DOA-likePersistentIdentifiers over DNS: a Prototype

draft-durand-doa-over-dns-03

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The ICANN Office of the CTO has initiated a research project related aimed at demonstrating if DOA-like, persistent identifiers can be achieved as an application of the DNS.

This talk will present the state of the research and introduce a prototype made in collaboration with the University of La Plata in Argentina that will be demonstrated at ICANN60 next week.

This research project is not an endorsement of the DOA technologies by the ICANN organization.
DOA & Persistency /1

- URLs can break for many reasons:
  - organizational changes
  - company name changes
  - mergers and acquisitions
  - ...
○ URLs can break for many reasons:
  ○ organizational changes
  ○ company name changes
  ○ mergers and acquisitions
  ○ ...

○ A number of solutions exist in the industry:
  ○ URL redirect
  ○ Tiny URL
  ○ ....
To address this issue, one of the DOA’s design goals was to provide persistent identifiers.

The DOA solution is the Handle System.

- Handle prefixes use numbers, not names overloaded with semantic.
- Handle suffixes use a flat space (no hierarchical structure).
To address this issue, one of the DOA’s design goals was to provide **persistent identifiers**.

The DOA solution is the Handle System:
- **Handle prefixes use numbers**, not names overloaded with semantic.
- **Handle suffixes use a flat space** (no hierarchical structure).
- The Handle System uses specific protocols that are **not standardized in open standard bodies** such as IETF.
  - Those protocols do not really add to the persistency story, they are mostly a different way to resolve identifiers.
Can the DNS Provide DOA-Styled Persistency?

- Short answer: Yes. We need 3 things:
  - Branch of the DNS name space to attach those identifiers
    - Persistency Anchor ($PANCHOR)
    - Maybe more than one to introduce competition
  - Naming convention similar to the one used in the Handle System
    - Use labels that do not have mnemonic properties
    - Do not map organization structure, use flat as much as possible
  - New DNS RR type to structure data
    - DOA RR type, (see: draft-durand-doa-over-dns-03)
## RR Type

<table>
<thead>
<tr>
<th>0:</th>
<th>DOA-ENTERPRISE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IANA SMI Network Management Private Enterprise Codes Registry (or Zero)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4:</th>
<th>DOA-TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Predefined values (1-100), user-defined values (101-99,999)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>8:</th>
<th>DOA-LOCATION</th>
<th>DOA-MEDIA-TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1: Local 2: URL 3: HDL</td>
<td>RFC1035 &lt;character-string&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10:</th>
<th>DOA-MEDIA-TYPE (continued)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RFC1035 &lt;character-string&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>DOA-DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Binary data Base64 encoded (Null is “-“)</td>
</tr>
</tbody>
</table>
DOA vs DNS Representation

DOA:

20.500.1234/object1
index 2
index 3
index 300

DNS:

$PANCHOR
1234.500.20.$PANCHOR
IN DOA Type 2
IN DOA Type 3
IN DOA Type 300
Example: BigCo

BigCo: Assigned label 12 under $PANCHOR
BigCo makes IoT devices, e.g. device model number 78902

<table>
<thead>
<tr>
<th>12.$PANCHOR IN DOA</th>
</tr>
</thead>
<tbody>
<tr>
<td>101 Description local</td>
</tr>
<tr>
<td>2  Webpage URL</td>
</tr>
<tr>
<td>1  Email local</td>
</tr>
<tr>
<td>100 Pubkey local</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>78902.12.$PANCHOR IN DOA</th>
</tr>
</thead>
<tbody>
<tr>
<td>101 Description local</td>
</tr>
<tr>
<td>2  Webpage URL</td>
</tr>
<tr>
<td>102 Firmware URL</td>
</tr>
<tr>
<td>103 Firmware-sig local</td>
</tr>
<tr>
<td>104 Firmware-version local</td>
</tr>
</tbody>
</table>
DOA over DNS Prototype
Universidad Nacional de La Plata

**Project Leader:** Pedro Brisson, Diego Vilches  
**IoT Development:** Fernando López, Francisco Torre y Emilio Crudele  
**DNS implementation & Web Interface development:** Matías Banchoff, Matías Ferrigno, Andrés Barbieri

www.unlp.edu.ar
• **CABASE – Argentina**

- Argentina Internet Association, founded in 1989 in Buenos Aires
- Has a membership of 400+ companies and entities
- Main project has been the national network of Internet Exchange Points (IXPs), currently has 27 IXPs that include 350+ ISPs and Connectivity Providers, services 14 million end users, delivers major Content Delivery Networks (CDNs) locally, and accounts for almost 60% of Argentina Internet traffic.
- Recently established the IoT Coordination Center & Marketplace for Argentina.
- Has attended ICANN since it’s formation and is member of the ISPCP leadership.
Bind Implementation

- CABASE registered the domain "persistent.lat" with the purpose of using it for this demo.
- Two VMWare virtual machines were instantiated for serving as master and slave DNS servers: ns1-doa.unlp.edu.ar and ns2-doa.unlp.edu.ar
- Both implemented with private branch Bind-9.11.2 provided by ICANN. DOA option will be made public with the release of bind 9.12.0 which is in final beta test.
- Ansible 2.3.2 implemented for provisioning.
- Zone persistent.lat configured with DNSSEC support.
- An small Django 1.11.6 application developed for updating DNS register (performing CRUD operations over DNS registers in a simpler way):
  - The user can create, update or delete DNS records.
  - Records are store in a small sqlite3 data base.
  - A cron task runs an Ansible playbook, which updates -if necessary- the configuration in both DNS servers.
IoT Device Implementation

- **$PANCHOR**: persistent.lat
- **Test hardware**: NodeMCU board
  - based on ESP8266 MCU with WiFi.
  - Price < USD 1.5 (on a 10,000 unit basis)
- **Test software**: Arduino
  - open-source platform used for building electronics projects. It consists of both a microcontroller and a programming interface IDE.
  - LWIP library patched to support DOA DNS records
1. DNS Zone Configuration Interface

2. DNS set up with IoT device data (RR)

3. IoT device boot. Request RR record

4. DNS Response RR Record: firmware version, url, etc.

5. Verify firmware version

6. Request for new firmware download

7. New firmware code

8. Reboot with new firmware

DNS Web Interface

SRV

Bind (DNSSec)

DOA over DNS

Firmware SRV

Internet
Photos
References

• draft-durand-doa-over-dns-03:

• IoT device code:
  https://github.com/iot-linti/Arduino-esp8266/tree/doa
  https://github.com/iot-linti/doa-sketchs/tree/master/DNSDOA-linti

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