draft-afrvrd-dnsop-stateful-hbs-for-dnssec-00

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Motivation

- There is much discussion about the **advent of quantum computers**
- Timeline for **practical QCs** that break current public key algorithms unsure, **estimations vary from 15 to 50 years**
- **Post-Quantum Crypto**graphic algorithms are seeing a lot of development (e.g. **NIST standardisation** effort, which is **in** the **final phase**)
- There is **momentum to start deployment of PQC algorithms** (i.e. expect requirements for PQC support to appear in a government tender near you some time soon)

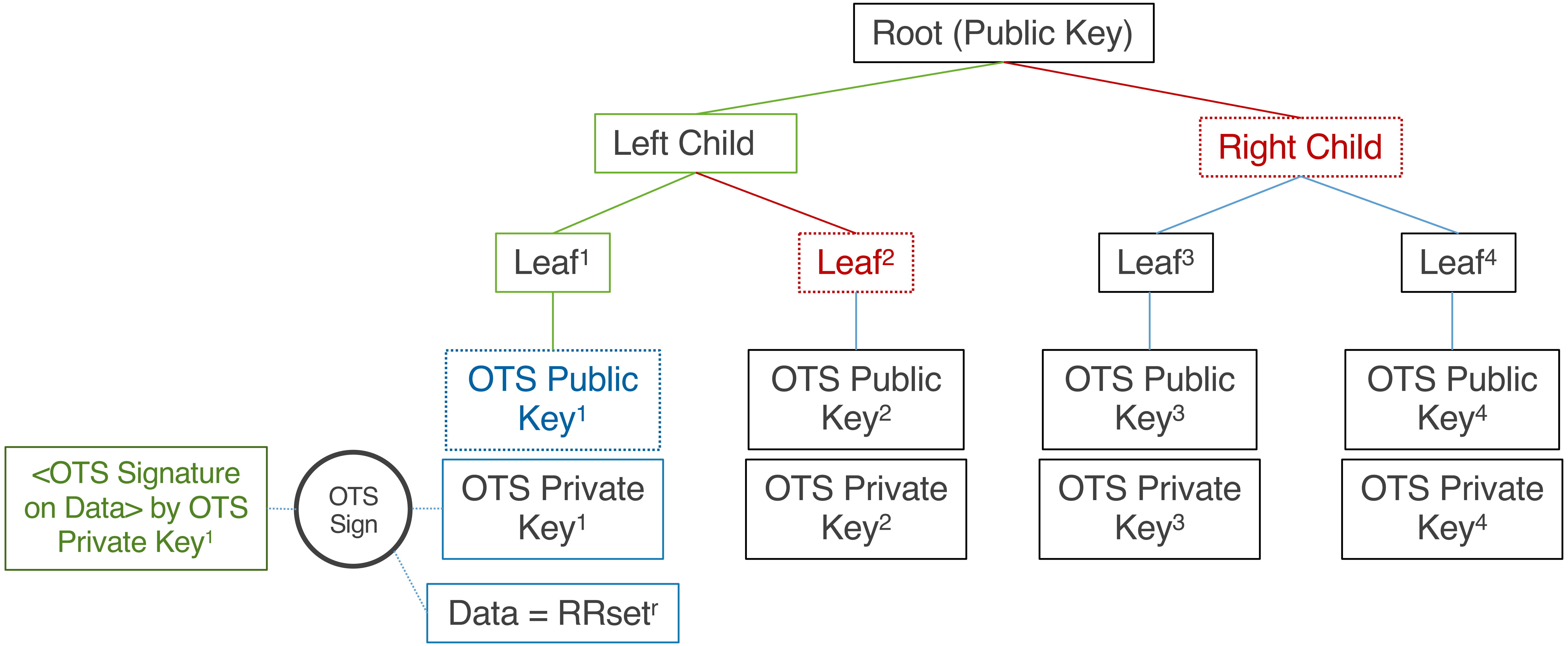
Motivation

- **But: DNSSEC signatures have** an **effective zero-year shelf-life**
- So **why care about PQC for DNSSEC?**
- Answer: **standardisation, implementation and transition cycle is long** (can easily be 10+ years, cf. e.g. Elliptic Curve algorithms)
- **Challenges with** “new” **PQC** algorithms: long-term security, unfavourable parameters for use in DNSSEC
- **We believe we need a “safe fallback” that is standardised**

Stateful HBS 101

- First proposed by Ralph Merkle, **constructed using Merkle trees**
- Stateful hash-based signature schemes are **considered to have very strong security** (if a secure cryptographic hash function is used; they essentially inherit their security properties from the hash function)
- Workings are **well-understood**, very **unlikely to encounter "cryptoanalytical surprises" that** suddenly **break** the **security** of HBS schemes
- Remain **secure in the face of** powerful **quantum computers**
- Note: stateless HBS also exist, e.g. SPHINCS+ being considered by NIST

Stateful HBS 101



Signature Composition: <OTS Signature on Data><Authentication Path>

<Authentication Path>: consists of Merkle tree node hashes that are used as an input along with companion sibling nodes to calculate parent node hashes

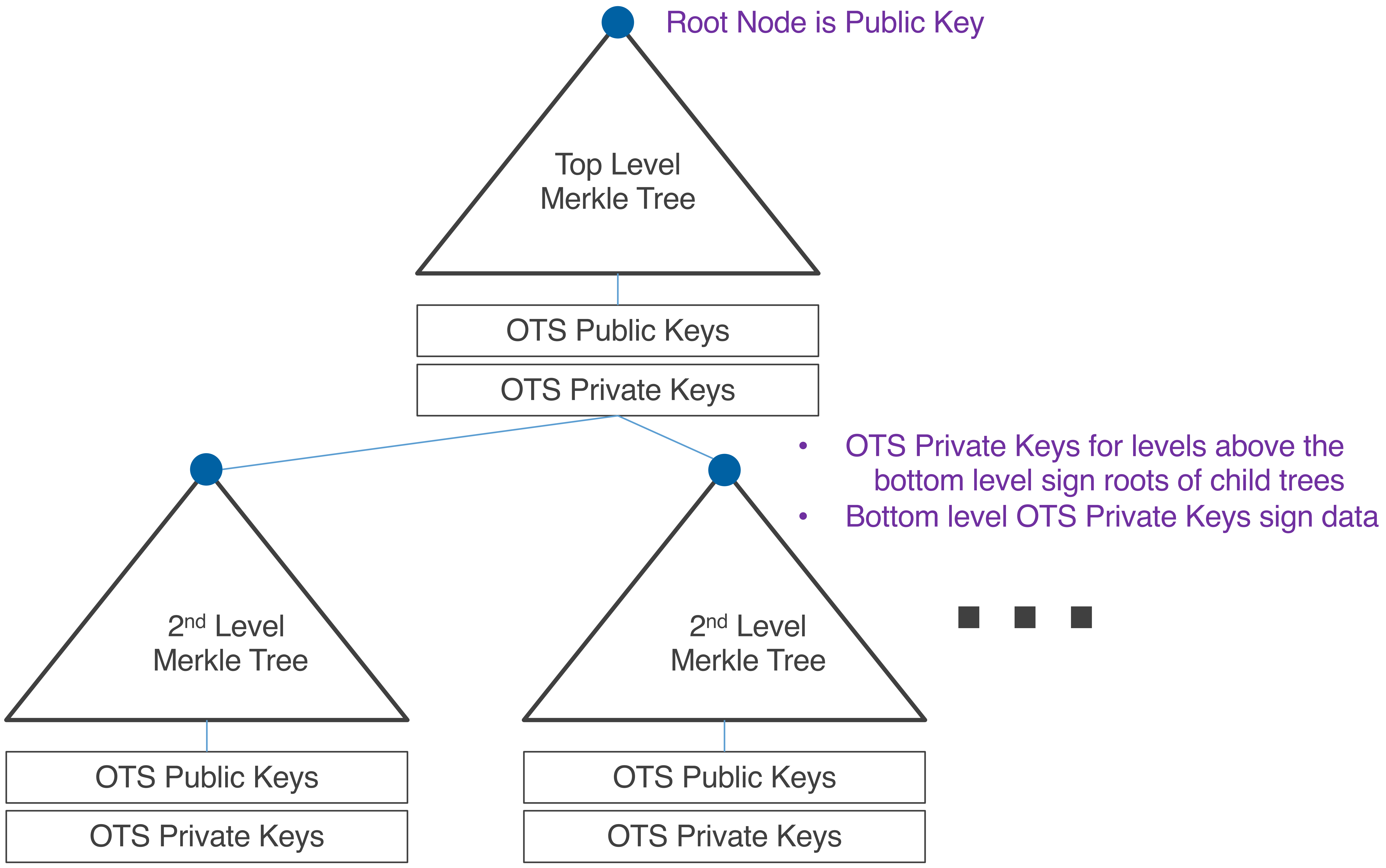
Example for signature on RRset^r by OTS Public Key^1

- <OTS Signature on data> = Signature on data (RRset^r) created using OTS Private Key^1 corresponding to OTS Public Key^1
- <OTS Public Key> = OTS Public Key^1
- <Authentication Path> = Leaf^2 | Right Child

Limitations

- Can create a **finite number of signatures with a signing key**, private key consists of a collection of one-time signing (OTS) keys
- **Essential to keep state** (re-use of the same OTS breaks security!)
—> challenge for online signers and distributed setups*
- **Signatures are (very) large** (≥ 2.5 kB) - public keys are small (~70 bytes)
—> requires EDNS0, and arguably TCP transport
- Therefore: **not the preferred option** for DNSSEC, **but a safe fallback**
—> given timelines, we argue standardising a safe fallback now is needed

Side step: online/multi-signer



Draft status

- Draft proposes how to use stateful HBS schemes in DNSSEC
- **Three HBS algorithms** included **in the draft**:
  - **HSS/LMS** [RFC8554]
  - **XMSS** [RFC8391]
  - **XMSS^MT** [RFC8391]
- **First “complete” draft —> interest in adoption?**
- NLnet Labs have done a **proof-of-concept** implementation **in Unbound**

Follow-up work

- **Considering a draft on implementation considerations** of stateful HBS in DNSSEC
    - Interoperability across implementations
    - Trade-offs of hierarchical trees
    - Parameter choices
    - Transport considerations
    - …?

Thoughts, questions, comments?

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