

Deployment and Use of the Domain Name System(DNS) in Deep Space

draft-many-tiptop-dns

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Key Requirements and Assumptions

- DNS resolution from deep space to Earth and reverse, to be avoided because of long delays and intermittent comms
- Need a local autonomous naming environment on celestial body networks with all the useful names
 - So that every name used on the celestial body network is resolved locally on that network
- Secure (aka DNSSEC)
 - To avoid redeploying a complete new trust chain, use same root, delegation tree and trust anchor
 - Do local DNSSEC validation on celestial body networks (with the trust chain uploaded)
- Management of DNS servers and zones done from Earth (don't want an astronaut to configure zone files, at least not yet...)
- N.B. Specially for Moon, it is not far fetch thinking that the Moon network may be « directly » (but highly secured/filtered) connected to Internet (Astronaut wanting to have video calls with family?). Therefore, avoiding name conflict is key: use the same root.
- Terminology:
 - « Local » means the celestial body networks infrastructure point of view.

Approaches

1. Pre-walk of all names used on the local network
 2. Pre-fetch all zones needed on the local network
 3. Special zone with only names needed on the local network
 4. Others
- All approaches share similar setup

Local DNS Infrastructure

- Common to all approaches, local DNS infrastructure:
 - Authoritative NS
 - Resolvers
 - Trust anchor preloaded
 - Some way to send data/zones from Internet to local infrastructure
 - Local use names are in the normal DNS tree
 - Clients using local resolvers
 - Use RFC8806

Approaches (1)

- Pre-walk of all needed names
 - Do a tree walk for all local names needed, with DNSSEC related RRs
 - Save and send to local infrastructure by some means
- Need to know all required names, do not forget one
 - If you do forget one, then when applications on celestial body networks will do DNS resolution will not succeed for that name.

* Suggested by Warren Kumari. All errors are mine.

Approaches (2)

- Pre-fetch of all zones in the needed name hierarchy
 - Carefully choose name hierarchy (TLD, 2ndlevel, ..), maybe dedicated?
 - Example: moon.spaceagency1.int
 - Have « access » to the zones
 - Send zones to local infrastructure by some means
- if not a dedicated name hierarchy, a lot of non useful RRs uploaded.

Approaches (3)

- Special zone
 - From a current zone, select only the needed RRs and then create a special version of the zone
 - sign it, send it to local infrastructure by some means
- need to carefully manage both versions of zones

* Suggested by Mark Andrews. All errors are mine.

Approaches (4)

- Local zones/split DNS
 - Ok if the celestial body network is managed by a single provider, as if there was only one managed network
 - Current deployment plans is based on multiple providers, multiple users, multiple networks
 - In that case, names are not known to other local networks
 - Might be ok for early deployments, specially on mission by mission basis, but does not scale and do not support well local interconnections of networks

Sending Zone Files to Deep Space

- Typical ways to send zone files include: DNS AXFR, IXFR, rsync, ftp, XoT
 - All uses TCP. Not suitable for deep space
- Recommended way: AXFR/IXFR over profiled QUIC as [RFC9250]

New TLD? 2nd Level? ...

- « Does not care »: approaches discussed before support any name hierarchy, but the chosen hierarchy has some impact depending on the chosen approach
- A new root? does not use current trust anchor. Delegation policies? Can of worms?
- While it may be tempting to define .moon, .mars, ... , it will still require quite a lot of policies and delegation trees and there are many various gray zones: spacecraft cruising, spacecraft at Lagrange points, ...
- Instead, just as on Internet: the owner of a service/host defines the names within its current name hierarchy. Careful considerations for optimal usage is however required: like with a specific zone so only names in those specific zones are required in full on the celestial body networks (and the trust/ns path).
- Examples:
 - habitat1.moon.spaceagency1.int
 - rover2.mars.spaceagency2.int
 - basestation1.moon.provider1.com

Other Approaches

- Do not use names. Only IP addresses.
 - Could be used in very early deployments with very limited number of hosts
 - Caveat: some applications/protocols do not work well without names (ex.: http \geq v1.1)
- Use a static file distributed by some means: hosts.txt
 - Could be used in early deployments with very limited number of hosts
 - Requires updating every hosts when a new host is added to the network. If networks are interconnected locally but managed by different organisations, updating becomes more complicated. The scaling issue arrives fast.

Next Steps

- To be added: more detailed info on RRs: which RR, TTL considerations, NS, zone signing, updates of DNSSEC records, ...
- Should an approach be specifically recommended, or leave it to space community/providers/operators... ?
- Specification: [draft-many-tiptop-dns](#)
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