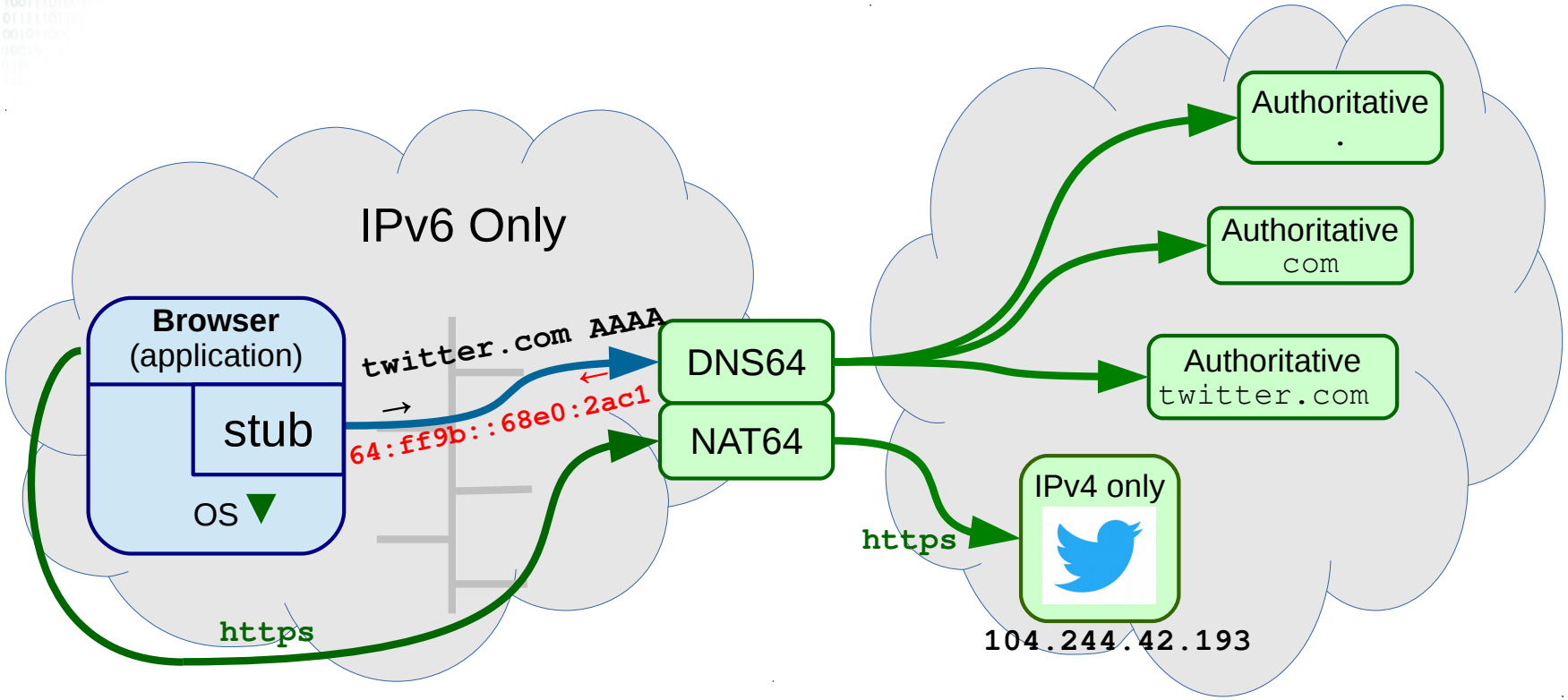
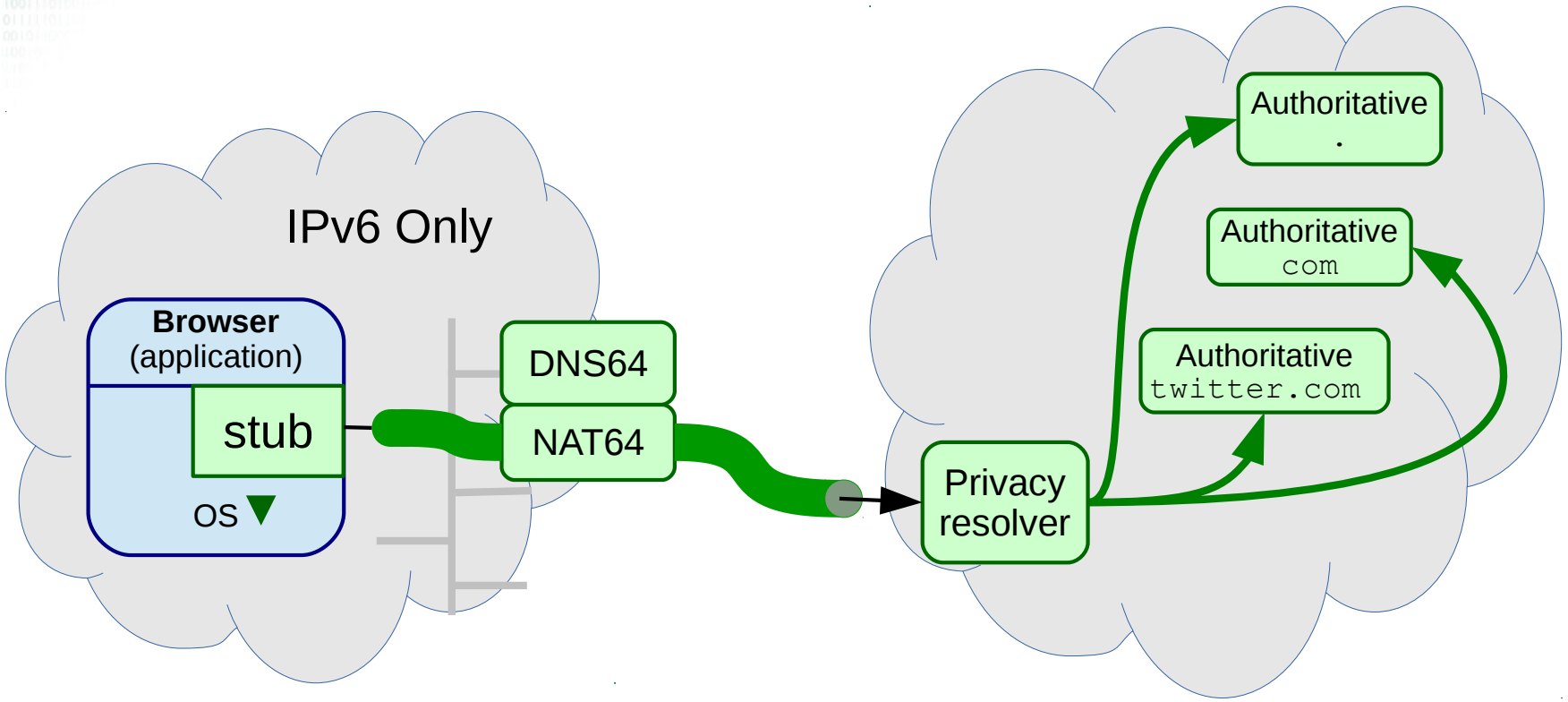
DNSSEC with DNS64 & NAT64



- Jen Linkova's "Let's talk about IPv6 DNS64 & DNSSEC"
  - https://blog.apnic.net/2016/06/09/lets-talk-ipv6-dns64-dnssec/
- With IPv6 prefix discovery, stub can do DNSSEC validation of A RR itself

DNSSEC with DNS64 & NAT64



- IPv6 address synthesis prefix discovery + DNS64 capability
  - https://tools.ietf.org/html/rfc7050
  - https://tools.ietf.org/html/rfc6147

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KSK Root Rollover

More roadblocks ahead

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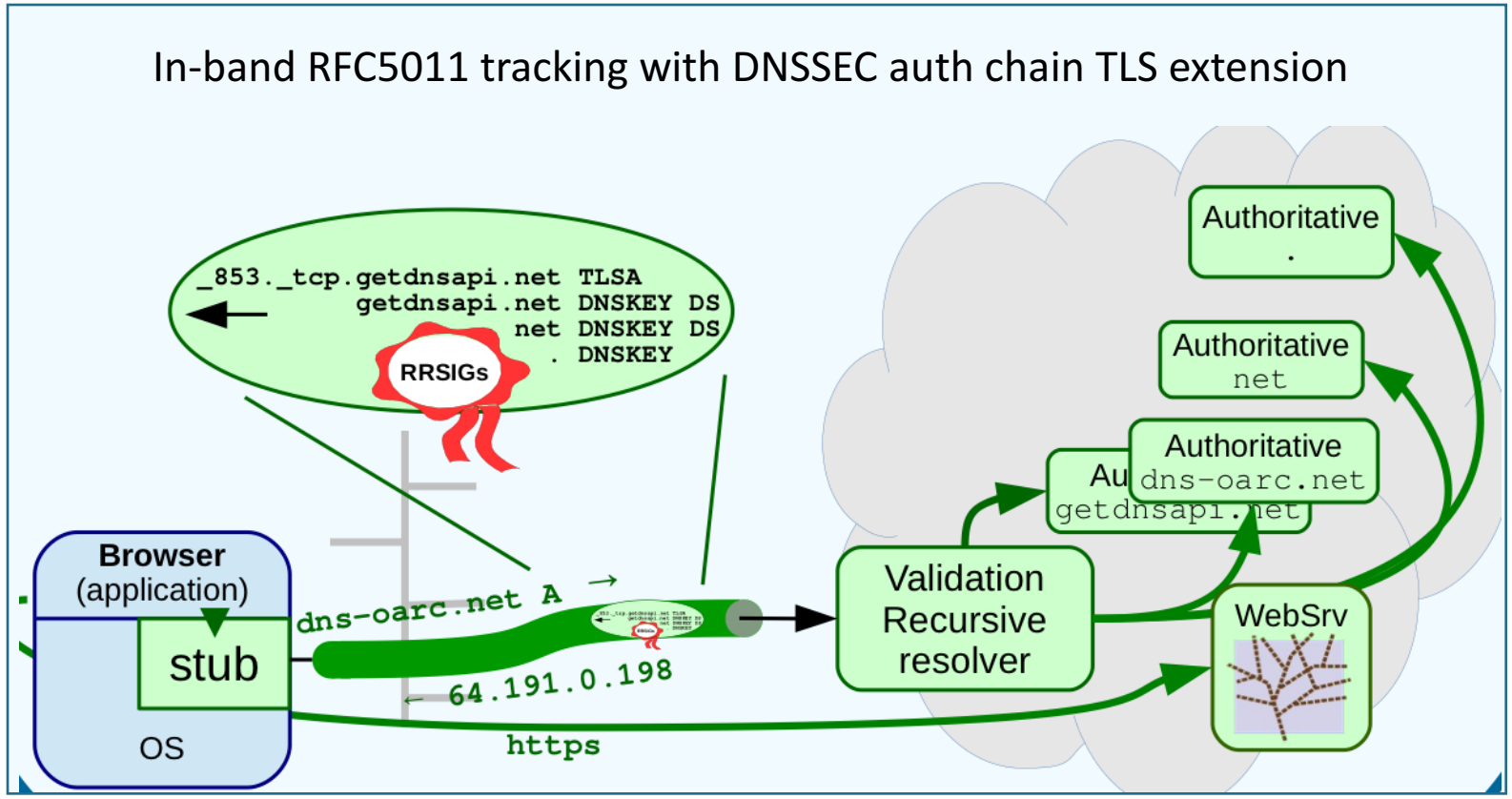
RFC5011 for DNSSEC Validating Stubs

- DNSSEC validating stub **must** do RFC5011



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KSK Root Rollover for Stub Library

- A stub library for DANE
  - runs with user's privileges
  - no system config
  - bootstrap DNSSEC capabilities
    - https://tools.ietf.org/html/rfc7958
    - unbound-anchor functionality

DNSSEC Roadblocks and Standards

- DNSSEC stubs capability requirements

Capability	Standard
DNSSEC validation	*(various)*
DNSSEC roadblock avoidance	RFC8027
IPv6 prefix discovery	RFC7050
IPv6 address synthesis	RFC6147
Automated trust anchor updates	RFC5011
Automated initial trust anchor retrieval	RFC7958

Living on the Edge

"Final Thoughts"

Wrapping Up

- Stub resolver/library experience complex e2e-ness
  - at the edge of the network many kinds of roadblocks/brokenness
- DNS-based security from the ground up
  - bootstraps with the stub
- Closing the gap in the last mile with ongoing work
  - overview of RFCs and drafts
  - most of discussed work is implemented in **getdns** and its stub resolver **Stubby**
- DNSSEC Authentication Chain Extension
  - https://tools.ietf.org/html/draft-ietf-tls-dnssec-chain-extension