Monitoring DNSSEC

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Introduction

- DNSSEC becomes more and more popular
- Expired RRSIG RR might result that zone not available
- Need for monitoring
- Monitoring systems exist but are too specific to be widely deployed
- Solution: Monitoring DNSSEC through SNMP

SNMP

- standard application protocol to manage and monitor devices running on IP network
- can be implemented for applications as well
- agent-manager architecture
- structure of the management information and SNMP variables defined in a Management Information Base (MIB)
- SNMP variables are assigned to Object Identifiers (OID) in a hierarchical manner

Research Questions

- What are vital life signs for monitoring DNSSEC?
- How to construct a MIB module for DNSSEC?
- How to conduct monitoring based on such a MIB?
- How do architectures for monitoring DNSSEC compare?

Approach (1/2)

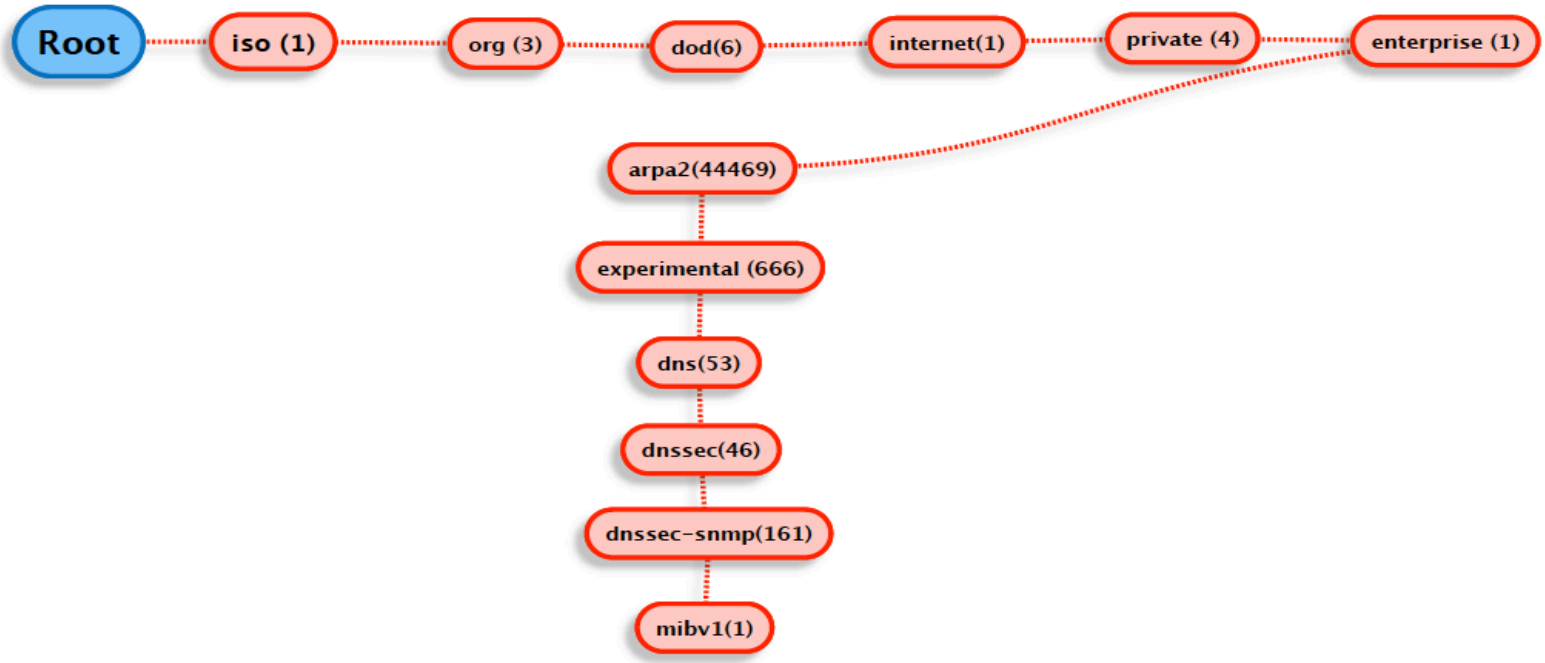
- To be independent on other software components (only AXFR and authoritative queries)
- Vital life signs for DNSSEC
  - Availability of a zone from a resolver point of view (initial check)
  - Verify DNSKEY RRSIG against published KSK
  - DS record count = delegation count (in a parent zone)
  - TTL checks
  - List of name servers for a zone
  - Expiration date of RRSIG for SOA, NS, DNSKEY
  - Discrepancies in serial numbers between slave and master (slave serving expired data)

Approach (2/2)

- Construct the MIB based on vital life signs
- Write the SNMP subagent (python-netsnmpagent)
- How data is retrieved from zones?
  - From a central repository: XML
  - DNSSEC data collected via AXFR requests, DNS queries to authorities and resolvers

DNSSEC MIB implementation (1/4)

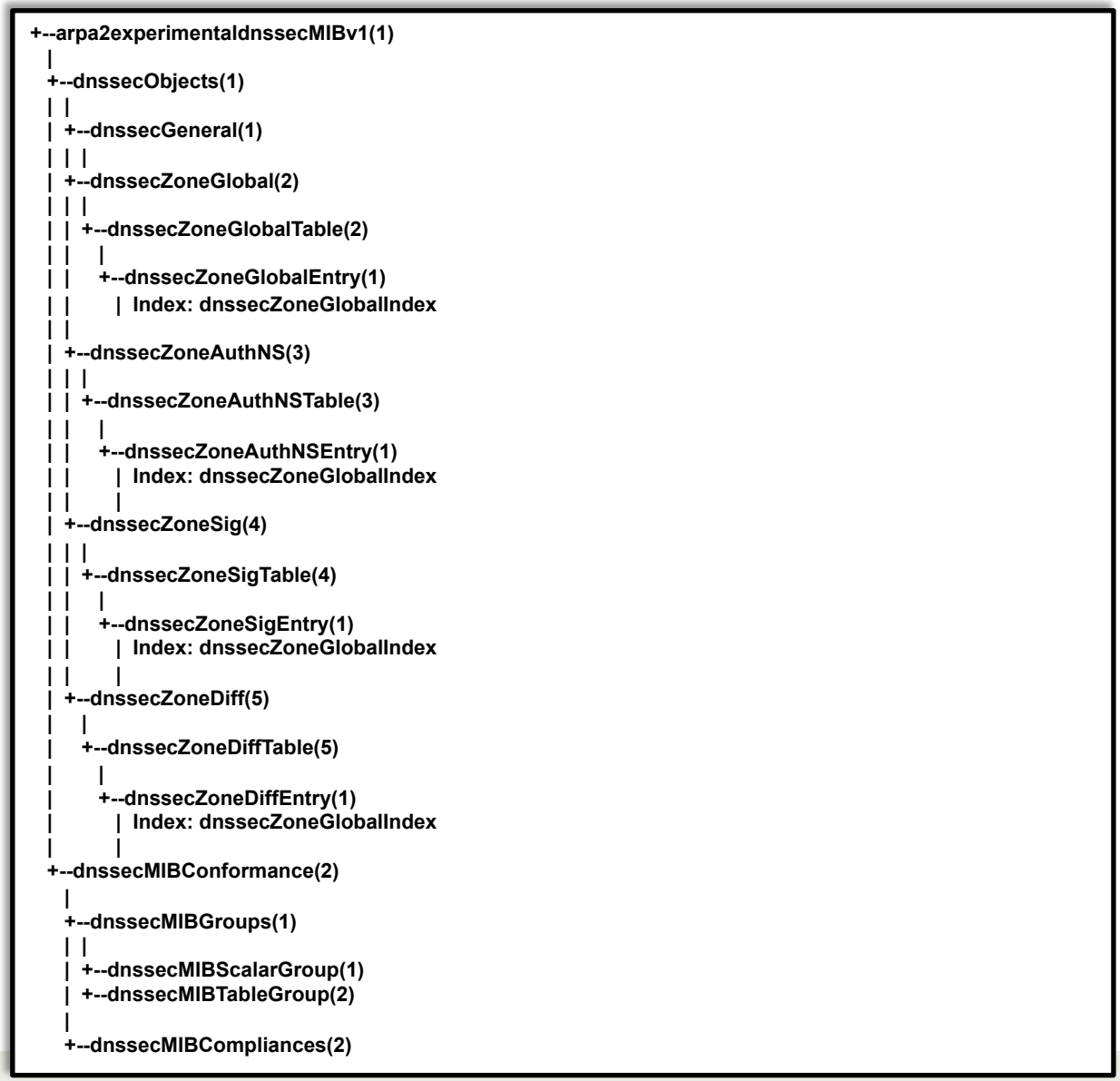
- OID entry point inside ARPA2 OID tree (enterprise OID 44469):
  - ARPA2-Experimental-DNSSEC-MIBv1
  - .1.3.6.1.4.1.44469.666.53.46.161.1



DNSSEC MIB implementation (2/4)

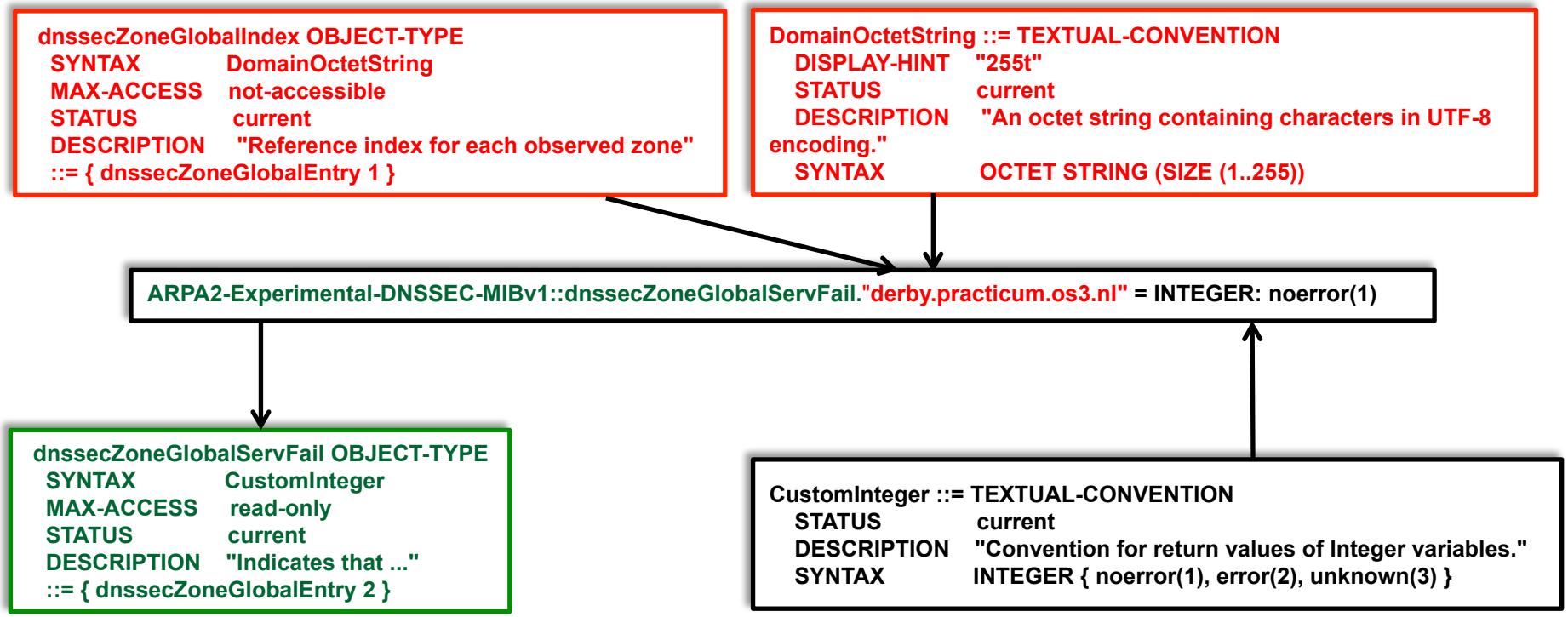
- Objects are defined using a subset of Abstract Syntax Notation One (ASN.1) called "Structure of Management Information Version 2 (SMIv2)" RFC 2578
- Objects organized in columnar (conceptual tables) or scalar objects.
- Four tables indexed by domain name (OCTET-STRING)
  - dnssecZoneGlobalTable, dnssecZoneAuthNSTable, dnssecZoneSigTable, dnssecZoneDiffTable
- Datatype INTEGER to represent boolean and numeric values, OCTET-STRING to represent strings (e.g domain names)
- Usage of Textual conventions to customize object-types

DNSSEC MIB implementation (3/4)

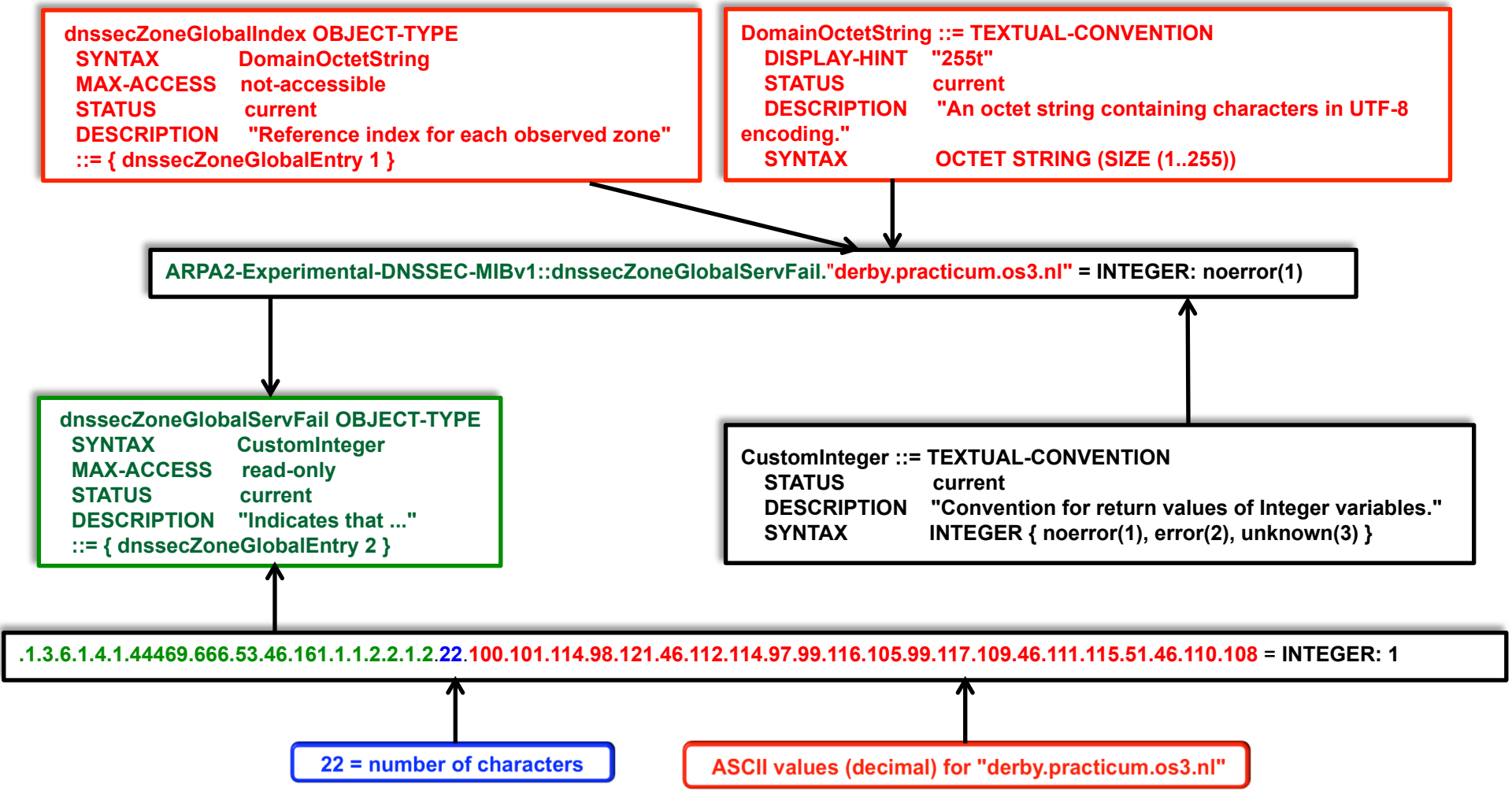


DNSSEC MIB implementation (3/4)

DNSSEC MIB implementation (4/4)



DNSSEC MIB implementation (4/4)



SNMP subagent implementation (1/4)

- NET-SNMP toolkit → de-facto standard for SNMP implementations on most OS
  - Includes applications (snmpget, snmpwalk, etc.) and libraries
  - Includes C API to write own AgentX subagents RFC 2741
  - Subagents register to snmpd master agent via Unix socket

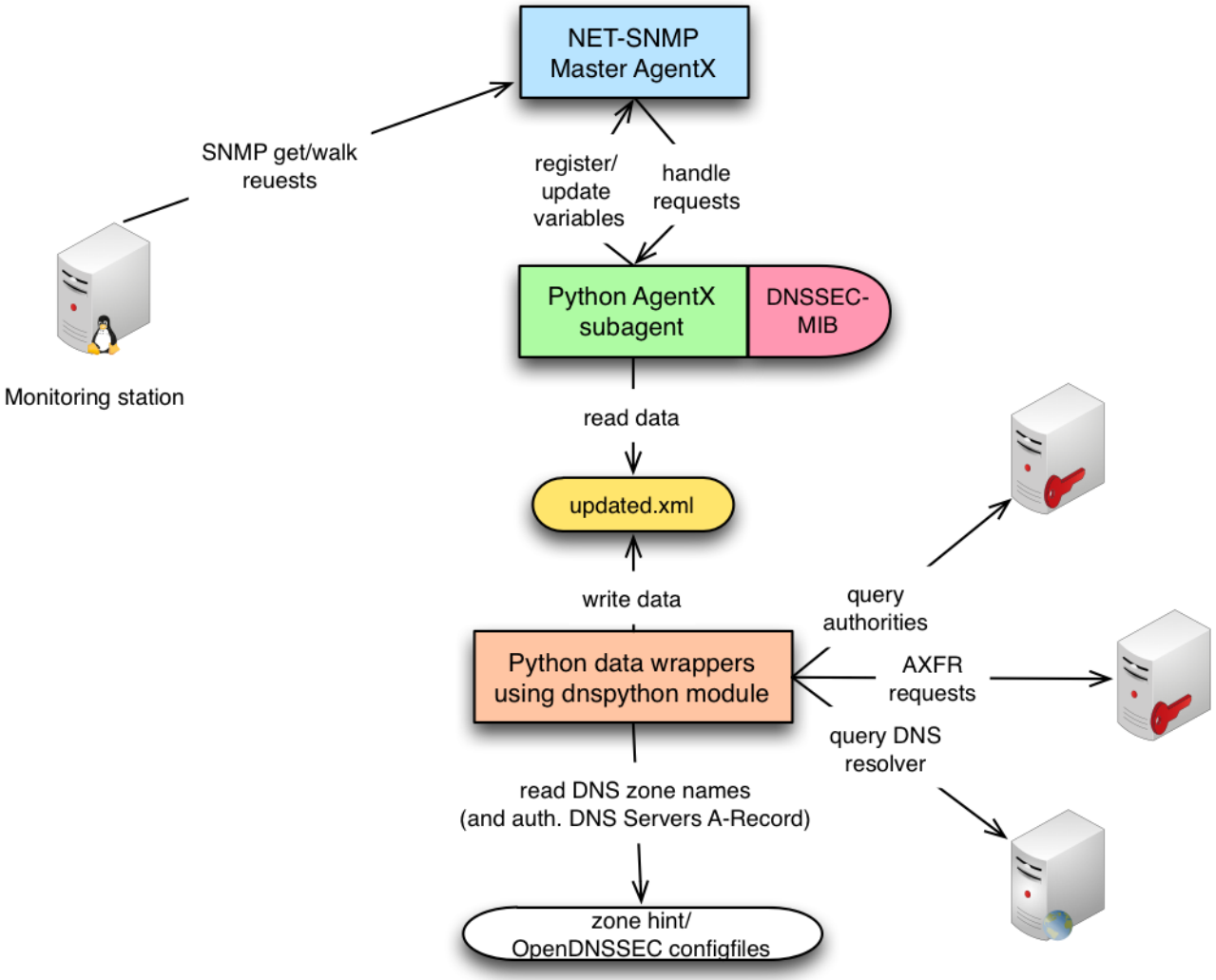
SNMP subagent implementation (2/4)

- AgentX SNMP subagent based on Python NET-SNMP API module “netsnmpagent” written by Pieter Hollants licensed under GPLv3

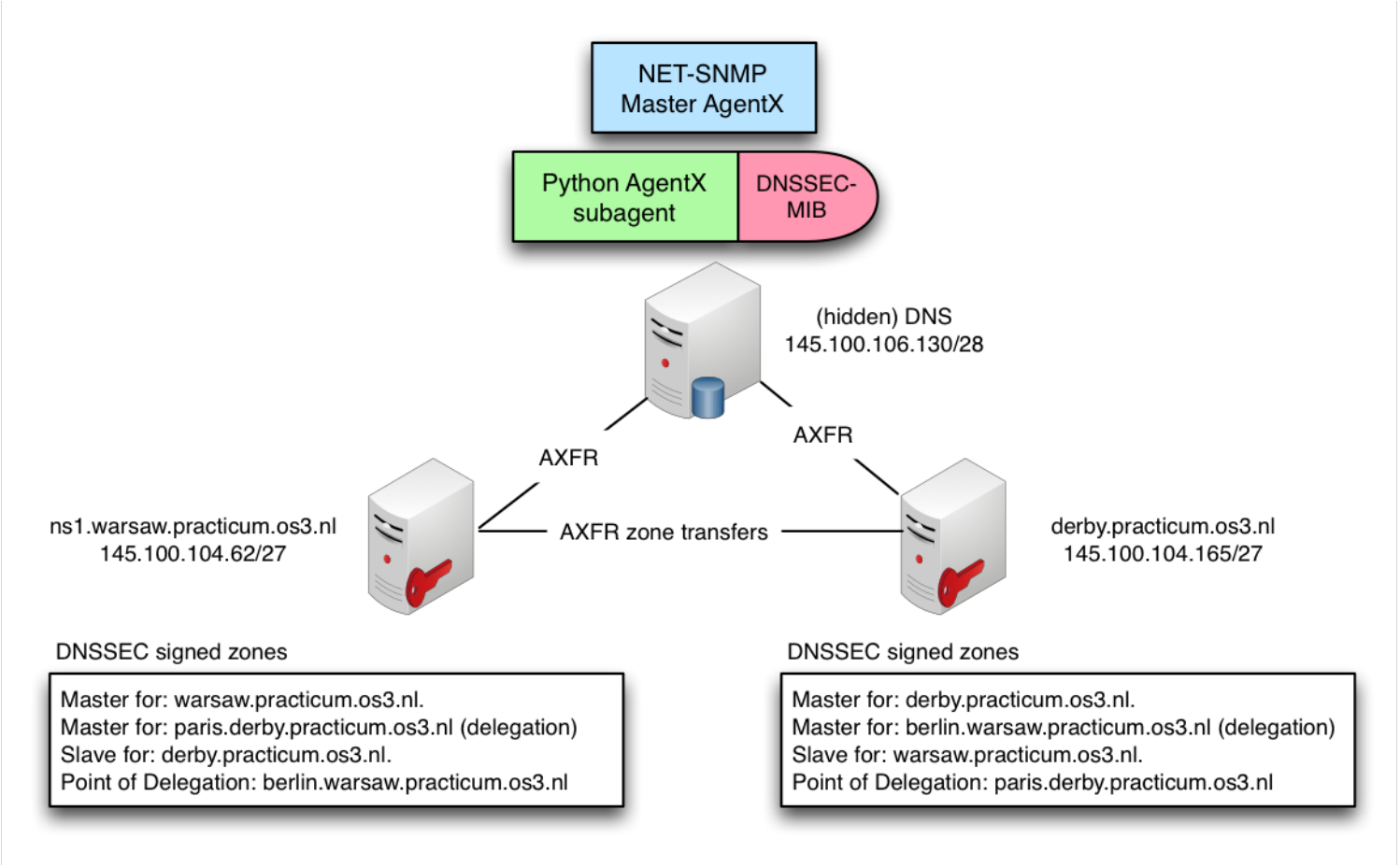
  Warning: Consider this when using our prototype !

  - UpdateSNMPObject() function is self written
  - Subagent is capable of most SNMP data types
  - Handles requests for our DNSSEC MIB
  - Allows to register, update and clear table rows and scalar values
  - Subagent works asynchronously, data update thread is decoupled from data providing thread
  - Data for subagent is provided by two main wrapper scripts (dnspython)

SNMP subagent implementation (3/4)



SNMP subagent implementation (4/4)



Conclusion / Future Work

- Proof of concept based on SNMP to cover critical data of DNSSEC signed zones
- Conduct monitoring based on proof of concept
- SNMP Notifications/Traps
- Expand MIB to cover more DNSSEC related data
  - Validation of all RRSIG RR (expired/non validated)
  - Check for broken NSEC3 chain
  - …

Demo