XFR over TLS

Encrypting DNS zone transfers

Shivan Kaul Sahib
Sara Dickinson
Allison Mankin
Willem Toorop
Pallavi Aras
What is the problem?
DNS zone transfers happen in plain text
DNS zone transfers happen in plain text => passive surveillance.
DNS zone transfers happen in plain text $\Rightarrow$ passive surveillance.

TSIG doesn’t provide data privacy.
DNS zone transfers happen in plain text $\Rightarrow$ passive surveillance.

TSIG doesn’t provide data privacy.

NSEC3/NSEC5 prevent zone enumeration, but not leakage through zone transfer.
Why should we care?
Contents of zone can contain sensitive corporate information.
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Regulatory or policy reasons why the zone contents must be kept private.
Solution!
Encrypt AXFRs (full) and IXFRs (incremental) using TLS as a transport.
XoT: XFR-over-TLS
Current status

**Adopted draft** by IETF DNS Privacy Working Group

Working on setting up testbed to answer some open questions
Existing

XOT-Based IXFR
Open Questions
Open Questions

Threat model
Open Questions

Threat model

Padding recommendations
Threat Model

1. Difference between leakage addressed by XoT and NSEC3/NSEC5?
Threat Model

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2. Would developing a DNS zone-specific threat model be of use?
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1. Difference between leakage addressed by XoT and NSEC3/NSEC5?
2. Would developing a DNS zone-specific threat model be of use?
3. Documented cases of passive surveillance on DNS zone transfers?
Padding

How should padding be done for

1. AXFR, to minimize leakage of zone size
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2. IXFR, to minimize leakage of update rates, DNSSEC resigning
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Is this a worthwhile goal? Arguments either way?
Padding experiments

Unsigned zone, regular updates

Large DNSSEC NSEC3 signed zone, no updates

Large DNSSEC NSEC3 signed zone, with updates
Thank you!
Summary: Questions for Discussion

Threat Model

1. NSEC3 vs XFR threat?
2. General DNS zone threat model?
3. Cases of passive surveillance on zones?

Padding

1. Experiment design for padding measurements
2. Is this worthwhile?
Extra Slides
Padding Policy

- Requirements could be context specific

- Packet sizes and timings vary depending on several factors:
  - Frequency of updates (manual reload vs steady dynamic updates vs batch dynamic)
  - ‘Condensation’ of changes
  - DNSSEC signed (NSEC/NSEC3)
    - Ongoing resigning of records as signatures expire (spikes or jittered)
    - Updates trigger resigning -> new RRSIGs

- Next slides present two extremes of patterns/packet sizes
Takeaways

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1. Unsigned zones can directly leak number of record updates even when encrypted.
2. Re-using a single connection for multiple zones would disguise the update pattern (+ performance gain)
3. DNSSEC signing with jitter disguises the actual updates, but pattern varies with zone size and signing details
### XoT - Authentication mechanisms

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<thead>
<tr>
<th>Method</th>
<th>Secondary</th>
<th>Primary</th>
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<tbody>
<tr>
<td></td>
<td>Data Auth</td>
<td>Channel Conf</td>
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<td>TSIG</td>
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<td>Oppo</td>
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<td>Strict</td>
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<td>ACL on master</td>
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Analysis: Using TSIG, Strict TLS and an ACL on the primary provides all 3 properties for both parties with reasonable overhead.
NSEC3 usage

Nominet UK (operates .co.uk) and uses NSEC3 as the default. We know of research data that shows the majority of DNSSEC signed SLDs do use NSEC3.