DNSSEC in Switzerland

2nd DENIC Testbed Meeting

SWITCH

Serving Swiss Universities

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About SWITCH

- The SWITCH foundation operates the national research network since 1987
- SWITCH provides different services to universities like wireless roaming, AAI, PKI, video conferencing and lecture streaming
- SWITCH is the registry for the ccTLD .ch and .li

DNSSEC in Switzerland

Why ?

- Currently the best solution to prevent cache poisoning
- „Normal“ evolution of the DNS protocol
- Provides low level infrastructure security
- Platform to integrate new services
- As a registry: DNSSEC has to be deployed by an top down approach.

Why now ?

- NSEC3 is available

Challenges ?

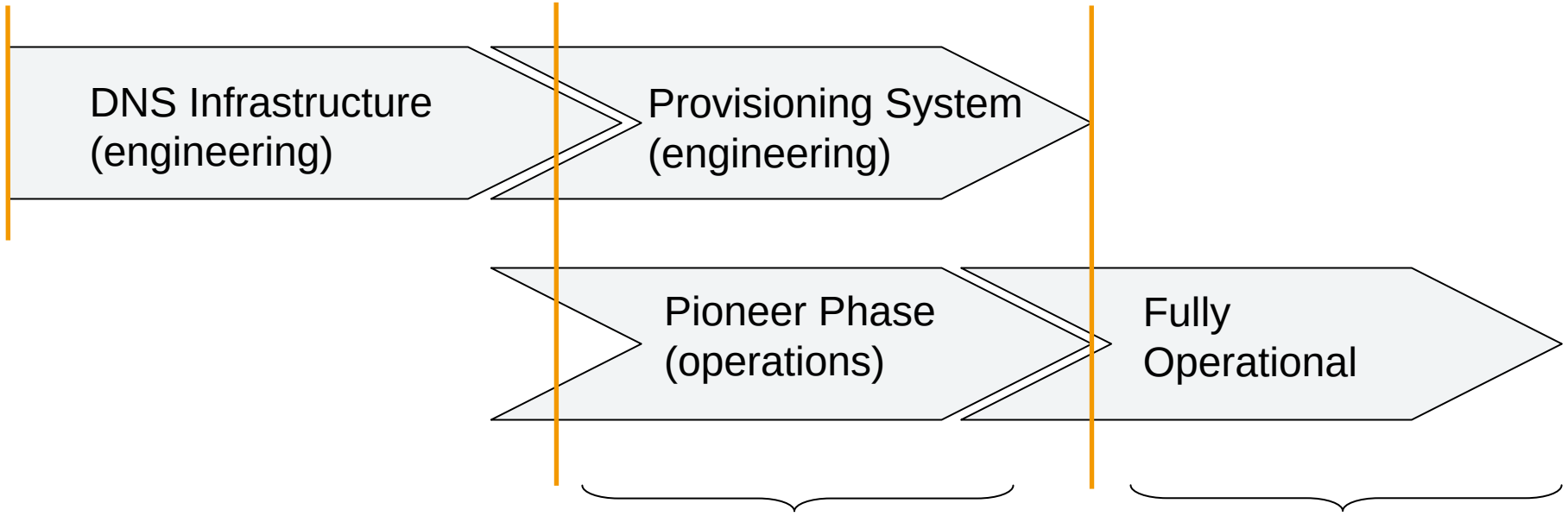
- Complex technology with a minimal amount of operational practice
- The implementation costs

Project Schedule Overview

1. March 2009
Start

21. Sept. 2009
publish first signed zone

2. February 2010
“Going Live” provisioning system



Since 2005
signed SWITCH zone

Project Task Overview

Phase 1: DNS

- Upgrade the DNS infrastructure
- Specify Key Management Practice Statement (KMPS)
- Implement the KMPS
- Develop signing tools
- Develop monitoring tools for registrants and our infrastructure

Phase 2: Pioneer Phase

- Build a community
- Organize workshops
- Accept DS records from “friends & family” by email

Phase 3: Provisioning Interfaces

- EPP interface for registrars
- Web interface for registrants

Phase 1: DNS

- Replace those secondary name server without DNSSEC support
  - New secondary in Brazil / new 2nd anycast network
- Renaming all name server host names to {a-h}.nic.ch
  - Reduces DNS answer packet size
  - Example: domreg.nic.ch -> a.nic.ch
- No hardware upgrades (no significant increase of cpu usage detected)

- Problem:
  - NS need enough RAM (requirement for .ch ~1.5GB)
  - Time to copy the full zone (450MB) to Brazil (tcp window tuning)
  - Increase BIND journal space for IXFR

Phase 1: KMPS

- Political questions
  - Who holds the pass phrase for the keys (shared between several persons?)
  - Where do we store the private keys (offline or online?)
  - Using HSM (hardware security module)
  - Using NSEC or NSEC3
- Technical questions
  - Key length
  - Signature and key life time
  - Key rollover scheme
  - NSEC3 opt-out
  - How we publish our keys

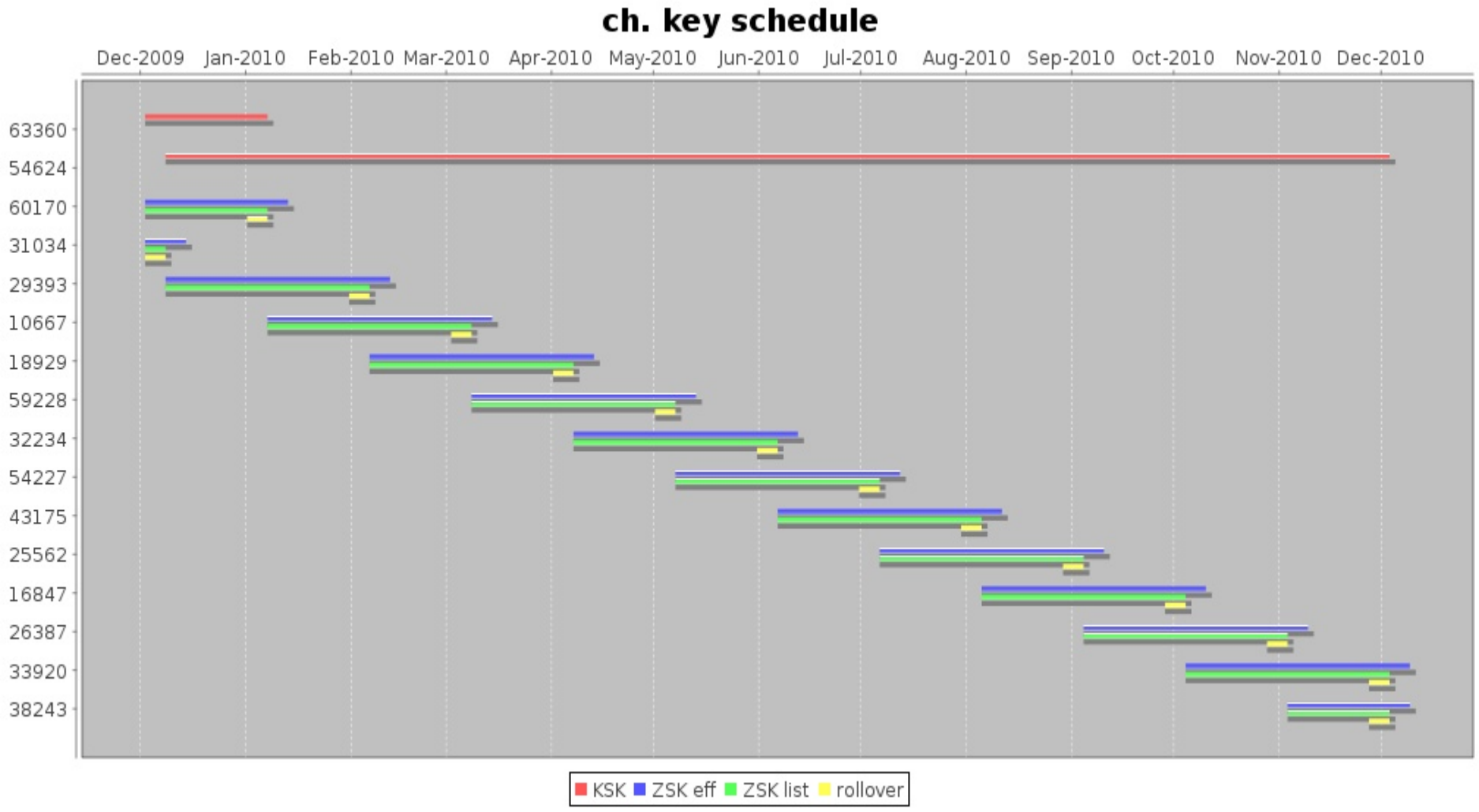
- Problem:
  - Ask the right questions
  - Less operational practice

Phase 1: Key Generation

- Key generation platform
  - Offline system runs diskless
- Using TPM chip as hardware random seed for key generation
- Several people (2 of 3) are required to unlock the active KSK
- Pre generating 12 ZSK and sign all zone apex with the right combination and validity period of the KSK

- Problem:
  - PKCS11 / Crypto Know-How
  - Key validity period pre calculation

Phase 1: Key Lifetime



Phase 1: Signing Tools

- Build own tools for key rollover management
  - Configuration is done according to a schedule file which is generated during key generation
- Signing the zone every hour with standard BIND tools
  - took about ~20 min without incremental signing
  - incremental signing ~9000 sigs/h
- Signing is done on a new DNS hidden master server

- Problem:
  - Because the KSK private keys will never be available on the signer, it needs a special logic to include the correct DNSKEY RRSIGS
  - Bugs with NSEC3 singing from BIND
  - Signature expiration jitter (use initial ¾ of sig. lifetime; then 1h)

Phase 1: Monitoring

- Additional DNSSEC tests for our new delegation checker
  - Pre-delegation check with DNSKEY / DS records (integrated in the direct customer web application)
- Additional test for .ch / .li according to the “key schedule” file
  - Test if the key rollover logic is in the right state
  - Test DNSKEY / SOA signatures
  - Test correctness of all published keys in our zone
  - Test correctness of all published keys in the root zone / ITAR
- Test some validating resolver from ISP. Problem: We can’t check all recursive name servers on the internet!

Phase 2: Pioneer Phase

Pioneer phase != Testbed:

- We sign the real .ch / .li zone

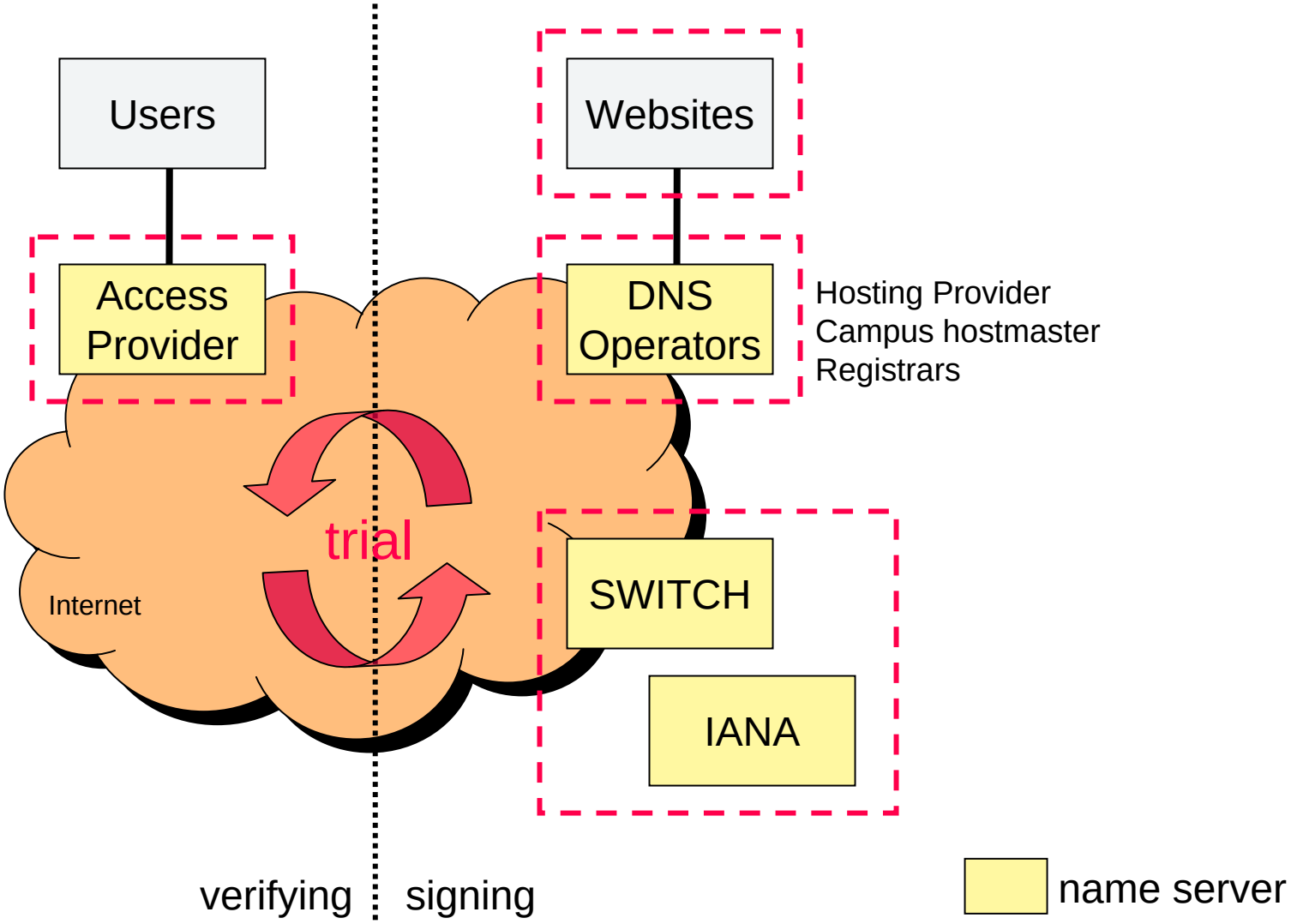
Why:

- Complex topic are hard to sandbox
- New operational processes needs real life testing
- Many involved parties (chicken-egg problem)

Desired participants:

- Verifying: Access-Provider / ISP
- Signing: Web-Site operators (Bank/Media/Shops)
- Provisioning: Registrars

Phase 2: Roles of Participants



Phase 2: Community

Where we found the “friends & family”:

- Asking on mailing lists
- Talking to friends

What we provide to them:

- Mailing list
- Information meetings
- Bilateral support

What was their motivation of participation:

- Understanding of the new technology!
  - Most have only personal interests (no official company task)
  - In rare cases DNSSEC is a company mission

Phase 2: Participants

~ 40 people (most Security or DNS Operators)

- Government
- Banks
- Media
- ISP (large public broadband isp) (only resolving)
- ISP (specialized isp for financial institutes) (resolving and signing)
- Web-Hosting provider
- Universities

Phase 2: Community Problems

- No time for this complex topic
  - Less time for learning -> Need external help
  - A reduced amount of time to implement own tools -> need better tools
- Hardware and DNS infrastructure problem -> same behavior as described in the cost study [1]
- We suspected that signing a zone is easier than enable signature validation. But in reality: No!
  - Signing is a new process (this is much more political)
  - Validation failure impacts more persons; but is also disabled really fast

[1] http://www.enisa.europa.eu/act/res/technologies/tech/dnsseccosts

Phase 2: Community Conclusions

- Most of the participants had no official company mandate
- 6 month is too short to get an official mandate
- Everything depends on few persons. You have to find the right ones!
- Most interested people: public ISP (resolving), ISP for financial customers and banks

- Lessons learned:
  - DNS is a critical but mostly forgotten system
  - We need to establish better communication channels to the large resolver operators in Switzerland

Phase 2: Technical Results

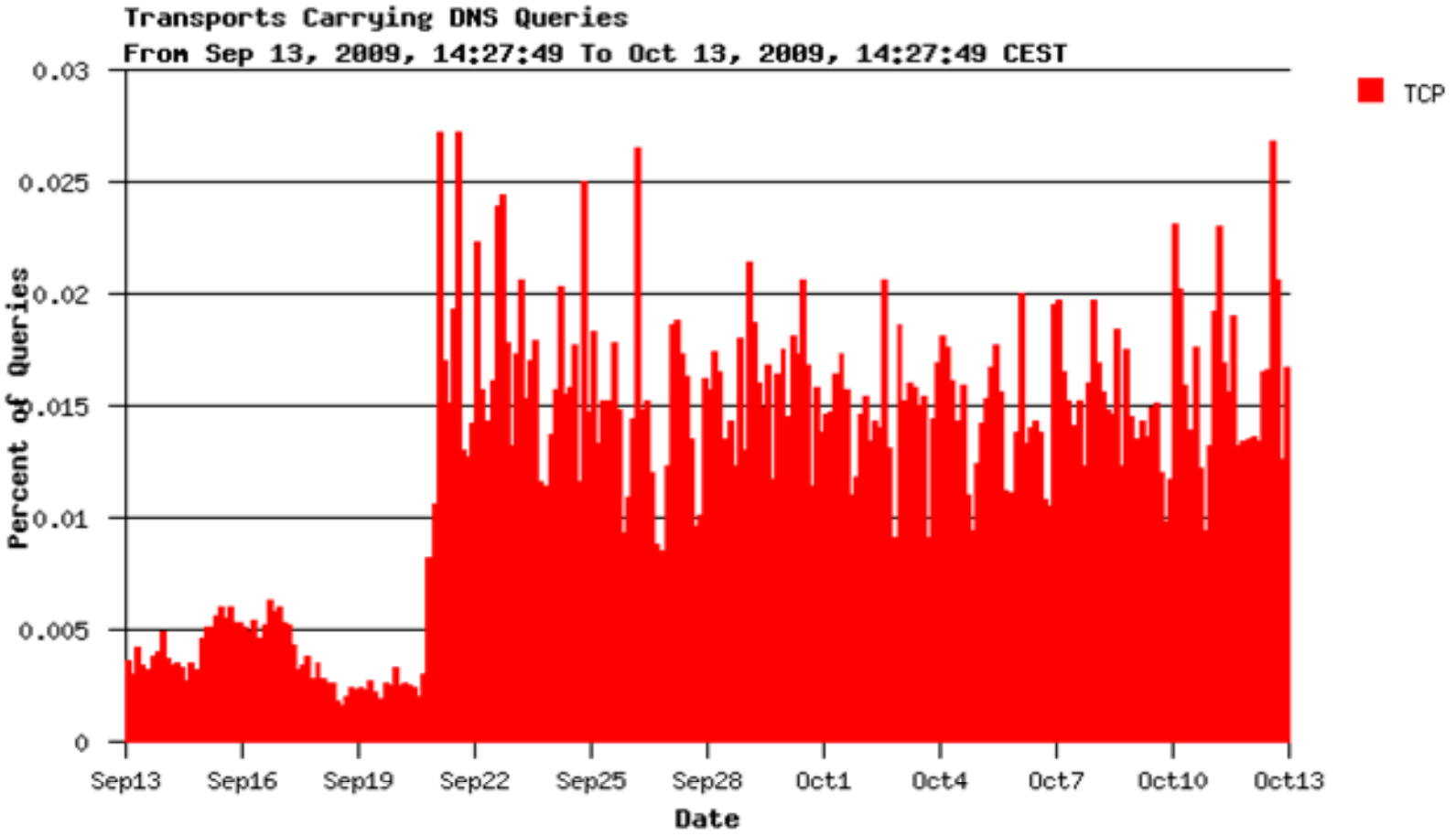
- Technical success:
  - Largest ISP validates DNSSEC signature (51% of all broadband users in Switzerland [1])
  - About 10 signed test domain names
- No grave technical problems recognized!
- Four examples of potential problems
  - Trust anchors update
  - TCP queries
  - Response packet size and home router
  - Fault tolerance with DNSSEC

[1] http://www.bakom.admin.ch/dokumentation/zahlen/00744/00746/index.html?lang=en

Phase 2: Trust Anchors update

- Until the root zone is signed, this is a operational problem
  - Validating resolver operators have to install and update the correct keys
  - Keys from Website, ITAR or DLV ?
- Problem:
  - Install wrong keys; old keys; untrusted dev keys
  - Hard to detect failures; only a few people knows the problem
  - Impossible to monitor for a registry

Phase 2: TCP Queries



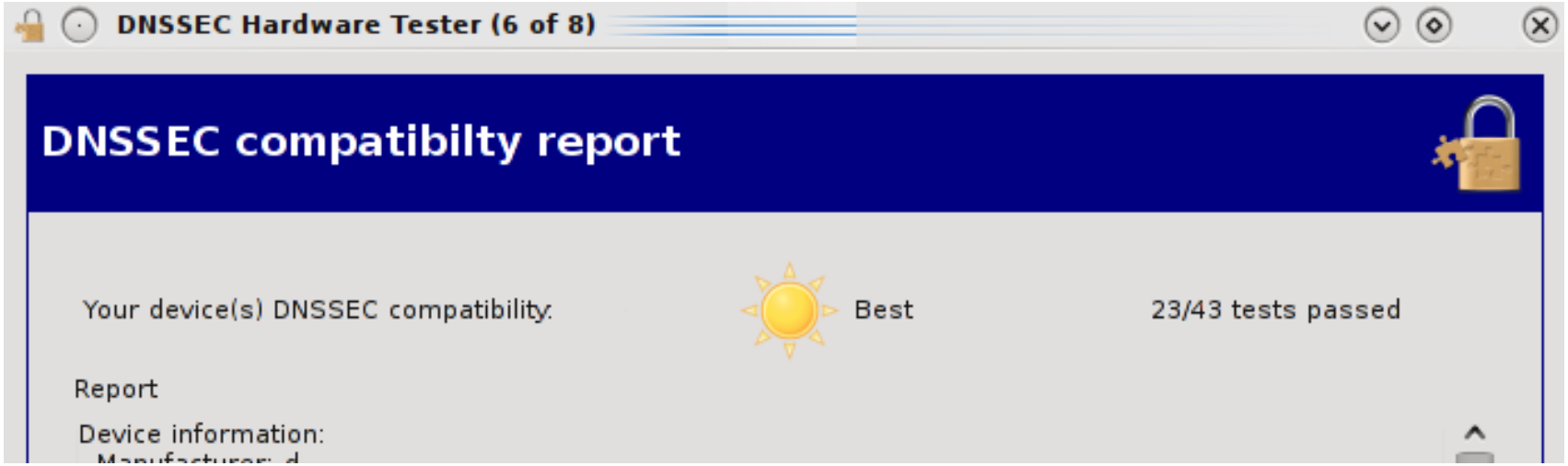
- Most of them are NXDOMAIN with EDNS0 (DO) and bufsize = 512

Phase 2: Validating behind a home router

•We tested the behavior with the most common ADSL router from the participating ISP (SMC SMCA1T-A).

•Tested with hardware tester from http://www.nic.cz/dnssectests

•Result:



Phase 2: Validating behind a home router 2

- Result detail:
  - Act as DNS proxy; announce himself in DHCP
  - Works with EDNS0 and DO/AD flag
  - No TCP
  - No IP fragmentation
- Means: No DNS responses > MTU (~1472 bytes) possible!
- Some response sizes under .ch
  - dig ch. SOA 405 -> dig ch. SOA +dnssec 2522
  - dig ch. NS 371 -> dig ch. NS +dnssec 2315
  - dig switch.ch. NS 173 -> dig switch.ch. NS +dnssec 430
  - dig dsdsdswitch.ch. NS 83 -> dig dsdsdswitch.ch. NS +dnssec 976

Phase 2: Validating behind a home router 3

- Conclusion:
  - No problem during daily usage!
  - You will run into problems if you like to validate signatures on the client
  - A browser plug-in like this will never work correctly (http://labs.nic.cz)

Phase 2: DNS Fault Tolerance

- There is no DNS fault tolerance with DNSSEC!

- Example:

sub.switch.ch on same authoritative server than switch.ch but without an NS record.

Standard DNS: This will work !
With DNSSEC: sub.switch.ch will be marked as insecure !

Is this really a DNSSEC problem? We learned: DNSSEC isn’t complex, but it shows you all “old” failures.

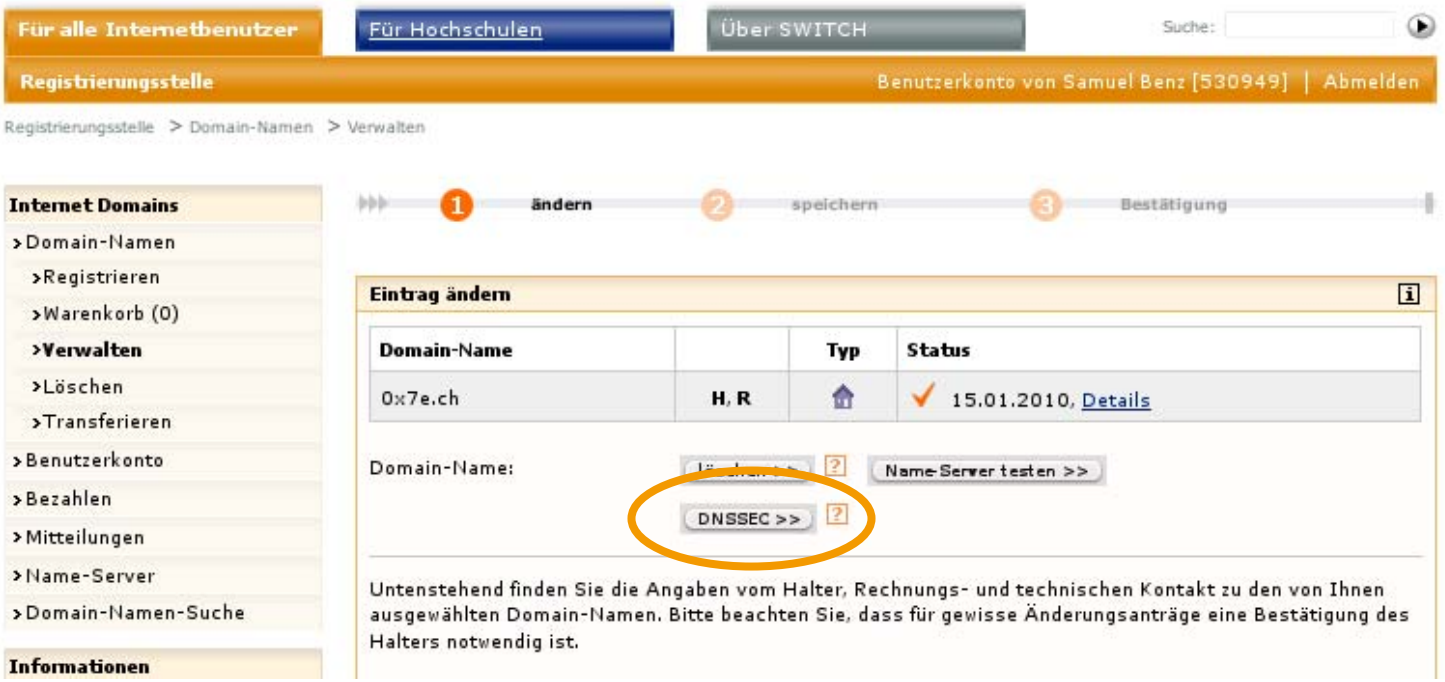
Phase 3: Provisioning Interface

- What does the provisioning system:
  - Currently: writes NS records to the DNS
  - With DNSSEC: it will also write DS records to the DNS
  - Responsible for NS / DNSKEY / DS exchange between the registrants, registrars and the registry

- Two ways to publish your keys:
  - Web interface on www.nic.ch (for direct customers)
  - EPP interface (extensible provisioning protocol) (for registrars)

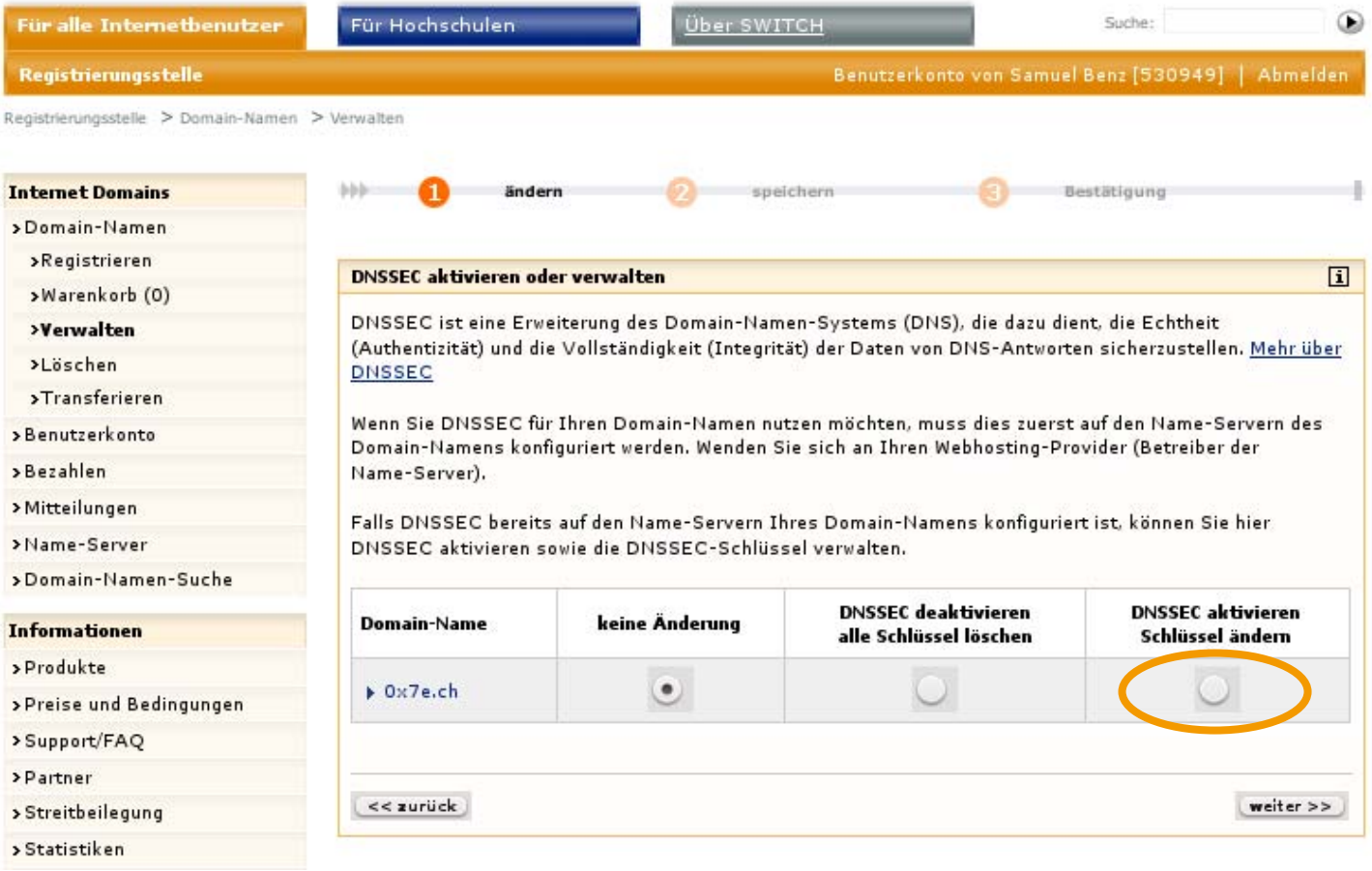
Phase 3: Web Interface

Planned workflow:



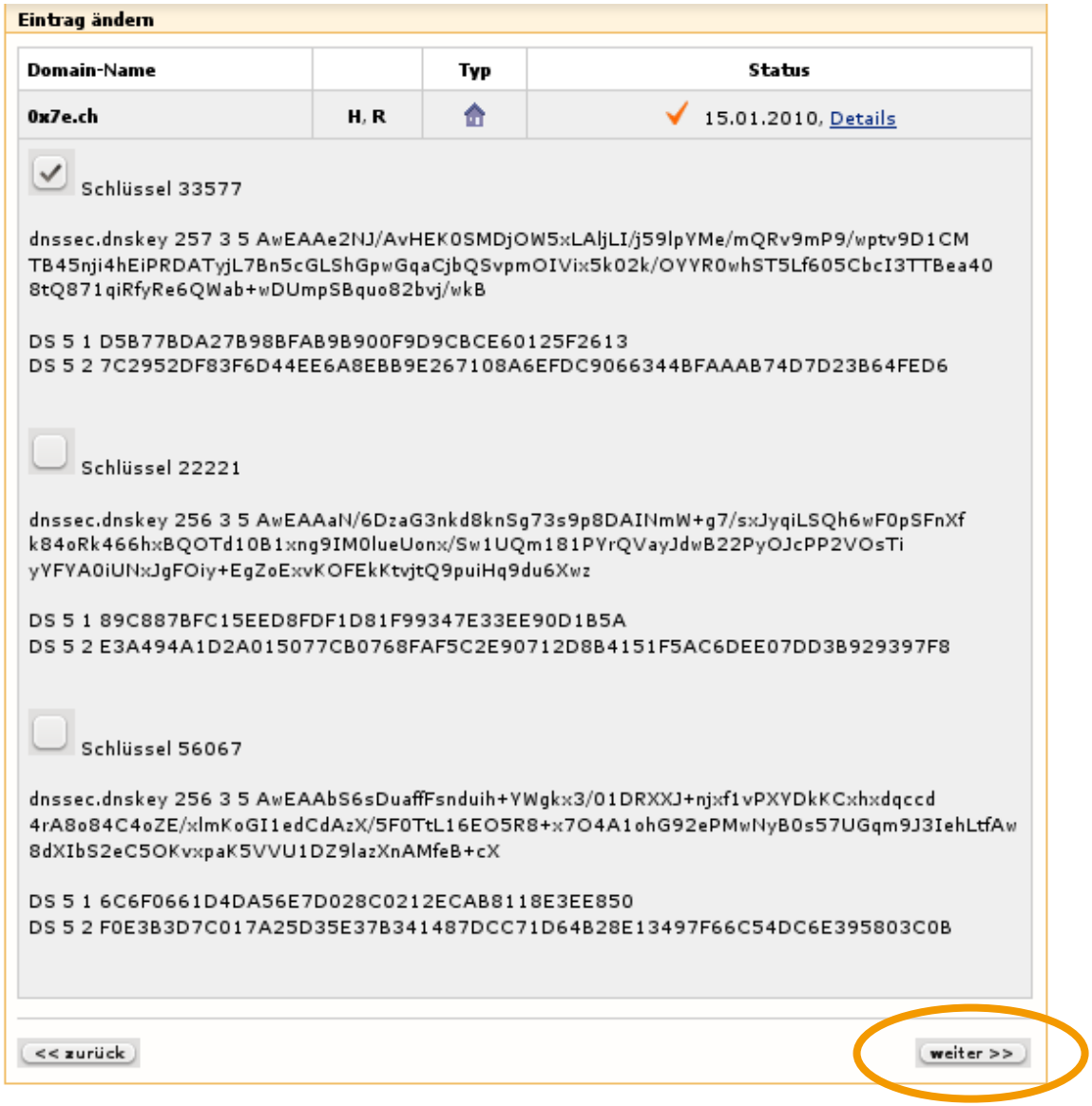
Phase 3: Web Interface 2

Planned workflow:



Phase 3: Web Interface 3

- Planned workflow:



Phase 3: EPP Interface

- RFC 4310
  - No SWITCH specific extensions
  - RFC 4310 extends the domain object
  - DS record must, DNSKEY record optional
  - We neither validate the submitted DS nor the DNSKEY records, we will write them unchanged to the zone

- Problem:
  - What about a transfer ?

Phase 3: How to transfer a domain with DNSSEC

3 Options:

1. All registrars must implement DNSSEC (or at least the disable DNSSEC command)

2. The registry silently disables DNSSEC during a transfer to a registrar without DNSSEC support

3. The registry prohibits a transfer to a registrar who does not support DNSSEC (loosing registrar had to switch off DNSSEC first)

We decide to implement option 3.

http://www.nic.ch/dnssec