A Brief Introduction to JPRS' DNSSEC Implementation Research for TLD

RIPE55 DNS WG

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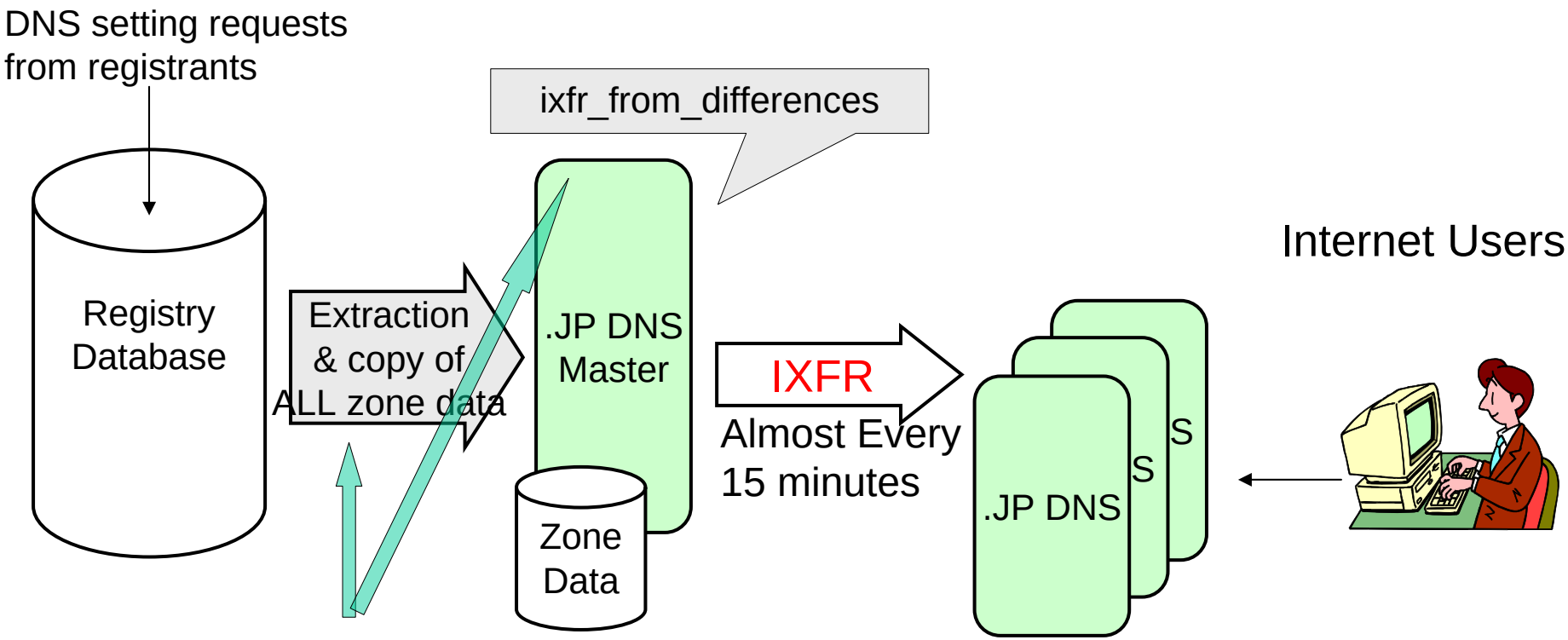
Background

- Current status of .JP
  - A million of domain names
  - Frequent DNS updates (every 15 minutes)
  - Zone synchronization to 30 DNS servers (including IP anycast & stand-by servers)
- Issue regarding to implement DNSSEC
  - Zone data signing with existing tool (e.g. dnssec-signzone) takes longer time than our update interval
- JPRS decided to create a prototype implementation to solve this issue

Frequent DNS updates : Current .JP System



Bottle-necks against
further update frequency &
creating DNSSEC related RRs

Major Requirements Defined in R&D

- Large zone administration
  - 10 million-domain class
- Rapid updates
  - Data updates by every minute (on service operation)
  - 100 domains update is performed within 10 seconds
- Reliable zone data synchronization
  - Checking sync. delay time
  - Checking data integrity
- DNSSEC capability
  - Compliance to RFC4033-RFC4035
  - Compliance to both of NSEC & NSEC3
  - Key management (generation/rollover)

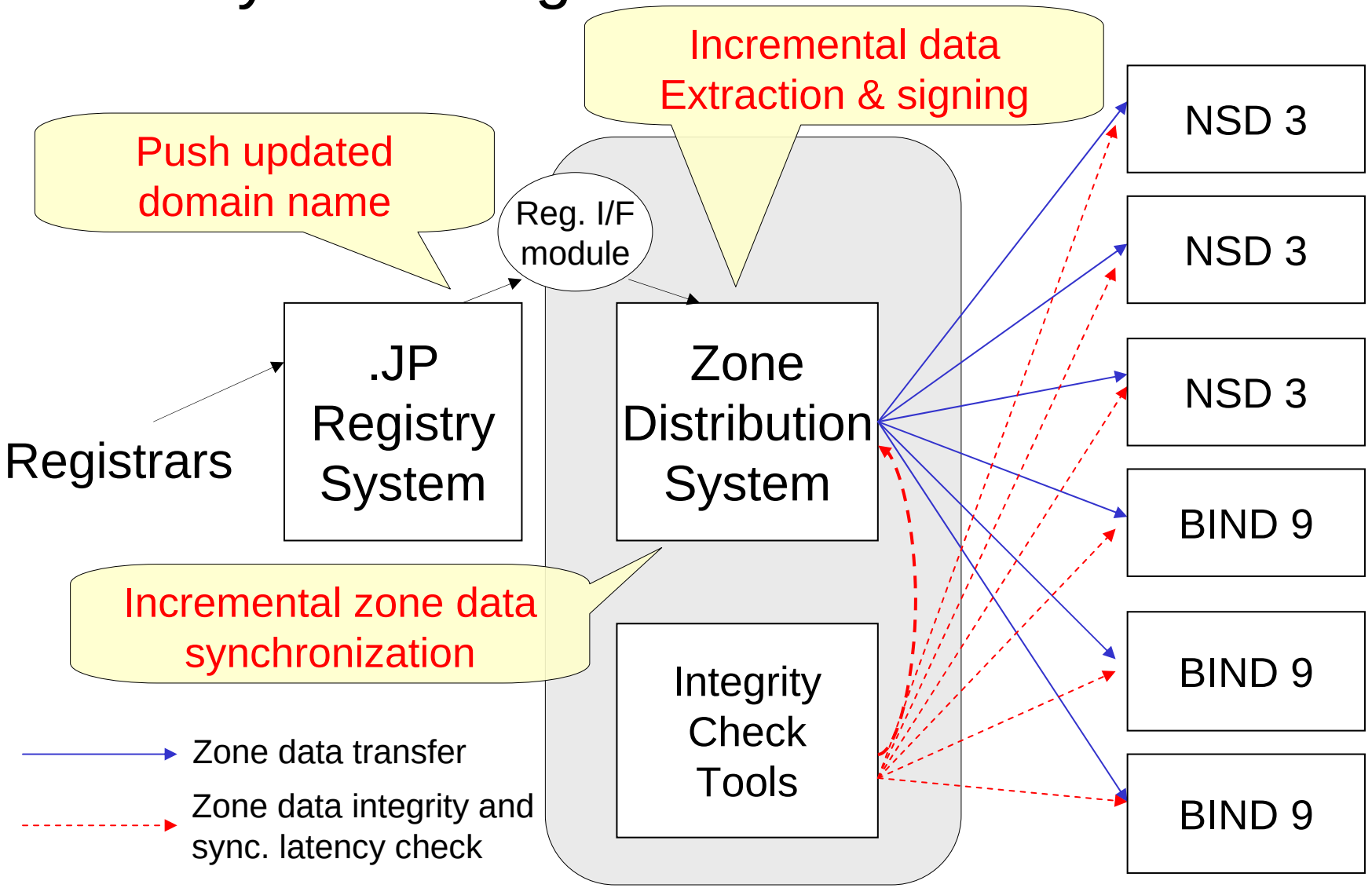
Design Concepts of the Prototype Implementation

- Easy integration to current Registry system
  - Least changes to Registry system
  - DNSSEC & related features are provided by the Prototype implementation
- RRset extraction from Registry database & DNSSEC signing in an incremental manner
  - For rapid updates of large zone
- Data integrity check of DNS servers without service interruption
  - Even when DNS sever has some delay from Registry Database

System Components

1. Registry System (pseudo .JP/real .JP)
2. Zone Distribution System
3. Integrity Checking Tools
4. DNS servers (BIND 9, NSD 3)

System Diagram



Zone Distribution System

- ‘Intelligent box’ between Registry system and DNS servers
  - Incremental data extraction from .JP Registry system
  - Zone data distribution to DNS servers
    - Using IXFR/AXFR for BIND, NSD, etc.
  - Zone data revision management
    - Possible to obtain any SOA #serial of zone data
    - For integrity check without service interruption
  - DNSSEC features (next slide)
- Implementation details
  - Developed from scratch by Java
  - PostgreSQL/Oracle/HSQL as backend DB

DNSSEC Features of Zone Distribution System

- Compliant to NSEC & NSEC3
- ZSK creation & RRset signing for all domains of Registry database on system initialization
- Incremental RRset signing according to the updates on Registry database
- Semi-automatic ZSK rollover & re-signing of RRsets
  - Semi-automatic means KSK private key needs to attach to the system manually for each time by security reason
  - When re-signing, old DNSKEYs / RRSIGs are deleted after appropriate time considering their TTLs

Integrity Checking Tools

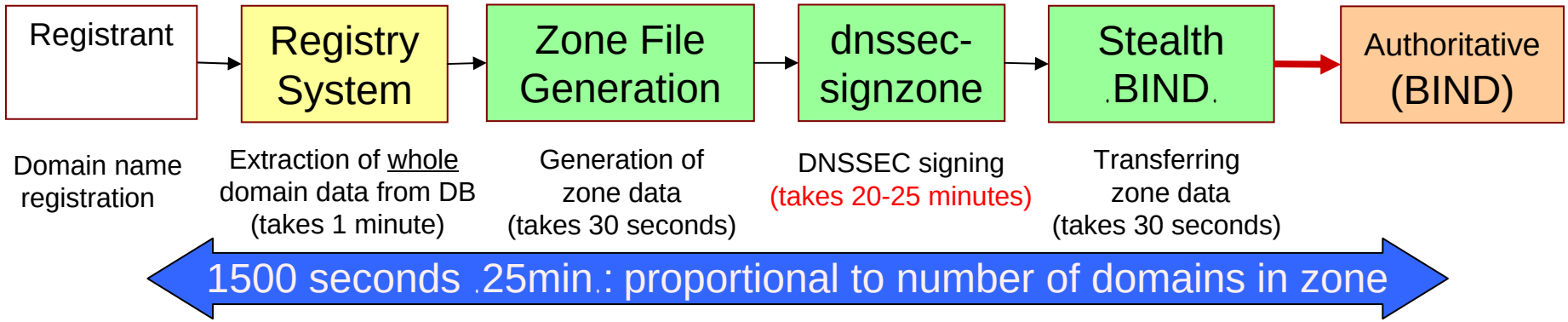
- Zone synchronization latency check tool
  - Measures update latency of each DNS server from Zone Distribution System and checks if the latency is in allowable time frame
  - Designed for frequent & light-weight checking

- Full data integrity check tool
  - Verifies zone data synchronization between Zone Distribution System and each DNS server
    - Obtains complete zone data from each DNS server and compares with corresponding zone data in Zone Distribution System
  - Designed for periodic (ex. daily/weekly) & comprehensive checking

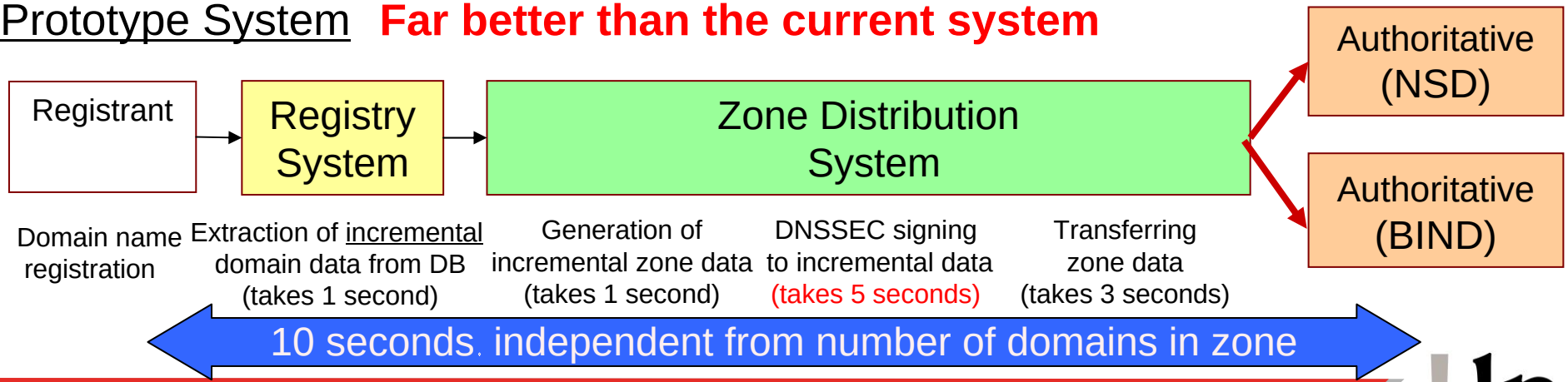
Update Performance: Comparing with Current System

In case of adding 100 domains to zone of 1 million domains, with DNSSEC signing

.JP registry System (current+DNSSEC)



Prototype System **Far better than the current system**



Field Test of Prototype System

- Check following performances
  - DNS update latency from .JP Registry database change
  - Data integrity of DNS servers after long term running
  - Without DNSSEC signing
    - Due to implementation problem at that time..
- Connected Zone Distribution System to real .JP Registry system for 1 month
  - Configured to pull out updated data every minute from .JP Registry database
- DNS servers were for internal test only
  - Placed in Tokyo & New York
  - Simulate queries from A.DNS.JP query log so that they had the same load as real .JP DNS servers

Field Test Scheme

Extraction of updated data by every minute

Prototype System

Zone Distribution system

IXFR

.JP DNS (internal) S S

Replay queries of A.DNS.JP

ixfr_from_differences

.JP Registry Database

Extraction & copy of ALL zone data

.JP DNS Master

Zone Data

IXFR

Almost Every 15 minutes

.JP DNS S S

Internet Users

Real System

System Integration needed for Field Test

- Modification to real .JP Registry System
  - Only added RDBMS trigger to .JP Registry database which generates updated domain names list
- Data import Java class of Zone Distribution System
  - To obtain incremental data from .JP Registry database according to the list
- Easy to integrate!
  - Relatively..

Field Test Results

- 2 seconds of DNS data update latency from .JP Registry database change
  - As an average
  - If DNSSEC signing were done, it would be took 5 seconds or so?
- NO data inconsistency after 1 month running

Conclusions/Summary of the R&D

- JPRS Developed
  - Incremental data processing mechanism of .JP Registry updates, including DNSSEC signing/key management features
    - As Zone Distribution System
- The field test results satisfied
  - JP TLD requirements of large zone, rapid updates, and reliable synchronization

Thank you!